Chapter 3

How to Do It? Getting Started in Authoring Computer-Aided Teaching/Instruction and What Software Features to Consider

Most authoring packages are "staging" tools, helpful in the multimedia equivalents of set design, prop management, special effects, script editing, movie projection, orchestra conducting and cueing. Park (1994, p. 52)

The single most important program a multimedia developer will invest time and money in is the authoring package. Ranging from dynamic presentation packages on the low end to media-savvy programming languages on the high end, authoring programs are the keys to integrating media into a compelling experience and creating the links that enable users to get the most out of interactive applications. Even if you've created polished graphics, crafted exciting video clips and developed dynamic audio tracks, the final product may miss the mark if you can't present those media elements in their best light. While a myriad offerings keep popping up, no one package does it all. As with any task, you will do best by analyzing what you wish to accomplish and then purchase the tool best suited for that task.

Burger (1994a, p. 48)
The competition is so intense among the many authoring software vendors, that I predict half of authoring software vendors listed in this chapter will fall by the way as aggressive vendors come out with native upgrades for Windows 95. Virtually all my student hypermedia learning materials are now authored in cbt Multimedia ToolBook from Asymetrix (800-448-6543). ToolBook over the years has been actively promoted and supported by two IBM-funded institutes: The Institute of Advanced Technology (IAT) in Chapel Hill offers almost continuous training programs for ToolBook and develops educational materials in ToolBook. The IBM Kiosk for Education at the University of Washington actively networks ToolBook applications for educators. Two limitations of ToolBook are its inability to cross platforms to other operating systems (e.g., MAC and UNIX) and the total absence of ToolBook engines on Netscape. If crossing platforms between MAC and Windows is important to you, and/or you want to easily make your work available to the world through a Netscape engine, then the answer to your authoring needs is probably the Netscape Navigator Gold (800-473-4875) that requires no programming (coding) skills and allows authors of hypermedia to make their works available with graphics, audio, and video on the World Wide Web (WWW). The Director from Macromedia (800-888-9335) is a somewhat more sophisticated hypermedia web authoring system with a Netscape engine that requires programming skills. Macromedia also offers Shockwave for playing Director’s video over the WWW. I stress that you really need to examine the other alternatives such as those mentioned in Chapter 3 of Jensen and Sandlin (1995) before you make a commitment to learn an authoring software system. Except for a few absurdly priced systems and those that still have runtime royalty fees, the problem is not one of price since most excellent packages are now less than $1,500. The problem is the amount of time and trouble it takes to learn how to author in a particular system. Good systems require scripting (coding), and most systems have a unique scripting system that takes a lot of practice. Some professors prefer to code directly in Visual Basic or Visual C++, but I recommend that you learn an authoring shell such as Netscape Navigator Gold, Blackbird, ToolBook, Director, Authorware, Icon Author, SuperCard, Apple Media Kit, Quest, or others discussed in Chapter 3 of Jensen and Sandlin (1995). I would avoid any shell that does not plan to have a Netscape engine for Web authoring. At present, most shell authoring systems will not reveal their Netwcape engine plans, such that the shells already having such engines have a momentary competitive edge.

Nations forging ahead in economic growth realize that the essential ingredient in the economy is widespread education and training at high technical levels. Before 1989, accounting educators were like most university professors who rely upon the following teaching methods:

1) Chalk-talk lectures with overhead transparencies, handouts, and occasional videotapes. Slides (35 mm) were seldom used because of the expense and the difficulty involved in preparing them for daily college lectures and updating them on the spur of the moment. Although reams of handouts were sometimes distributed, photocopies are expensive and become awkward for students to store and organize vis-à-vis computer files with effective menus and hypertext linkages.

2) Socratic questions and cases requiring students to seek answers for themselves. The Socratic method is the preferred method of teaching by many educators largely due to student interaction in the learning process. It is, however, not the most practical method for teaching technical basics and computational details.

In 1989, one of the authors (Jensen) started projecting computer screens in class from a liquid crystal display (LCD) connected to a laptop computer. The incremental cost was $200 for the LCD plus $750 for course management software to install in the laptop. The monochrome LCD was soon, and happily, replaced by a thin film matrix color version for $4,500. This color LCD now only serves as a back-up classroom projection device when equipment malfunctions in new electronic classrooms that contain multimedia devices, three-beam ceiling projectors, and connections to campus and national computer networks. Computer-aided teaching, as the term is used in the context of this chapter, allows an instructor to perform many functions with or without electronic classrooms and campus networks. These include the following:
I. Give lectures and teach cases using colored and animated projections in the classroom. Instructors can author original lessons and/or modify some electronic teaching materials supplied by the publishers of textbooks.

II. Make lessons and problem solutions available on a campus network so students can replay them any day and any time of day. Runtime discs can be copied for students if a campus network is not available.
   a. This reduces the amount of note taking in class and allows students to replay teaching materials at each student's learning pace.
   b. This saves photocopying costs, because students can now replay lecture notes in computer labs and on their home computers.
   c. Hard copies of graphics screens can be printed on a graphics printer to distribute in class or to be inserted in a research paper. Because there are so many frames of animated graphics, only selected frames are usually chosen for hard copy printing. Very little printing is necessary because students can access lessons from a campus network and/or floppy discs. In class it is much faster to locate screen projection images on the computer than to fumble through a stack of acetate overhead transparencies.
   d. Student progress on each lesson is tracked by the central computer and various other course management features are available.

III. Record and replay responses of students discussing cases or seminar topics.

IV. Assign student projects where the students develop their multimedia presentations for classrooms and labs. This involves students in participative learning as well as practice in computer technologies.

This chapter focuses on how educators can get started using hardware and software for the above aids in teaching. Electronic classrooms and computer networks are not necessary at the starting point. Funding grants are available from a variety of sources. For example, a directory of some of these sources is given by Eckstein (1991). Summaries of grants and assistance in writing grant proposals can be found in Columns, Spring 1994, p. 3. (See Appendix 4 for details on how to subscribe to newsletters, magazines, and journals.) The CETA Newsletter tracks funding sources for accounting educators. Summer fellowships are also available from Teletraining Institute (405-744-7510). Short courses and training workshops are listed in Appendix 6. For example, the Institute of Advanced Technology (See Appendix 6) has course materials, training workshops, the INFOBITS Electronic News Service, videotapes, satellite broadcasts, the Express Author front end to Multimedia ToolBook, and prepared hypermedia learning materials. Apple Computer offers a variety of similar products and services for Mac and Power PC users. One of the most interesting servers for technology in education is the MIT university “MIT EVAT Report-Models for the Future” at <http://www-evat.mit.edu/report/>.

(1993), Rosenberg et al., (1993), Shaddock (1992), Sherman (1993), Stone and Buckland (1993), Thalmann and Thalmann (1993), Tway (1992), Vaughan (1993), Waterworth (1992), Wodaski (1992, 1993), Yager (1993), and Yavelow (1993). Since technology changes so quickly, however, we have found most hard copy reference books out of date by the time their first copies are off the presses. For this reason, we elected to make this an electronic disc book that can be updated and revised much more easily by both readers and the authors (Jensen and Sandlin).

### Purposes of This Chapter

The focus of this chapter is on emerging technology options for educators seeking to author or otherwise modify teaching and research materials with only a modest starting investment. Although it is helpful to have authors such as Lynch (1993) catalog the "Core Skills in Multimedia Development" and "Steps in Developing a Multimedia Project," we believe that faculty and other developers of learning materials should dive into hypermedia authoring waters even though they are lacking in some core skills and/or are lacking in some of the hardware and software items of their dreams. For most of us, hypermedia authoring is a bootstrapping, part-time effort for which we will never have ideal skills or facilities. We urge you not to wait for the "pros" to make these materials available on a silver platter. By the time such materials are available to you, the silver will have tarnished in light of the rapid changes both in technology and in the content of what you want to make available to your students. The best teachers in modern times will be able to author their own materials, merge materials made available from others, and help students locate other sources of learning materials.

The prior chapter indicates why educators may want to wade into CAL waters and perils they may encounter along the way. The present chapter serves as a guide on how to go about taking the first steps. Related sources of information include Burger (1993). Readers are urged to track some of the literature listed in Appendix 4, especially the free journals and newsletters that have been a tremendous source of inspiration and information to us in our own ventures into authoring hypermedia learning materials. Books such as this book and Burger (1993) become obsolete the instant they go to press such that it is extremely important to track the Appendix 4 literature on a regular basis.

Berger, the Director of Instructional Technology at the University of Michigan, discusses four levels of computer usage (1993). These uses are paraphrased as follows:

1. Enhancing existing courseware (e.g., transforming photocopy handouts into course materials on word processors and spreadsheet exercises made available to students on networks such that these materials can be more easily searched and manipulated in problem variations and updated for new literature).

2. Using existing courseware (e.g., using supplements such as those listed in Appendix 1 from textbook publishers, including electronic transparencies, spreadsheet templates, databases, simulations, and computer test banks).

3. Adapting existing courseware (e.g., combining computer files and videodiscs from a variety of sources into an integrated package with some sort of integration software such as the hypertext and hypermedia software discussed below. This includes the development of full CMS courses discussed in this chapter).

4. Creating original courseware and other learning materials (e.g., the authoring of original CMS, hypertext, or hypermedia materials)
Readers are referred to Chapter 0 for definitions of terms and acronyms used in this chapter. It will be helpful to print a copy of Chapter 0 to refer to while reading or searching this and other chapters of this book. A type of software termed course management software (CMS) offered by various vendors is designed for CAL and has certain “CMS core” features such as CMI utilities, interactive branching from student answers that might determine lesson sequencing, multiple-image files, colored graphics animation, audio feasibility, and other features discussed in greater detail below. Particular focus is placed in this chapter on CAL “authoring” as opposed to CAL “presentations.” Authoring refers to developing (writing of text, recording of audio, importing of video, inserting graphics, etc.) hypertext and hypermedia learning, entertainment, and reference materials. In the literature such as NewMedia, the term “authoring software” refers to software for hypertext and hypermedia development and does not refer to common word processing options such as Microsoft Word, Word Perfect, and Word Star. Latest directions in hypermedia authoring are discussed by Burger (1994a). Future trends are indicated by Park (1994). In Chapter 3, core and non-core attributes of both course management software (CMS) and alternate (ALT) are discussed. The term “authoring software” is often contrasted with “presentation software” which is designed for development of graphics, and possibly some multimedia components. Presentation software does not have full “hyper” capabilities of nonlinear navigation, runtime versions, and course control utilities. For example, the NewMedia 1995 Tool Guide contrasts presentation software (pp. 09-12) with authoring software (pp. 17-25). Robinson and Lee (1994) discuss the fine line between authoring and presentation software. In Appendix 6, we have provided a database for word searching using “authoring” versus “presentation.” Authoring software options are the focus of attention in Chapter 3. Authoring software comes in two types. Options not having separate scripting languages have only “pre-scripted” options such that hiding and displaying objects, moving objects, etc. are relatively automatic using icons and menus that are already coded.

**Course Management Software (CMS)**

Various CMS and other hypermedia vendors and phone numbers are listed in Appendix 6 and later on in this Chapter. All CMS vendors offer packages with the most CMS “core” features (details regarding the software mentioned in this section appear later in the chapter):
Authoring and Runtime Versions of the CMS Software. To author lessons or modify commercially-available lessons an educator must have the appropriate authoring license from the CMS vendor. The authoring software of CMS vendors is usually about as difficult to learn as word processor software such as Microsoft Word or Word Perfect. Unlike word processors, spreadsheet software, and most graphics packages, however, lessons that an author has rendered in CMS software can be distributed to students or sold commercially with "runtime" versions of the software that will run the lessons on a computer but do not allow the user to modify, edit, or update the lessons. Runtime software enables students to utilize electronic books and other course materials without having to buy any authoring license. This, for example, is a key advantage of all CMS systems and most hypertext software (ToolBook, HyperCard, HyperWriter, ScriptX, etc.) over Harvard Graphics, Word Perfect, Lotus 1-2-3, Excel and a majority of other software options not having free runtime versions of their software. Synonyms for runtime software include "delivery software," "reader software," and "playback software." Runtime licenses are normally free in non-commercial distributions of lessons. All CMS vendors used to charge some type of fee to each author and/or user of a commercial runtime product but competitive pressures have led many of them to increase the price of their authoring licenses and eliminate the runtime royalty fees. Many "non-CMS" hypermedia vendors with somewhat similar software (that lacks some of the CMS core features) have free runtime licenses. Major CMS customers in the past have tended to be corporations and other agencies rendering technical training courses or marketing promotions where the full package of CMS core features are desired in CAL and CMI settings. Some public accounting firms are now developing training courses in CMS or other hypermedia software. Apple Media Kit (AMK) from Apple Computer is an example of how costly runtime fees can become. The AMK runtime module is $5,000 for unlimited use within an organization whereas runtime fees must be negotiated (two to three percent) for commercial sales items. There is a strong incentive for authors to seek out authoring packages that are accompanied by free runtime for all users/students. Many of these alternatives are discussed and compared in this chapter.

Student Tracking and Course Record Keeping. These utilities allow the progress of each student to be automatically monitored and reported upon throughout an entire course. For CAL and CMI purposes, course management may include tracking how far a student progresses in each lesson. Student tracking and progress reporting are the main CMS core features that usually distinguish CMS vendors from their rivals that sell animation, hypertext, and hypermedia authoring and runtime software. Although CMS software is not utilized, a testing/tracking program developed for accounting, finance, and information systems courses at The University of Northern Iowa uses a software program shell to enable the professor to deliver Lotus 1-2-3 spreadsheet-based examinations to networked computers in classrooms, laboratories, and other facilities connected by modem according to Wyatt and Heian (1994). This program employs no specific prerequisites to instruct students in the use of Lotus; rather, spreadsheet skills are introduced on a need-to-know basis. In order to emphasize the use of the computer as a tool which can be used to develop and implement learning, the focus is kept on the intellectual content of the course. Student feedback files are also maintained along with objective and essay test responses. In these courses, the computer is used to present material, to explore conceptual relationships, and ultimately to evaluate student comprehension. Educators at The University of Northern Iowa hope that because the computer is central to the course and the means of achieving course objectives, it will become as transparent as the pen or the calculator in traditional classroom approaches.
**Examination Templates.** Questions may be authored in a variety of templates, including templates for essay questions. Examinations may be graded and recorded automatically. Templates are provided for ease of designating point weightings and lesson branching contingent upon student responses or total examination scores. All CMS systems mentioned below have examination generating utilities. Some options not having full CMS core features nevertheless have examination generators (e.g., the Learning Processor from Pinnacle Software and the POWER-CD from ZCI Publishing).

**Interactive Branching Options.** This allows the response of an instructor/student to determine what part of a lesson is encountered at the next stage of the teaching/learning process. Some software is more menu driven than others in interactive processes. Interactive branching utilities are features of CMS packages that are often lacking in rival products from non-CMS vendors who rely more upon menu choosing (clicking) than interactive branching based upon a student's responses to questions and problems.

**Software Switching Utilities.** Runtime software switching options allow instructors or students to shift from a CMS lesson into other software such as Lotus 123, Microsoft Excel, Lotus Freelance, Word Perfect Presentations, or Harvard Graphics and then return to the exact point in the CMS lesson where the temporary diversion took place. CMS packages vary as to the degree of spontaneity and the degree of choice allowed in runtime software diversion switching.

**Student Written and/or Oral Response Options.** Most CMS vendors have runtime utilities that allow students to write answers that both appear on the screen and are recorded into the records. The next phase will be to have utilities for displaying and recording audio responses. One of the latest technologies on the scene is voice input/output for computers. Voice animation will become widespread in the next two or three years. Computers from Apple Computer have the current edge since Apple Computers are equipped with microphones and speakers than most PCs presently on the market. Word processing programs either have or will soon have voice animation. Thus far, voice animation is limited mainly to messages and short inputs such as purchase orders. A drawback in voice animation is the amount of computer storage required for digitized audio. It will be some time before entire books are available in computerized voice animation.

**Authoring Software Allowing Instructors to Render Animated and Colored Computer Graphics.** Animation entails movement of an image or partial image (e.g., graph component, equation symbol, background highlights, borders, text, financial statement segment, elements of a data table, etc.). For a review of animation (pp. 14-16) and 3-D animation (pp. 29-40) see NewMedia 1995 Tool Guide. (The addresses and phone numbers of NewMedia and other periodicals are contained in Appendix 4.) Animation is used for highlighting, contrasting, entertaining, and other types of attention directing in lessons. CMS animation is not synonymous with full-motion video where each frame of a lesson appears for a mere 1/30 of a second in typical full-motion video. Animations in videographics are much more difficult to render due to the number of frames to be authored. CMS animation features are either not available or are not as effective in many graphics programs intended more for printers and slide shows. For example, any Harvard Graphics, PowerPoint, or Lotus graph can be imported and "brought to life" by animation and presentation software such as those options reviewed in NewMedia's Tool Guide for 1994, pp. 14-16. Animation is much more important than mere cartoon-like entertainment. Animation has significant pedagogical importance in manipulating pieces of equations,
making graph components evolve in pieces and on differing dimensions, highlighting portions of tables, highlighting portions of text, and demonstrating flows in systems. Paul Mace's Grasp software discussed below is a superior DOS animator giving rise to three-dimensional effects. Grasp authors must have technical computer programming skills. The CMS vendor animation capabilities vary greatly as to animation speed controls that adjust to computer speeds and ease of animation authoring. Various other animators are available such as Animator Pro from Autodesk Inc.

(CORE 8) Capturing/Editing Utilities. This allows instructors both to capture (take a snapshot of) virtually any screen image on a monitor and to modify that image (e.g., animate, add text, add drawings, change colors, add more colors, etc.) This enables the professor to bring in graphics screens from other software such as Harvard Graphics or 3-D Perspective and add animation and explanatory text. Capture utilities make scanner and video camera inputs of images available in CMS-authored lessons. Capturing is somewhat of a bother and authors prefer software to have as many filters as possible for common file extensions (BMP, PCX, TIF, GIF, etc.) in order to avoid having to go through capture routines. American Training International has the most graphics filters among CMS vendors at the present time. Microsoft Windows reduces the use of capturing utilities due to the ease of using the Windows Clipboard. Adobe Photoshop for Windows and some other graphics software can be used for converting Mac images into PC formats.

(CORE 9) Multiple-Image Files. Multiple graphics and text screens can be combined into a single lesson file in CMS authoring. This differs from older versions of graphics software "slide" shows and paintbrush software where each screen had to be stored as a separate file. Building animation into slide shows becomes extremely cumbersome, whereas animation is a relatively simple task, albeit time consuming, in CMS and related options such as those reviewed in NewMedia's Tool Guide for 1994, pp 14-16. Some slide shows not only require separate files for each distinct image, they require awkward preparation of "scripts" to sequence the presentations. CMS lessons for courses may have hundreds of hours containing thousands upon thousands of graphics images stored in a few computer files. The CMS scripts for sequencing are either: (i) fixed at the time the materials are authored, or (ii) variable based upon conditional branching (where user interactions determine sequencing) or discretionary returns to the course or lesson menu. The point here is that users do not have to be troubled by having to prepare complex scripts unless the author of CMS materials intentionally forces or allows such scripting activity.
Audio/Video Authoring. All CMS packages allow for audio video digitizing into lessons so that students can hear explanations while viewing the computer screen. Most now also have the ability to digitize segments of compressed video on QuickTime or Microsoft Video for Windows. Windows users should make certain that the audio/video hardware and software meets the MCI standards established by Microsoft Corporation for Windows and Windows Chicago users. For example, make certain that the software is compatible with MCIWAVE.DRV (driver to play Waveform Audio files), MCICDA.DRV (driver for compact-disc digital audio), MCISEQ.DRV (MIDI sequencer audio for musical keyboard input), and MCIAVI.DRV (driver for video sequences). Most low-end video productions featuring QuickTime or Video for Windows do not have sufficient compression to display full-motion (30 frames per second) in full-screen size. For educational purposes, however, smaller window videos may suffice at slower frame rates. When the information highway comes to town with sufficient broad band capacity for high-end digital video, most analysts predict MPEG compression will be the wave of the future. However, due to anticipated lags in customer purchases of MPEG hardware boards (cards), interactive CD-ROM-type video authoring will probably be in QuickTime, Ultimedia Video, or Video for Windows software. Microsoft Corporation is now shipping Video for Windows that boasts a 50% higher frame rate (18 fps) plus some improved device control features. MPEG and Indeo compression hardware significantly improves fps rate to 30 fps and have more video window size options. Insignia Solutions (415-694-7600) manufactures the RapidTrak caching utility that speeds up audio and video. See both later portions of this chapter and Appendix 6 for details.

Word Processor and Database Automatic Importing. Some vendors have or will soon have the ability to automatically import text, spreadsheets, graphics, and data from other sources. For example, if a textbook is written in Word Perfect or Microsoft Word, all or portions of the text can be imported into the hypertext/hypermedia presentation package. For persons wanting to develop electronic textbooks on CD ROM discs, this is an extremely important feature that is not yet available from many vendors. Vendors vary widely regarding existence of and ease of using this feature, so it is very important to ask about the ease of importing text, spreadsheet data, graphs, etc. For example, the HyperWriter Autolinker software discussed below creates hypertext applications automatically from existing documents. Some CMS vendors have made it possible to import rich-text format (RTF) files that retain formatting, whereas others only allow importation of ASCII or ANSI text that loses all formatting and has to be formatted all over again after importing.

Applications Consulting. Nearly all CMS vendors have consulting divisions that, for a fee, assist authors or entirely prepare training courses, textbook supplements, etc. For example, HyperGraphics Corporation rendered nearly all the early HyperGraphics electronic transparencies available from major accounting textbook publishers. Tencore and Macromedia Authorware do extensive applications consulting with publishing companies.
Some features and criteria to consider from selected CMS vendors or other competitors, that are not currently available in every CMS option, are the following highly worthwhile "non-core" features (not listed below in terms of priority) of authoring software for hypertext and hypermedia development:

(NON-CORE 1) **World Wide Web Engine.** Probably the most important feature to emerge since 1995 is the ability to author for the World Wide Web in such a fashion that the users do not have to install any files on their computers other than a WWW browser such as the popular Netscape Navigator. If you want to easily make your work available to the world through a Netscape engine, then the answer to your authoring needs is possibly the **Netscape Navigator Gold** (800-473-4875 and <http://www.netscape.com/>) that requires no programming (coding) skills and allows authors of hypermedia to make their works available with graphics, audio, and video on the World Wide Web. **Multimedia ToolBook** from Asymetrix (800-448-6543 and <http://www.axymetrix.com/>) and **The Director** from Macromedia (800-888-9335) and <http://macromedia.com/>) are somewhat more sophisticated hypermedia web authoring system with Netscape engines that require some programming skills. **Shockwave** for playing Director’s video over the WWW. Competition is heating up so much on this issue that we anticipate that virtually all surviving vendors of authoring software will soon announce similar WWW engines. Our advice is to avoid any alternative that does not have such an engine.

(NON-CORE 2) **Word Processor, Spreadsheet, and Database Filters.** A major problem arises when authors have extensive works already typed into word processors, spreadsheets, and/or databases. We advise that you inquire about filters in a hypertext/hypermedia software package that will minimize the amount of retyping and reconstructions of graphics. For example, Asymetrix Corporation offers the Database Connection that greatly facilitates directly incorporating databases from multiple vendors into Multimedia ToolBooks. To our knowledge, none of the hypertext/hypermedia authoring vendors offers complete filtering from Word for Windows, Word Perfect, Excel, Lotus, or other word processing and spreadsheet software. However, some offer better filtering than others and it may be worthwhile to compare filters before making a software choice. At a minimum you should probably choose an alternative that will filter Rich Text Format (RTF) text in the Microsoft standard.

(NON-CORE 3) **Price.** The price of a software package should probably not dictate your choice unless you are buy multiple copies or a site license. Cheap alternatives and the highest price alternatives are often limited relative to mid-priced options such as Multimedia ToolBook and Director options. High priced options, however, often cross platforms to UNIX operating systems and force authors to pay more for the UNIX options. In our opinion, other features are more important that price unless there is also a runtime/royalty fee. Do check on runtime/royalty since most vendors have eliminated such fees and those that still impose such fees are probably out of touch with market realities. Also watch for traps such as the Macromedia trap on Authorware that imposed a runtime royalty fee if the product was authored in Authorware purchased at an academic discount. An option that has a runtime/royalty fee is not necessarily better than one that has free runtime. Beware of options that advertise free runtime. Be sure to check whether it is truly free in all instances and whether there are some authoring features that will not play back in the runtime version of the software.
Cross-Platform Capabilities. Until recently it was not possible to cross-platforms such that hypertext/hypermedia books authored in one operating system would run under other operating systems. Authorware was one of the first options to claim cross-platform capabilities between Mac and Windows operating systems. However, it turns out that only books authored on a Mac can be translated into Windows but not vice versa. And even then, books with animations, high-resolution graphics, and multimedia features do not translate well except in unique circumstances. More serious cross-platform options have more serious cross-platform capabilities. Macromedia Director is more limited in authoring features than Authorware Professional but in some ways has more useful cross-platform capabilities between Mac and Windows operating systems. Newer hypermedia engines have been added to the Netscape Internet browser, notably Macromedia Director that will allow users to put hypertext, audio, animations, and other hypermedia works on the Internet so that users from virtually any platform (e.g., Windows, Macintosh, and UNIX) to view the materials authored in Director. Other engines with less hypermedia capabilities and bandwidth requirements are also available to replace HTML tagging. See NewMedia, August 1995, pp. 19-20. The top of the line cross-platform options are Sybase’s GainMomentum and Kalieda’s ScriptX. GainMomentum at $10,000 per license will cross platforms between UNIX, Windows, and Windows NT. But even the top of the line cross-platform options do not adjust for significant variations in graphics resolutions, number of colors, animations, video/audio incompatibilities, and other complications arising between different hardware capabilities and operating system differences. At this juncture, cross-platform capabilities are limited to rather simple books and do not stand up to claims made by some enthusiastic sales representatives. Rosenthal (1995) compares hypermedia authoring software having cross-platform capabilities. Some will only will only playback on cross-platforms but cannot be used to author in the platform of choice. Apple Media Kit and ScriptX authoring will run in DOS, Mac, Unix, and other operating systems, but neither option can be used for authoring in DOS or Windows. Insight into Multimedia and TIE can be used to playback in UNIX but authoring can only be undertaken in Windows. Hardware that crosses platforms in emulation (such as playing back Windows software in emulation on a Mac computer) frequently does not work well with complex authoring systems such as CBT ToolBook or Quest options that only perform well in Windows. Often very expensive options are priced for cross-platform capabilities that are limited in terms of authoring features present in software that will not cross platforms. GainMomentum authoring package from Sybase crosses platforms between UNIX, Windows, and Windows NT. However, in spite of its very high price this package does not contain many of the wonderful authoring features found in Windows-only CBT ToolBook that is less than 10% of the cost of GainMomentum.

Preauthored Textbook Supplements (sometimes termed "electronic transparencies" for major textbooks). When these supplements are available, textbook adopters are not forced to author teaching aids "from scratch." In accounting, HyperGraphics took an early lead in this feature for basic computer and accounting textbooks, but most publishers of accounting textbooks have now dropped HyperGraphics supplements. Popular presentation software used by publishers include Astound and PowerPoint. However, frequently textbook supplements are disappointing due to content. Often there is nothing new or significant in these materials that students do not already have printed in the textbooks themselves. See Appendix 1 for accounting textbook supplement details.
A File Compression Utility. Such a utility in a CMS package saves having to buy supplementary compression hardware and software. These compression utilities differ from newer full-motion video compressors that require special hardware (e.g., DVI and Fractal options require compression boards). Compressors not requiring any special hardware allow an author to compress a completed lesson file or entire course down to possibly a third of the storage capacity needed at the authoring stage. For example, 40 Mb laptops can contain over 1,000 hours of HyperGraphics compressed lessons that would not possibly fit on a hard drive without lesson compression. Among CMS vendors, HyperGraphics has both a compression (Build) utility and a decompression (Unbuild) utility that accompany the authoring package and Quest has a DOS compression utility. Graphics images may be compressed (e.g., as JPEG images) and full motion video clips can be compressed (e.g., Apple Computer's QuickTime for either Mac or Windows users and Microsoft Video for Windows). IBM's Linkway will similarly compress DOS and OS/2 files without requiring hardware compression boards.

Student Response Pads. These are hand-held wireless audience response pads which allow individual answers or group frequency responses to be immediately displayed in front of the class. The pads themselves must be separately purchased. HyperGraphics is the only CMS vendor that sells response pads with built in CMS software utilities. Barry Rice at Loyola College in Maryland performs Multimedia ToolBook authoring with student response pads for accounting applications in a Windows environment. Indiana University at Bloomington uses student response pads in large sections of courses in accounting.

Remote Control Devices. These are hand-held remote control devices which allow an instructor to control the course delivery from any location in the classroom rather than having to control presentations from a keyboard or mouse at a fixed location. HyperGraphics is the only CMS package that has wireless remote control features built into the CMS software. The accompanying remote control hardware is priced at $275 and connects to the computer's serial port so that the remote control delivery is not restricted to particular brands of LCDs or other classroom projection equipment. Wireless mice are available but not all wireless mice work well from lecturing distances in a classroom. A buyers' guide for remote controls is given by Glass (1994). Beware of inexpensive infrared wireless mice. These typically are too limited in range to be effective in classroom presentations. For classroom remote mouse controls usually the more expensive devices are required (e.g., the AirMouse selling for $395 from Airmouse Remote Controls at 802-878-9600, Sayett Smart Remote selling for $325 at 800-678-7469, and RemotePoint for $199 at 805-484-1331) . Some wireless mice do not yet have full track ball control features, but they can be used for limited presentation controls of menu/icon driven lessons. Many others are limited to particular projection hardware, especially particular models of LCD panels. For example, the Cyclops (800-447-7694) eye and wand for an Ovation LCD Projection Panel can be used for wireless remote control of lessons driven by a mouse. Proxima's Cyclops will not perform all track ball functions, but it will click, double click, and drag. The price is $1,195 (plus $8,995 for the Ovation LCD panel) subject to negotiated educational discounts. Since the Cyclops connects to the Ovation LCD panel rather than the computer's serial port, the Cyclops, unlike the HyperGraphics remote control system, cannot be used with electronic classroom three-beam projectors. Mind Path Technologies (214-233-9296) has a new Presentation Remote Control that is tremendous.
(NON-CORE 9) **Student Roster Projections.** Random selection of student names to be flashed on a classroom screen is a useful feature to hold student attention, especially if the student must respond aloud with an answer, an idea, or a question during a lecture or case presentation. Flashing names on a screen keeps students alert in anticipation of being called upon while their names appear in front of the entire class. HyperGraphics excels on this feature and student name flashings can be triggered from a remote control device.

(NON-CORE 10) **Touch-Screen Capability.** IBM offers software/hardware with “TouchSelect” monitor overlays that allow authors and students to control presentations by touching menu choices on a monitor screen. Interaction (617-923-6001) extends this further with its Crystal Clear touchscreens that will simultaneously combine finger and mouse controls. Other vendors offer similar products (e.g., MicroTouch and Elographics). Of course, some computer hardware will allow for stylus pens to be used in place of keyboard and mouse controls. Any CMS software that runs on such hardware can be controlled with a stylus.

(NON-CORE 11) **Multimedia Device Switching.** These are controls allowing instructors to easily shift back and forth between videotapes, videodiscs, compact discs (CD-ROM digital computer and CD-I analog television versions), 35 mm slides, and network connections to libraries, mainframe computers, and other learning centers. Instant Replay Professional excels among DOS options having this capability, although most Windows and Mac CMS vendors provide multimedia switching capabilities. Ilcon Author from AimTech provides similar device switching for Windows and Unix users. If multimedia devices in a classroom can be linked with fiber optic cable, Rauland-Borg Corporation (708-679-0900) offers its Ranger remote controls for device switching (but not mouse controls of computer software).

(NON-CORE 12) **Rescaling and Aspect Ratio Changing of Graphics and Text.** The ability to easily rescale all or any part of a screen image is an important feature that is generally not available in CMS or related authoring software, even in the most expensive authoring packages such as GainMomentum. This prevents authors from changing the sizes of images without having to export the images to external software. If an imported image is distorted, the ability to change aspect ratios for better proportioning is important. Until recently resizing and aspect ratio changing were not features available in CMS or related authoring software. Very few, if any, hypertext/hypermedia options now have rescaling options comparable to those of such paintbrush software as Adobe Photoshop and Micrografx Picture Publisher. This means that authors must usually import graphics images into a paintshow program, resize a picture, and then paste it back into a hypertext/hypermedia book. Related features may also be lacking in authoring software. For example, graphics drawn in the software can usually be rotated and inverted, whereas imported bitmap pictures cannot be rotated or inverted. One exception is Macromedia Director. Director is one of the very few hypermedia authoring systems that has a utility for changing the scale and aspect ratios of imported bitmap pictures as well as rotating and inverting such pictures.

(NON-CORE 13) **Clip art, audio clips, video clips, and animation clips.** Clip file availability saves time and effort in authoring some learning materials. Since most authoring packages lack ability to rescale and change aspect ratios of pictures, it is helpful if the vendor includes a database of drawings that can be re-scaled. For example, the older version of Asymetrix ToolBook included a clip art database of ToolBook drawings. It was unfortunate that no such database was provided in more recent versions of ToolBook. Of course, bitmap pictures, audio files, and video files are available in the
thousands on commercial CD-ROMs. Most of these have no copyright restrictions and reduce the number of times an author must resort to more troublesome screen capturing, scanning, audio recording, and video recording. For a listing of options and vendors, see Appendix 6. For a review of many of these options see Rubin (1993). Be careful to read the reproduction restrictions. Some clips allow you to reproduce items for non-commercial uses and distribution within your own organization (campus) but not commercial applications. Other clips may be freely reproduced in all commercial ventures. Art, audio, animation, and video clip availability saves time and effort in authoring some learning materials using the above software options. Tens of thousands of clips that have no copyright restrictions or altered restrictions are commercially available and some of them are included in software packages. These reduce the number of times an author must resort to more troublesome screen capturing, scanning, audio recording, and video recording. For a listing of options and vendors, see Appendix 6. For a review of many of these options see Rubin (1993). Be careful to read the reproduction restrictions. Some clips allow you to reproduce items for non-commercial uses and distribution within your own organization (campus) but not commercial applications. Other clips may be freely reproduced in all commercial ventures. Zimmerman (1994) discusses record company policies with respect to music clip inserts into multimedia. Most charge royalties of three to nine cents on each item (e.g., disc) reproduced (not necessarily sold) unless the clips are taken from "royalty free" music byte files or copyrights have expired. Copyrights on music and video, however, extend much longer into time than patent rights.

Word Processing Features. Text search, spell checker, and other features common in word processing software are not available in some options. None of the CMS or hypertext/hypermedia options are full-featured word processors. Most CMS vendors have new or forthcoming upgrades that will have internal spell checkers. Many hypertext vendors do not offer spell checkers, and most do not have word processor utilities such as thesaurus libraries, index generating capabilities, automatic text wrapping (around graphics images), repagination options, automatic format revision, automatic font changing, window splitting, simplified mathematics coding, and most other features of advanced word processing software. All CMS options allow text importing in ASCII form, but this can be very awkward and time consuming when mixing animated graphics with text that needs to be altered for font sizes, font styles, and positioning around graphics. ASCII is the American Standard Code for Information Interchange computer character set (text and symbols) that enables transfer of text and data between different computing systems. For example, files from word processors such as Microsoft Word, Word Perfect, and Word Star often cannot be imported to hypertext or hypermedia software without conversion to ASCII code (most word processors will change files to ASCII "txt" files). The downside is that nearly all formatting and font variations are lost in ASCII conversions such that imported ASCII text may have to be re-formatted by line by line and altered for font preferences. Very few software alternatives have "filters" that import word processor files directly without having to convert to ASCII codes. In hypertext authoring, choice of a hypertext software option should include a question concerning whether "filters" are available for avoidance of ASCII text conversions. Although most word processors are not yet capable of authoring animations, some word processors are adding more graphics and multimedia options. One such word processor called Podium was developed at The University of Delaware's Instructional Technology Center. The latest versions of Word Perfect for Windows have more spreadsheet and graphics capabilities. We hope that in the future, more hypertext authoring packages will include filters such that text imported from common word processors (e.g., Word Perfect, Microsoft 'word for Windows, and Word Star) will retain font style, font
characteristics, and formatting features. This would eliminate the extremely tedious task of having to fix up imported text.

(NON-CORE 15) **Scroll Bar Text Fields.** If volumes of text are to be imported (e.g., the text of a book or a number of journal articles) into courseware, it is important that the software used allows authors to create text fields with scroll bars such that a separate text field or page does not have to be created for small bits of text such as each 50 words. For example, HyperGraphics software discussed below does not allow for creation of text fields with scroll bars. If the text of a book is to be imported into a HyperGraphics electronic book, it is necessary to import only about 50 words at a time into separate text fields. This is extremely awkward and time consuming. Other options such as Asymetrix ToolBook and HyperCard allow for creation of scroll bar text fields into which much larger blocks of text can be imported. However, low caps such as 12,000 word caps placed upon the block sized may still be inconvenient when large volumes of text must be imported. Also the need to create separate pages for each block of text can lead to an inordinate number of pages in electronic books where fewer pages with scroll bar text fields are usually better for navigation and presentation.

(NON-CORE 16) **Hypertext and Hypermedia Customized Scripting Capabilities.** Hypertext refers to software that enables authors and/or users to arrange and rearrange text based upon fields for hierarchical linkages, keyword linkages, reference linkages, and clusterings based upon attributes. Hypertext software usually allows for creating "buttons" to click on for menu choices and lesson branchings. Hypermedia refers to a similar scripting software for media devices as opposed to text. Both hypermedia and hypertext software allow for automatic and/or custom scripting of presentation orderings. Most allow for constructing of control button branchings and user interactions. Some of the packages contain code writing utilities, often termed script coding languages, that allow for complex coding scripts that order presentations for users. An extensive list of vendors and product attributes is provided in Appendix 6. For a review authoring options also see NewMedia 1995 Tool Guide, HPEC Syllabus (May/June, pp. 14-18), 1994 Multimedia Source Guide from T.H.E., Burger (1994a), and Park (1994). (The addresses and phone numbers of NewMedia, HPEC Syllabus, and other periodicals are contained in Appendix 4.)

(NON-CORE 17) **Database Features.** The extent of database features is one of the main factors that distinguishes expensive authoring packages from their cheaper counterparts. For example, the top-of-the-line GainMomentum selling for $10,000 per license from Sybase is largely a database package with hypertext, hypermedia, and network capabilities beyond what is are contained in packages of the competition,. Database features greatly facilitate handling of masses of text and data. Most packages now have dynamic linkage utilities to database software, but this is not the same as packages that have database features included in the basic package. Current database packages have some multimedia features are reviewed in the NewMedia 1995 Tool Guide (pp. 27-31).

(NON-CORE 18) **Text Translation to Audio (Text Recognition)** An increasingly important feature in hypermedia authoring is the ability of the software to automatically read text aloud as well as display it on the screen. In the early days, authors had to record sound files that would read the text aloud. This was both inconvenient and added greatly to the amount of storage space required for the book. Now software exists for converting text into audio without having to pre-record the audio files. Mac AV computers were among the first computers to have speech manager options. Now such options such as Text Assist from Creative Labs (800-998-1000) are available for PCs. We hope that in the future, text recognition utilities will be directly available in
Chapter 3
Page 17

hypermedia authoring packages so that outside software will not have to be used for such purposes. This is one of the various areas were Apple Corporation hardware/software is a step in front of PC competitors. Related to text translation software are the somewhat simpler options for verifying data entries such as audio repeating of numbers keyed into spread sheets and cash registers. ProofReader from Microsoft’s Sound System (800-426-9400) is one such system that works well with numbers but has only a minimal dictionary of words in addition to the number system. Search Appendix 6 for identification of other software firms that have speech manager, text translation, speech recognition, and/or voice-activation options.

(NON-CORE 19) Speech Translation to Computer Text (Speech Recognition) and Voice-Activated Command Software These software options enable computers to interpret speech or other audio commands along with keyboard, mouse, and joystick commands. To date, vocabulary limitations and other problems make this a less than perfect option for authoring at the moment. Alternatives for the PC are reviewed by Tynan (1995), who contends that the top alternatives really work at present and then warns that even the top packages do not yet work for conversational speech. See also Zarowin (1995)/ It is doubtful that writers across the world will be content with the effectiveness and efficiency of dictating text to their computers using present software. We tried the popular Voice Pilot from Dragon systems (617-965-5200) for using menu commands in Windows, but we find it makes many mistakes in recognizing our simple verbal requests. Significant progress has been made in relatively expensive systems for persons unable to use their hands. Gellerman (1994a) reviews technology now available and calls speech recognition “the final frontier” of computer communications. The ability to talk directly with a computer was anticipated years ago in Star Trek television shows and with the supercomputer named HAL in the popular film “2001 Space Odyssey”. Eventually speech recognition will be commonplace when using both large and small computers. Apple intends to make advanced speech recognition a viable feature in its future Gershwin (System 9.0) operating system. Now such options such as Voice Assist from Creative Labs (800-998-1000) are available for PCs See Thyfault (1994) for a review of applications already in place in business firms. See also “text reading.” One of the most promising alternatives is the NCC DigitalDictate-VoiceType system favorably reviewed by David D. Van Fleet, School of Management, Arizona State University West, P.O. Box 7100, Phoenix, AZ 85069-7100 ICDDV@ASUACAD.ASUVM.INRE.ASU.EDU. ProofReader from Microsoft’s Sound System (800-426-9400) is one such system that works well with numbers but has only a minimal dictionary of words in addition to the number system. Search Appendix 6 for identification of other software firms that have speech manager, text translation, speech recognition, and/or voice-activation options. See also “disabilities products.”

(NON-CORE 20) Word Processor Filters for Hypertext. Although mentioned above, this feature is discussed in greater detail here. For professors who already have huge files of learning materials (possibly entire textbooks) in word processing formats (e.g., WordPerfect or Microsoft Word), an important feature to watch for are “filters” in hypertext software that allow importing of parts or all of word processing files without having to first convert those files into ASCII codes. All hypertext options allow text importing in ASCII form, but this can be very awkward and time consuming when mixing animated graphics with text that needs to be altered for font sizes, font styles, and positioning around graphics. ASCII is the American Standard Code for Information Interchange computer character set (text and symbols) that enables
transfer of text and data between different computing systems. For example, files from word processors such as Microsoft Word, Word Perfect, and Word Star often cannot be imported to hypertext or hypermedia software without conversion to ASCII code (most word processors will change files to ASCII "txt" files). The downside is that nearly all formatting and font variations are lost in ASCII conversions such that imported ASCII text may have to be re-formatted line by line and altered for font preferences. Very few software alternatives have "filters" that import word processor files directly without having to convert to ASCII codes. In hypertext authoring, choice of a hypertext software option should include a question concerning whether "filters" are available for avoidance of ASCII text conversions. HyperWriter was perhaps the first hypertext software to offer word processor filters. American International Training was the first CMS vendor to develop this highly useful filtering feature. Firms such as Window Book, Inc., 61 Howard Street, Cambridge MA 02139-2911 (800-370-2410) provide services for converting huge volumes of word processor text into hypertext. Authors will, however, probably want to subsequently customize and improve the hypertext outcomes with new navigation buttons, hotwords, animations, graphics, etc. When using hypertext software having word processor filters, using an outside firm for hypertext conversion is no longer necessary. Multimedia ToolBook and various other hypertext/hypermedia software options have rich-text format (RTF) importing utilities. RTF is a standard established by Microsoft Corporation to allow text to be transferred between software packages without losing most formatting properties that are lost in ASCII and ANSI text transfers. Most modern word processing packages provide the option of saving documents in RTF. Such documents may then be imported with formatting intact if the receiving CMS, hypertext, or hypermedia software has an RTF importing option. This is an important feature to look for if you are planning to import high volumes of text from word processing software.

Text Search in Runtime Versions. This common feature in database and hypertext software is not available in CMS or related options discussed in this paper. Most of the hypertext options listed above offer text search features, although some are more efficient than others in runtime. HyperWriter, Guide, and Hyperties excel in runtime text search. Since it is difficult to write detailed menus for searching out any term or concept in a course, a runtime text search feature is very helpful to users. This feature is extremely useful in new CD-ROM databases of GAAP such as Researcher from Price Waterhouse and the Electronic GAAP from John Wiley & Sons (see Appendix 1).
Simulation Coding, Script Coding, and Other Program Coding Capabilities. Simulation is becoming increasingly important for interactive learning materials. Two types of simulations are: (1) Precomputed simulations where all computations on every branch are computed in advance (while authoring a lesson) such that learners may only proceed along one of several predetermined branchings; and (2) Runtime-computed branchings where learner parameter choices affect the branching options or outcomes during delivery of the lesson. None of the standard CMS options, to the authors' knowledge, are capable of runtime computing (e.g., string/math functions) that are common in traditional simulation software. Grasp, Quest, Tencore, GUIDE, Hyperties, ToolBook, and other software options facilitate shifts into computer code writing that can be inserted into runtime computing simulations, but such simulation coding is tedious and requires coding skills. Standard CMS packages can be used only for "precomputed" branchings. For example, an author may allow in advance for six different problem solutions that depend upon a choice of six different settings of parameters. The user, in such instances, is not allowed to choose any combinations of parameters that are different from the six designated in advance by the author. Nor can stochastic outcomes that require randomizing computations be allowed unless the author resorts to sophisticated computer code writing. It would be a tremendous improvement if CMS vendors added runtime simulation computing that did not entail code writing.

Windows NT Authoring and Runtime Versions. Some hypermedia vendors, will soon have upgrades for 32-bit processing under Windows NT. Many of the vendors who do not provide 32-bit upgrades will fall out of future markets, because the new Intel Pentium Pro processors will soon dominate the user market.

Bridges Between Operating Systems. Macromedia's Authorware, Macromedia's Director, Global Information's TIE, and AimTech's Icon Author are examples of authoring options listed below that have versions for more than one operating system that will play back on selected operating systems. This property is often called "crossing platforms." Authorware and Director will cross between Windows and Mac operating systems. Icon Author and TIE will cross platforms between Windows, Unix, and DOS systems. ScriptX has the most utilities for crossing between operating systems. Mac users may obtain low-cost emulation software to run DOS and Windows software, and some Mac and Power PC options bundle this utility with the purchase price. This may allow runtime delivery (on a Mac) of lessons authored in HyperGraphics, Quest, Tencore, etc., but users may find that running in emulation is too slow to be effective. Also, PC programs that require a large amount of memory may not run on a Mac, and animations may run in slow motion. For example, lessons authored in CGA HyperGraphics will run under Soft PC on a Mac. The authors have never been able to get the EGA HyperGraphics version to run under Soft PC on a Mac. The point here is that some, but not all, lessons authored in DOS or Windows may run on a Mac or Power PC computer, and those that do run may run painfully slow in emulation form. Conversion software is available for converting Mac HyperCard Stacks into Multimedia ToolBook Windows books. Although this software works well for simple books (e.g., books having no complex animations and high-resolution graphics) that aren't in color, the converted books don't look well for complex books with greater color depth of high resolution graphics and complex animations. The same problem arises in most conversion software (e.g., that of Macromedia's Authorware and Director). Even ToolBooks created in 24 bit color PCs may not be suited for PC displays having lower color depths. Mac computers attempt to dither 24 bit color images into acceptable images for lower color-depth Mac computers, but PCs do not dither these images automatically. As books become more complex, a point is reached where authors must rewrite books for to cross
platforms between Mac and Windows operating systems. Graphics and animation incompatibilities are the major hurdles that bridges cannot cross. Someday in the next century, operating systems such as Taligent's Pink will render bridges and multiple authorings no longer necessary, but in the remainder of the Twentieth Century, authors will have to be bothered by such troublesome differences in operating systems. The choice of both an operating system and authoring software for that system remain crucial decisions that authors may either rejoice in or bemoan over time. One question to ask is how long before Windows Chicago will run in native form and in runtime form as tests of the speed to which vendors adjust to new technologies, because virtually all analysts are predicting that Windows Chicago will take the market by storm, possibly even more than the rate at which Windows became the market share leader in the past several years. Newer hypermedia engines have been added to the Netscape browser, notably Macromedia Director that will allow users to put hypertext, audio, animations, and other hypermedia works on the Internet so that users from virtually any platform (e.g., Windows, Macintosh, and UNIX) to view the materials authored in Director. Other engines with less hypermedia capabilities and bandwidth requirements are also available to replace HTML tagging. See NewMedia, August 1995, pp. 19-20.

**Full-Motion Video Compression.** Accounting educators may want to add realism to CMS lectures by inserting segments of full-motion video such as videocamera footage comparing "parallel factory assembly lines" with "series factory assembly lines" in managerial accounting cases and cost analyses. It is important to note which video compression utilities are supported by the authoring software. Full-motion video adds realism to settings of cases and problems. This footage may now be stored and replayed from digital computer storage rather than videotape. Newer compression options such as Intel's Indeo/DVI, Apple's Quicktime, Microsoft's Video for Windows, IBM's MM, MPEG, and Iterated System's Fractal Compression will more efficiently compress graphics and full-motion video files. systems boards and standards (e.g., MPEG-2 and MPEG-1) for the most popular emerging form of compressed full-motion video standard for computer file storage. MPEG compression requires MPEG playback boards and/or MPEG authoring boards such as the Optibase MPEG-1000 digital video codec (compression/decompression) board (800-451-5101). Although MPEG-2 is superior to MPEG-1, MPEG-2 requires at least quad speed CD-ROMs that, thereby, limits the use of MPEG-2 in the commercial market. However, even MPEG-1 is considered a better video compression alternative than its competitors. MPEG encoders are reviewed by Sauer (1996). The are still relatively expensive in the $4,000 to $25,000 range for hardware plus software ranging from $89 to $1,000. Until there are millions of computer users with enough computer hardware capacity to decode MPEG digitized video, Microsoft Video for Windows and Apple QuickTime will probably remain more common in authoring of education materials. MPEG video files have an mpg file extension and will not run on computers that do not have special MPEG playback hardware/software installed. The main difference between JPEG compression and MPEG compression is that JPEG still compresses on a frame-by-frame bases that makes editing frame-by-frame much easier. However, MPEG allows for much more high-density compression of video. MPEG video cannot be edited frame-by-frame in a traditional manner. The first editable MPEG authoring system was the REALmagic Producer (from Sigma Designs at 800-845-8086). Sauer (1996) gives the highest rating of "awesome" to MPEGWorks encoding (recording and editing) software on PrimeView II hardware from FutureTel (800-658-5868 or <http://www.futuretel.com/>). The combined cost is presently in the $7,000 to $10,000 range from FutureTel.
Videodisc Control Utilities. Videodisc technology is rapidly losing ground to CD-DVD digital video discs that are smaller and will hold computer data as well as video. However, when there are relevant videodiscs available, it is important to be able to search and play sectors on videodiscs. Most hypermedia authoring software options have videodisc utilities.

Videotape Control Utilities. Videotape interactive controls and random access software developments were almost nonexistent due to the painfully slow access time in locating individual frames in hundreds of thousands of frames on a videotape. Newer hardware such as the "Sixth-Generation" VCRs having over 30 times the previous search speed, 3D-type TBC with full memory, built-in time code generators and readers, freeze-frame utilities, four-channel audio output, color framing control, 16:9 aspect ratio transitioning to wide-aspect ratio television, and many other attractions are now bringing this long-awaited option for hypermedia authoring. Videotape will never equal videodisc performance in random access speed, but videodisc recording will never be as cheap and simple as videotape recording, especially home and office recording outside professional video studios. For education purposes, we anticipate seeing more and more videotape hypermedia authoring, especially desktop authoring by educators who are developing their own videotapes to use in conjunction with hypermedia controls. An example of a sixth-generation videotape recorder/player vendor is Panasonic Broadcast & Television Systems Co. (800-524-0864). The VCR-Commander from QualTech Inc. (703-759-4472) is an interactive VCR controller system for PCs that includes time-coded calibration utilities.

Trouble Hotline. Educators may find themselves more on their own when learning to author hypermedia lessons. Many authoring software vendors supply a manual and a tutorial disc. Manuals and tutorials often leave a lot to be desired in terms of convenient indexes, menus, completeness, illustrations, and authoring tips. Educators may have to "discover" authoring ideas in animation, imported graphics modifying, and branching that possibly might have been explained by vendors in both the manuals and the tutorials. A contact list of users classified by academic discipline would be helpful so that authors can commiserate with one another on occasion. Most vendors offer technical consulting by telephone or email, although most now charge for such services after a limited time (e.g., 90 days) following the purchase of the software.
Simulation and Virtual Realities. At the edge of high technology education and training are virtual realities and related simulations that immerse learners in cyberspace to a point where the bounds of reality and fantasy are extremely blurred. Systems presently available in game arcades in most major cities of the world are computer games where users wear headgear and wired gloves. Virtual Reality (VR) versions in research and training centers may have complete body suits and VR options where more than one person can interact simultaneously in the same simulated environment. Serious training centers using VR exist in the military and various medical centers. During the Gulf War, pilots and tank commanders practiced missions in virtual realities. Naj (1993) reports that VR is serious business for surgeons and other physicians, and for some investment research analysts such as those involved in CREF college pension fund investing who enter virtual reality space to analyze financial data. VR is now making its way into science education, but it will probably be years before this type of technology makes its way into accounting education and training. Although virtual reality most of its applications to date in training and entertainment, there are some applications in data analysis such as the use of VR to analyze international portfolio data in the TIAA/CREF Pension Funds. Winn (1984) contends VR will become a major part of university curricula. He cites evidence that VR is especially successful for learning disadvantaged and physically handicapped students.

Opinions of Developers. Greenfield (1992b) surveyed some leading "systems developers" and asked them: "What is the one best-selling feature of your program?" Their responses (some of which relate to previous CORE or NON-CORE attributes) were as follows in the terminology of those software developers:

1. It contains 16 instructional strategies that are organized the way teachers think.

2. It separates structure from content.

3. A wealth of capabilities are offered yet the user doesn't need a programming background to harness them.

4. It has an unlimited branching depth, branching as many times to as many levels as one desires.

5. It has royalty-free licensing for runtime versions of the courseware.

6. It's designed with three levels of authoring capabilities, so novices and experts can go online.

7. Teachers can tailor courseware and be creative with material, delivering in a way that is interesting to students.

8. It's user-friendly. One can start to use it the same day one learns it.

9. Instructional strategies are built into the system.

Familiarity Among Users. Although there are no clearly dominant authoring software packages that overwhelm the market, consideration might be given to using packages that of leaders whose products are better known among other authors and users of learning and entertainment materials. For example, HyperCard took an early
lead for Mac products but then died down after HyperCard software was not kept up to date with competitor options. (The latest release that adds color and animation options make HyperCard somewhat more competitive.) However, in Syllabus, November/December 1993, the listing by Apple Computer of authoring software does not even mention HyperCard as a "course authoring tool" in the pp. 4-5 listing of authoring tools. Apple Media Kit is discussed in that article where on p. 5 it is called "a tool designed for more advanced developers." At this point in time, market leaders include Asymetrix ToolBook and Microsoft Visual Basic for PC authoring. Among the hypermedia software authoring options for PCs, PC Computing in July 1994 on Page 90 claims that Asymetrix Multimedia ToolBook "surpasses most competitors in features and functions while retaining its price advantage and royalty-free runtime arrangement." Mac authors prefer HyperCard, Microsoft Visual Basic, and Macromedia Authorware and Director. The Prentice-Hall publishing firm seems to have opted for Authorware for future hypertext and hypermedia products in book publishing. Unix operating systems authors often prefer Icon Author from AimTech. The Irwin publishing firm seems to have opted for Icon Author for future hypertext and hypermedia products in book publishing. For authors who want video products that play on VCR players and television, the popular authoring software has become the Video Toaster from NewTek that runs on an Amiga line of workstations. However, even more video authoring is performed on Apple AV systems using most any software that runs on a Mac. The PowerPC will probably replace the Apple AV when the PowerPC options become widely available. High end video systems include the systems from SGI and SUN. These and other alternatives are discussed in subsequent parts of this Chapter.

**Speech Recognition.** Speech recognition entails the ability of the computer to interpret speech or other audio commands along with keyboard, mouse, and joystick commands. To date, vocabulary limitations and other problems make this a less than perfect option for authoring at the moment. Significant progress has been made in relatively expensive systems for persons unable to use their hands. Gellerman (1994a) reviews technology now available and calls speech recognition "the final frontier" of computer communications. The ability to talk directly with a computer was anticipated years ago in Star Trek television shows and with the supercomputer named HAL in the *2001 Space Odyssey*. Soon speech recognition will be commonplace when using both large and small computers. Apple Computer intends to make advanced speech recognition a viable feature in its future Gershwin (System 9.0) operating system. See Thyfault (1994) for a review of applications already in place in business firms.

**CD-ROM, CD-DVD, or Related Authoring Aids.** Many instructors in modern times would like to transfer their electronic course materials to optical discs such as CD-ROM, CD-DVD, CD-I, and videodisc options. Some vendors now offer, or will soon offer, software that facilitates this process. For example, some of the latest options include block marking and object tagging for linking and indexing when memory problems arise. The outlook for CD-ROM in the long haul is not so rosy. Billips (1994, p. 100) predicts the following:

> As a lingering vestigial remnant of the mechanical age, the CD-ROM has no place in a fully digital communications environment and is no doubt destined to the same scrap heap as the eight-track. The new Nintendo/Silicon Graphics Inc. (SGI) media environment, for instance, uses a silicon cartridge that is two million times faster than CD-ROM.

In our viewpoint, however, the CD-ROM will remain the standard until better alternatives can be recorded as simply and as cheaply in homes and offices as CD-
ROM discs can now be mastered (burned) for less than $10 per disc on desktop recorders costing less than $1,500.

(NON-CORE 34) **Accounting, Tax, and Auditing Modules.** Some software options have built-in aids for writing accountancy cases, accountancy simulations, and student project assignments in accountancy courses. One example given in Appendix 4 is the Rittenberg and Schwieger **adVenture Software** from Dryden Press that contains audit simulation aids such as statistical sampling tools and data files. Also listed in Appendix 4 is the McCormack and Cassel spreadsheet software from McGraw-Hill for writing cases in cost analysis and decision making. Often these features are front ends to more general software such as Lotus.

Many CMS and alternative hypertext packages lack many of the options that are very useful in database, word processing, spreadsheet, and desktop publishing software. It would be very helpful to have more mathematical symbols and equation writing aids. These are but a few important areas where CMS software packages need improving. (Some like Asymetrix ToolBook have made strides along these lines.) Spreadsheet software vendors and graphics software vendors may soon add some of the core and non-core features listed above.

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**Software Options**

Various course management software (CMS) packages are available. These usually have common core features plus unique advantages and disadvantages vis-a-vis their competitors. Advantages are inclusions of CMS core utilities such as examination templates and record keeping utilities. Disadvantages are that virtually all CMS vendors have fallen behind the leading-edge authoring vendors in areas of networking utilities, speech recognition, hypermedia editing, and other features that have given those vendors their market niches. Many of the CMS vendors clung too long to DOS and Mac platforms while the markets exploded in Windows, Windows 95, and Windows NT. It is important to obtain literature and demonstration discs from each vendor before selecting the one CMS or related package which is to be used to author CAL lessons and to control presentations in the classroom. Unfortunately, there is no one vendor that stands out as having all "non-core" features mentioned earlier in this paper. Most packages allow for authoring colored and animated computer graphics. All CMS packages have "core" features along with a subset of the "non-core" features. When any two vendors advertise the same feature, one may have a more sophisticated version of that feature. An extensive list of vendors and product attributes is provided in Appendix 6. For a review of CMS and other authoring options. Also see NewMedia Tool Guide for 1995 and HPEC Syllabus (May/June 1994, pp. 10-13). The addresses and phone numbers of NewMedia, HPEC Syllabus, and other periodicals are contained in Appendix 4. One of the most interesting servers for technology in education is the MIT university “MIT EVAT Report-Models for the Future” at <http://www-evat.mit.edu/report/>. We stress repeatedly in this book that readers should not judge either authoring software or hardware based upon price alone. High priced options are sometimes inferior and out of date relative to lower priced options. The highest priced options such as Authorware, Icon Author, and Tencore in our viewpoint and in the viewpoint of many analysts are not necessarily better than lower priced options and are indeed inferior in terms of some core and non-core features. Do check on runtime/royalty prices, however, since these are important. An option that has a runtime/royalty fee is not necessarily better than one that has free runtime. Beware of options that advertise free runtime. Be sure to check whether it is truly free in all instances and whether there are some authoring features that will not play back in the runtime version of the software.
Another warning we want to stress is that CMS authoring packages are not necessarily better for authoring than the alternative (Alt) options discussed later in this chapter. Many CMS vendors have a tendency to be slower in adapting their software for new technologies in spite of being higher priced alternatives. HyperGraphics and Tencore still do not have Windows versions available years after competitors had Windows upgrades from DOS. For example, one of the authors (Jensen) authored extensively in HyperGraphics only to discover that the vendor was way behind in adapting to multimedia options. He now prefers Asymetrix Multimedia ToolBook even though it does not have all the CMS core features. One question authors seeking widespread markets for their electonic books should ask is how long before Windows 95 and Windows NT will run in native form as a test of the speed to which vendors adjust to new technologies. Even more important is the question of cross-platform capabilities that are now present in high-priced authoring packages such as GainMomentum from Sybase and ScriptX from Kalieda Labs. Several vendors of CMS authoring packages of possible interest are compared below:

(CMS - 1) Allen Communication, 140 Lakeside Plaza II, Salt Lake City, UT 84116 (800-325-7850) or (801-537-7800). The authoring package is called **Quest** and is currently available in DOS Windows for $3,995. Quest is more WYSIWYG than most CMS competitors and has unique "Design" and "Frame" utilities. At the Design level, authors can make design decisions regarding structure and flow in thumbnail hierarchies. At the Frame level, authoring commences just as the users will see the course materials in hypertext and hypermedia form. A free demonstration disc is available on request. Quest is a highly versatile CMS option for PC users due, in part, to having limited CMS word processing capabilities (spell checker, symbol search, text replacement) without having to export text to a word processor. Quest also has a new file compression utility. The new upgrade allows graphics resizing and aspect ratio alterations. For C programmers, a feature of Quest is the ability to code in C coding. This allows authors to code simulations and mathematical computation routines. Unlike Tencore Author, there is no added fee for the Quest Authoring Language software. A disadvantage for accounting educators is that, to the authors' knowledge, none of the accounting textbook publishing firms have Quest materials available to adopters such that Quest users may simply modify and update publisher electronic transparencies. Quest dropped its runtime fees such that authors can distribute their materials commercially with free runtime software. An independent market research study reported in the 1993 Computer-Based Training Report (617-749-4929) rated TIE from Global Information systems higher than Icon Author in ease of use, flexibility, multimedia, development time, and combined average. However, this study was conducted before the new Windows version of Quest was available.

(CMS - 2) American Training International (ATI), 12638 Beatrice Street, Los Angeles, CA 90066 (800-955-5284). The Windows version of **TourGuide** and Anthology for DOS/Unix developers are among the latest full-line CMS options to combine authoring, presentation, and student record management. A free demo disc is available upon request. The Presentor utility evaluates student responses to questions and measures progress toward course objectives. A DVI motion video development package is also available. Prices range from $3,370 to $10,000 for various bundled options. A $1,000 lifetime runtime fee is charged for an author who wants to develop commercial sales products that users can run without licenses for ATI products. ABI offers some competitive advantages over its closest competitors. It combines some of the best of Authorware but is more object oriented, like ToolBook. It has more filters for graphics files than its CMS competitors and its hypertext competitors, and picture size and aspect ratios are easily modified. Unlike most of its competitors, it has filters for common word processors such that manuscripts written
in Word Perfect, for example, can be imported directly without having to convert to ASCII text. This is a major competitive advantage. It has a spell checker and word search features. It does not have a scripting language such as those found in Quest, Tencore, and ToolBook. Nor does it have student response pad or remote control utilities such as those of HyperGraphics.

(CMS - 3) Asymetrix Corporation, 110 - 110th Avenue NE, Suite 700, Bellvue, WA 98004 (800-448-6543). The popular Multimedia ToolBook authoring system has been extended to a CMS version known as Multimedia ToolBook CBT that eliminates need for coding skills to obtain CMS features. A student version of Multimedia ToolBook that does not have the CBT features is available for $99. The CBT upgrade introductory price to educators was $249 (others pay $449) plus the $295 educator price for Multimedia ToolBook 3.0. The regular price of the combined package is $777 to educators. Features include a library of 2,000 courseware templates that contain navigation controls and staging areas, student data tracking, bookmarking, student log files, hotword linkages to glossaries, over 200 pre-coded drag and drop interaction “widgets” for questions, answers, actions, bookmarks, 3D layout elements, data validations, media clips, response checking, examples, etc. Asymetrix also offers a Developers Services Program for $556 per year that claims to have five-star technical support. Student response pad software is not included but can be obtained from third party vendors whose software is presently being used by Professor Barry Rice at Loyola College of Maryland. An introductory book on ToolBook Version 3.0 is given by Holtz (1995). In 1995, Asymetrix three features that give it a heavy competitive edge. One is a Netscape engine that facilitates authoring for the World Wide Web on the Internet by allowing users to run ToolBooks without having to install a single file other than the Netscape browser. A second huge innovation is the Database Connection software that unifies databases of multiple vendors of database software. The third innovation is a user-friendly 3D F/X utility for rendering 3D animations.

(CMS - 4) Center for Computer-Assisted Legal Instruction (CALI), 565 West Adams Street, Chicago, IL 60661-3691 (312-906-5307). Details regarding CALI are provided in Appendix 5. The software called LessonBuilder is based upon a hypertext software called HyperPAD from Brightbill-Roberts & Co. LessonBuilder costs $450, but a special price of $150 was offered to recipients of the CETA Newsletter described in Appendix 4. This CMS software is evaluated in CETA Newsletter, November 1993, p. 3 and receives highlighted treatment in Appendix 5 of this book. The reason we gave it special treatment is the widespread usage of LessonBuilder in schools of law. Since it is not a hypermedia option, it is of less interest to us than hypermedia options. However, for authors who want a CMS option for hypertext, the LessonBuilder option based on HyperPAD hypertext is a relatively simple DOS package that will soon have a Windows version. One comparative advantage is a better-than-usual manual and tutorial on how to author the CMS courses. Like HyperGraphics, LessonBuilder can be used on very inexpensive low-end computers, including those with only CGA graphics adaptors.

(CMS - 5) Computer Teaching Corporation, 1713 S. State St., Champaign, IL 61820 (217-352-6363). The DOS authoring package contains TenCore Producer and Tencore Author. A free demonstration disc is available upon request. Tencore tends to work with large-scale training programs to develop customized courseware. It does not try to compete with the other CMS vendors for presentation and individual course development. A variety Tencore programs are also available, including
Tencore LAS coding language and Tencore CMI course building system. There are no plans at present to upgrade Tencore for Microsoft Windows or Mac users. Although these, like most DOS programs, will run under Windows, authors are not afforded the highly useful Windows utilities such as the Clipboard and Windows multimedia players. The Tencore Producer price is $1,440 to educators and $1,800 to others. TenCore Producer is a menu driven DOS package comparable to most CMS competitors such as Quest. The Tencore Author is a programming language allowing for writing in Tencore's own computer code at an added price of $2,400. Code programming languages such as Tencore Author and Quest Authoring Language make numerical computing and writing of sophisticated simulations and interactive games possible in runtime (student use) computing. TenCore has the longest history among CMS vendors, and there are many corporate adopters of Tencore. It excels in DOS options for diagnostic testing and branching into training areas where students reveal their greatest needs for more learning. It is designed for development of complete training courses that combine hard copy, learning discs, films, slides, etc. It is not yet upgraded for full-motion video compression and standardized multimedia switching to the extent found in Windows and Mac operating systems. The authors do not know of any accounting textbook publishers that supply Tencore learning materials. Unlike most CMS vendors, Tencore does have a small international network of dealers and a quarterly newsletter called Tenfold. It is indeed unfortunate that the company remains entirely DOS based. It is also unfortunate that a $1,200 runtime fee charged for each item produced. An independent market research study reported in the 1993 Computer-Based Training Report (617-749-4929) rated Tencore lowest in ease of use, flexibility, multimedia, development time, and combined average when compared with TIE, Authorware, HyperCard, and Icon Author.

Discovery Systems International, Inc., 7325 Oak Ridge Hwy., Knoxville, TN 37931 (Phone 615-690-8829). The Course Builder software package sells for $1,495, but academic purchasers need only pay $995. This a CMS system designed for Mac has the main competitive advantage of point and click ease of use vis-a-vis its Authorware competitor. There is a free runtime version that allows authors to sell Course Builder lessons and books without having to pay a runtime royalty fee. This makes Course Builder more convenient for academic developers who wish to sell their products. There are no spell check and search utilities in the present version. One drawback is that for hypermedia, developers may have to purchase additional modules, e.g., the Video Module, the QuickTime Module and the VLogic Module. Its closest competitor is PEAK from Major Educational Resources.

Global Information Systems Technology Inc., 100 Trade Centre Dr., Ste. 301, Champaign, IL 61820 (217-352-1165). The TIE (Training Icon Environment) hypermedia authoring system for Windows sells for $3,500, but educators can purchase TIE for $500. The Unix version is $5,500. A free demo disc and CD-ROM are available. Alternate packages exist for both Windows and Unix operating systems. No runtime fee is charged. Like Icon Author, TIE will cross between Windows, Unix, and DOS platforms (i.e., lessons authored on one platform will play back on another platform if graphics and animations are not too complicated.) An added $500 is charged for the cross-over capability. It allows for scripting in the Tutor language originally developed for the Plato system at the University of Illinois and is a lot like the Tencore Author language. A free demo disc and CD-ROM are available. An independent market research study reported in the 1993 Computer-Based Training Report (617-749-4929) rated Tencore lowest in ease of use, flexibility, multimedia, development time, and combined average when compared with TIE, Authorware, HyperCard, and Icon Author.
Training Report (617-749-4929) rated Tie highest in ease of use, flexibility, multimedia, and combined average when compared with Authorware, HyperCard, Icon Author, Quest, and Tencore.

HyperGraphics Corporation, 308 N. Carroll Road, Denton, TX 76201 (Phone 800-369-0002 or fax 817-565-0959). A free demonstration disc is available upon request. The DOS authoring software package (called HyperGraphics tbt Author) is currently available in CGA or EGA versions. The CGA version runs under DOS on a Mac having Soft PC software, but the EGA version appears to be limited to PCs. A VGA version for Microsoft Windows users will be available for the first time in summer of 1992. Current prices are $750 to educators and $2,500 to others. Add-on software includes voice imposing ($1,500), tbt Encyclopedia, clip art files ($300), and tbt Teaching Assistant which allows students to interact in classrooms equipped with HyperGraphics electronic response pads (at $250 for each cordless unit). HyperGraphics has no simulation or spreadsheet computing capabilities without diverting to other software during a runtime presentation. HyperGraphics Corporation was engaged by various publishers to author electronic transparencies for textbooks. This company also developed training modules for large firms like AT&T and automobile manufacturers. HyperGraphics also sells its own educational and training materials for vocational training and secondary schools.

Early advantages of HyperGraphics over other CMS competitors were: (1) the built-in options for teaching from a hand-held remote control device; (2) the "build" utility that compresses entire courses onto one or two discettes; (3) the built-in options for hand-held student response pads; (4) the built-in option for randomly displaying student names on the screen; (5) the templates for constructed (open-ended) questions/problems in addition to the more common multiple-choice, objective-answer templates; and (6) the supplementary electronic transparencies that accounting textbook publishers have made available so that instructors who purchased authoring licenses could modify and update those supplements. HyperGraphics tbt Author lacks spell checker, word/symbol search, and text replacement utilities and has no plans at present for adding these features. Unlike most of its competitors other than Tencore, HyperGraphics has no plans at present to add features for graphics resizing and changing of aspect ratios.

The current EGA version of tbt Author has more color options and higher resolution than the former CGA version. However, the EGA version requires so much RAM that some users may have difficulties authoring EGA lessons. We had to replace DOS 4.1 with DOS 5.0 to get the EGA version to run on our computers. Also the EGA lessons can only be delivered on EGA or VGA machines, thereby leaving out present CGA computer owners. At the time of this writing, the promised Microsoft Windows version of tbt Author is still not on the market. It appears that HyperGraphics will not have the hypermedia capabilities of most of its competitors (e.g., Video for Windows, MPC standard audio capabilities, object oriented programming, etc.). Also, HyperGraphics, unlike some of its CMS competitors, still requires royalty negotiations for runtime of each commercially developed product.

Huge drawbacks of HyperGraphics authoring are its limitations when authoring hypertext. There are no scroll bar text fields. Pages of text must be typed or imported in separate blocks of less than 100 words, which makes text importing virtually impractical. There are no simple hotword navigation options and OLE support. A second huge drawback is the inability to author and playback MCI
standard audio and video files. The forthcoming VGA version is extremely awkward and slow for use in authoring lessons. For these reasons, one of the authors (Jensen) found it necessary, after authoring thousands of hours of HyperGraphics courseware, to shift into Multimedia ToolBook authoring.

(CMS - 9) Macromedia, 600 Townsend St., Suite 310W, San Francisco, CA 94193 (Phone 800-888-9335 or network to <http://www.macromedia.com>). A free CD-ROM demonstration disc is available. The CMS authoring package for educators is called **Authorware Academic** and for either the Mac version or the Microsoft Windows version is $150 for from Prentice-Hall at <http://www.prenhall.com/> or 800-811-0912. Persons not classified as educators must pay $4,995 for Authorware Professional. It is possible to author materials on a Mac and translate to Authorware for Windows but graphics images and animations sometimes do not cross platforms very well in practice. Authors in Authorware interested in cross-platform options are recommended to first author the materials on a Mac or Power PC computer. The Windows version for any user is now available in upgraded multimedia PC computers from Acer Corporation (800-346-3469). Like most Mac and Microsoft Windows software, Authorware relies heavily on pull-down menus and has graphics capabilities. It is not especially user friendly or efficient for authoring large volumes of work. Unlike ABI products mentioned above, Authorware is not object oriented in the sense of current trends in computer programming. Nor does it have scripting language options like Quest, IconAuthor, Director, ToolBook and other popular competitors. This stifles creativity in authoring. A spell checker is available along with search utilities. The new upgrade will also allow graphics resizing and aspect ratio alterations. Authorware is mainly a software company and does not deal in electronic response pads, instructor remote control devices, or other hardware options available from some CMS competitors (although Authorware does sell a sound digitizer.) Authorware has become one of the most, if not the most, active CMS partner with publishing firms in generating interactive multimedia textbooks. For example, Prentice Hall, a division of Paramount Publishing, in 1994 will introduce a wide assortment of high school and college textbooks in multimedia Authorware Academic. An excellent accounting example is the Hollingsworth’s ThinkTax listed in Appendix 1. Professors will be able to customize these texts with their own authored multimedia materials. Other major publishing firms have opted for Authorware on selected texts. No announcements have been made by major publishers as to plans to include accounting texts. Authorware did generate some earlier supplements in accounting for the Richard D. Irwin publishing company and is now actively generating courseware for Prentice-Hall. Some accounting firms such as Arthur Andersen and Ernst & Young are experimenting with Authorware for development of training courses. Authorware has a utility for translating its Mac lessons into DOS runtime versions. The main disadvantage is that DOS users cannot play back these lessons in the same color and animation quality. As mentioned earlier, Authorware has a runtime royalty fee that discourages some commercial authoring in Authorware. However, the runtime fee applies only to mass-distribution items such a CD-ROM books sold in retail outlets. ’s closest competitor that crosses over between Windows, Unix, and DOS is TIE from Global Information Systems. An independent market research study reported in the 1993 Computer-Based Training Report (617-749-4929) rated TIE from Global Information Systems higher than Authorware in ease of use, flexibility, and multimedia. Authorware beat out TIE on development time. Closely related to Authorware is the extremely popular Macromedia **Director** whose latest version
has better text handling utilities and a Netscape engine. **Shockwave** for playing Director’s video over the WWW.

Authorware It is not an object oriented system and has no separate scripting language comparable to the C code language for Quest and the OpenScript language for ToolBook. It is possible to code mathematical computations and script-like controls. Authorware is an icon-based authoring system intended to primarily compete with with such options as Icon Author from AimTech, Peak from from Major Education Resources, Course Builder from Discovery System, and Expanded Book Toolkit from Voyager. It only has 13 icon options as compared with Icon Author's 62 icons. Icon Author and Authorware are compared in a detailed analysis by Rosenthal (1994). Both are rated high by him. Icon Author is preferred for Unix operating systems; Authorware wins out for Mac computers. Neither is probably as cost/effective or as flexible (e.g., scripting language capabilities) for PC users as other other alternatives discussed in this chapter. For example, Apple Media Kit, Quest, ToolBook, and other options have scripting language capabilities. Faculty developers of commercial applications are particularly discouraged by the runtime/royalty fees of Authorware, Icon Author, Apple Media Kit, and a number of other options compared in this chapter. Authorware Professional seems to be the popular choice for training modules in some accounting firms, notably Ernst & Young (Mac Applications) and Price Waterhouse (Windows Applications). It is also used in some Arthur Andersen training modules. See Appendix 1 for some applications that are conmmerically available such as the Price Waterhouse FAS 109 Learning the Less Taxing Way, Corporate Tax Explorations: Advanced Corporate Tax Issues for Auditors, and Tax Foundations: How to Audit Corporate Tax Provisions selling on CD-ROM for $1,000 each. Macromedi Authorware and Director have become the choice of some universities (e.g., the huge CUNY system in New York) and other schools for site licenses. The University of Iowa has a cite license for Director.

(CMS - 10)Major Educational Resources, 10153 York Road, Suite 107, Hunt Valley, MD 21030 (Phone 410-628-9200). The Personal Educatonal Authoring Kit (**PEAK**) sells for $1495 with substantial discounts for multiple license purchases. It is very similar to Course Builder from Discovery Systems. This is an authoring sytem for Mac computers. It is an adaptaion from HyperCard that allows users ease in not having to write scripts for common authoring tasks in course development. It does not have the full features of either Authorware or Course Builder. Runtime is free. No spell checker is available. Extensive clip art files and science images are available at added prices.

Among the various CMS authoring packages mentioned above, there is no one package that excels on every criterion. At this point in time, we find the Multimedia ToolBook option discussed above and below to be our choice for Windows operating systems. Macromedia Director is our choice among options that cross platforms between Mac and Windows although it is not a full CMS package. Newer hypermedia engines have been added to the Netscape browser, notably Macromedia Director that will allow users to put hypertext, audio, animations, and other hypermedia works on the Internet so that users from virtually any platform (e.g., Windows, Macintosh, and UNIX) to view the materials authored in Director. Other engines with less hypermedia capabilities and bandwidth requirements are also available to replace HTML tagging. See **NewMedia**, August 1995, pp. 19-20. **TIE** is our choice among Unix options and options that cross platforms between Windows and Unix. Authorware, Course Builder, and PEAK are full CMS options listed above for Mac authoring, although the majority of Mac users have opted for alternatives such as HyperCard, Apple Media Kit, and Macromedia Director that are not full-featured CMS alternatives. Authorware from Macromedia
is probably the most widely used CMS package among Mac users and is becoming a software of choice among some of the largest publishing firms. We repeat the earlier warning, however, that Authorware requires runtime royalties on large-distribution electronic books that may discourage some authors from developing commercial coursework in Authorware.

There are CMS-related software options, designated below as alternate ALT and analog video VID options in this chapter, that lack some of the core features of course management software (CMS). These other lesson authoring options are worth considering in lieu of CMS if course management features such as student tracking, examination grading, interactive branching, and runtime software switching with lesson returns are deemed unnecessary. Most ALT and VID options have some key advantages over the CMS packages. For example, most are much cheaper than CMS packages that often exceed $2,000 with runtime and authoring licenses. Some options listed below have free runtime versions for commercial users. Many options are better than CMS alternatives for hypertext, hypermedia, graphics rendering and animating. No one system is ideal for all features. An extensive list of vendors and product attributes is provided in Appendix 6. For a review authoring options also see NewMedia Tool Guide for 1994, pp. 19-27. Names of vendors, addresses, and phone numbers for such products can be obtained from word searches in Appendix 6. In contrast to "presentation software" options such as Harvard Graphics and PowerPoint, the ALT options are referred to in the NewMedia Tool Guide as "authoring" options for hypertext and hypermedia. The selected ALT "authoring" options highlighted below facilitate multimedia presentations and full-motion video not yet available in some of the CMS options:

(ALT - 1) AimTech Corporation, 20 Trafalgar Square, Nashua, NH 03063-1973 (800-289-2884). The **Icon Author** is a multimedia package that sells for $5,000 to the public and $995 to educators. A version running on Unix/Motif operating systems costs $10,000. IBM was an early advocate of ToolBook, but now has entered a joint venture (800-426-3333) to support IconAuthor from AimTech. According to Alia (1995), "IconAuthor fits into the IBM authoring strategy between its professional programming tool, VisualAge, and Visual ScriptX, which sits atop Kalieda's next-generation object-oriented language." Icon Author is primarily a corporate training package that is not too viable for commercial books and courses since there is a hefty negotiated runtime royalty. Also, text is primarily authored in a word processor and then imported as an RTF file from the word processor. Graphics cannot be imported and rescaled for many popular graphics formats. Icon Author and TIE from Global Information Systems have a competitive edge that lies in being able to run in Windows and Unix platforms provided there are no complex graphics and animations to translate. Neither is not an object oriented system and no scripting language is available in Icon Author (a good programming language is available for TIE.) . Icon Author is an icon-based authoring system intended to primarily compete with Authorware, although is does not have all the CMS features of Authorware. It does have 62 icon options as compared with Authorware's 13 icons. Icon Author and Authorware are compared in a detailed analysis by Rosenthal (1994). Both are rated high by him. Icon Author is preferred for Unix operating systems; Authorware wins out for Mac operating systems, although Rosenthal does not compare it with Apple Media Kit, Course Builder, Peak, SuperCard, and the other Mac alternatives. Neither is probably as cost/effective or as flexible (e.g., scripting language capabilities) for PC users as other other alternatives discussed in this chapter.
(ALT - 2) Allegiant Technologies, Inc. (619-587-0500). This was an early Aldus product that was sold to Allegiant Technologies. A number of software packages are available, one of which is SuperCard listed at $189 for academics and $495 for the rest of the world. This is a hypertext and hypermedia toolkit for Mac computers. A Windows 3.1 version is scheduled for 1995. As the name implies, it is a "super" colored version of HyperCard, but it is not a full CMS package like Authorware, but at a much lower price it can perform many of the same tasks. It lacks some of the ToolBook features such as a spell checker, a text search utility, and clip making utilities. Newer versions overcome some of the severe problems of older versions such as the speed of screen updates. The popular A.D.A.M. human anatomy CD-ROM Mac version was authored in SuperCard. There is no runtime/royalty fee.

(ALT - 3) Apple Computer, Inc., 20525 Mariani Ave., Cupertino, CA 95014 (800-538-9696) and affiliated third party vendors provide an array of free or low-cost Mac hardware/software options such as HyperCard, Apple Media Kit, QuickTime, and a variety of computers that will output to video as well as computer images. HyperCard was once a widely popular hypermedia software for Mac computers. It has since waned in popularity due mostly delays in upgrading by Claris and Apple Computers. In fact in Syllabus, November/December 1993, the listing by Apple Computer of authoring software does not even mention HyperCard as a "course authoring tool" in the pp. 4-5 listing of authoring tools. Apple Media Kit is discussed in that article where on p. 5 it is called "a tool designed for more advanced developers." It is available for Mac and Windows operating systems. Murie (1994) discusses outlines some belated but "new life" that Apple Computer has breathed into HyperCard. At a much higher authoring end, Apple Media Kit (AMK) or Apple Media Kit presently has an Apple Media Language module that will be compatible with ScriptX hypermedia script coding when ScriptX becomes generally available. The authoring software comes in the $1,195 basic AMK plus $2,995 for the Apple Media Language module. The runtime module is $5,000 for unlimited use within an organization whereas runtime fees must be negotiated (two to three percent) for commercial sales items. AMK is reviewed by Brenner (1993). A key feature of AMK is the cross-platform capability that allows for delivery (runtime, reading, playback) in Mac and Windows operating systems. One important feature is the AMKQuicktime is a file compression package that does not require a compression board. It is intended for extensions to full-motion video on Mac systems and Windows systems. Apple computers have the tremendous advantage of many built in graphics and audio capabilities. Many of the earlier hardware limitations have been overcome in the Quadra series of computers. Apple also has its new Newton Device for portable network interfacing and portable scanning. Third parties offer some of the best graphics and video software packages for Mac computers. Apple products tend to be more user friendly than PC hardware and software, especially when installing these products into the computer; however, there are a larger variety of software packages available for PC computers. Whereas Mac computers can be made to run most DOS and Windows programs, PC computers will not run Mac programs. A major advantage to Mac users is the virtually seamless way in which they will be able to upgrade to PowerPCs forthcoming from the joint venture between IBM and Apple Computers. A major drawback for developers of commercial products is that PC computers and CD-ROMs have the lion's share of the USA market and an even larger share of the global market. For example, CD-ROMs developed on a Mac computer often have to be re-developed at considerable expense to run under Windows so that a wider market is opened up for the products to be used by customers who only have DOS or Windows software to run CD-ROMs.
(ALT - 4) Asymetrix 110 - 110th Ave., N.E., Suite 717, Bellevue, WA 98004, (800-624-8999 or network to <http://www.axymetrix.com/>). The authoring software is called 

**Multimedia ToolBook**, plus there are other add-on options such as 3D/FX graphics generator for 3D animations and Mediablitz for assembling scores of multimedia components. The academic price is $99. Asymetrix also offers 

**Multimedia ToolBook CBT** which is a full-line CMS system discussed above. In addition, for $195 the 

**ToolBook Database Connection** linkages to most database software options is available from Asymetrix. Among the hypermedia software authoring options for PCs, 

**PC Computing** in July 1994 on Page 90 claims that Asymetrix Multimedia ToolBook "surpasses most competitors in features and functions while retaining its price advantage and royalty-free runtime arrangement." The latest version (3.0) of ToolBook is described the four and one half stars by 

**Multimedia World** (June 1994, p. 48) as the "Top-Rated" hypertext/hypermedia authoring tool. All Asymetrix software runs under Microsoft Windows. Authors need no longer purchase the hypermedia front end 

**Express Author** toolbook from the Institute for Advanced Technology (IAT) listed in Appendix 4. This and other front ends are less important in the new 4.0 or higher versions of ToolBook. Numerous ToolBook training programs are given by the IAT and others listed in Appendix 6 for aspiring ToolBook authors. Express Author was for a short time useful for beginners who want most of the script coding to be performed automatically until they become more familiar with the ToolBook OpenScript authoring language. However, due to MediaBlitz and auto-scripting features of the the new versions of Multimedia ToolBook, there is little reason to purchase any front ends like Express Author. All these authoring options have been the hypermedia software of choice by one of the authors (Jensen). ToolBook can be used to create colored and animated graphics projections, although rendering ToolBook lessons may be time consuming in comparison to some CMS options. ToolBook has become the market share leader in the Windows hypertext/hypermedia arena, although it is less user friendly than many of its competitors. The main advantage of ToolBook is that it uses hierarchical menu driven "book" hypertext hierarchies that some users may find appealing. It is object oriented and is somewhat analogous to HyperCard stacking on a Mac computer. Both ToolBook and HyperCard seem better suited to computer-aided instruction (CAL) in laboratories than to classroom CAT applications. Multimedia ToolBook facilitates preparation of multimedia presentations that switch back and forth between full-motion video and computer text and graphics. ToolBook also includes, at no extra fee, a programming language called OpenScript for coding string, logic, and computational routines. The new version called ToolBook 2.0 has many improvements, some of which are listed in NewMedia, January 1994, p. 34. These include improved hypertext authoring of volumes of text, multi-window applications, OLE options, a drag-and-drop interface, full text search, spell checking, embedded TrueType fonts, 24-bit color, new animation tools, media file management tools, and many others. 

**ToolBook will be a major player, if not the major player, in authoring of academic courseware and electronic books for PCs.** This stems in part by its advocacy of IBM Corporation in conjunction with the IAT Institute of Advanced Technology (see Appendix 4). Software does exist for conversion of Mac HyperCard stacks into ToolBooks, although graphics images and animations may have to be re-authored after the conversion.

One tremendous factor in favor of ToolBook has been its promotion by the Institute for Advanced Technology (IAT) at the University of North Carolina. The IAT offers workshops to help professors learn ToolBook and has developed a multimedia frontend package to simplify multimedia ToolBook development.
Publications, videos, workshops, and conferences are available for training educators for authoring and/or using Multimedia ToolBook learning materials. For example, the Institute of Advanced Technology (See Appendix 6) has course materials, training workshops, the INFOBITS Electronic News Service, videotapes, satellite broadcasts, the Express Author front end to Multimedia ToolBook, and prepared ToolBook learning materials. See Appendix 6 for listings of training programs around the world.

(ALT - 5) Autodesk, Inc., 2320 Marinship Way, Sausalito, CA 94065-9910 (414-331-0356). The Autodesk Animator and Autodesk Multimedia Explorer programs ($695) are not full-featured authoring alternatives. These are, however, relatively easy to use options for generating animation files to use in courseware. Generating multiple frame sequences for animations is always a tedious process. Having specialized software designed for animation authoring can make it as easy as possible.

(ALT - 6) Brightbill-Roberts & Co., Suite 421, 120 E. Washington St, Syracuse NY 13202 (800-444-3490). We are not longer able to locate this firm. The hypertext software HyperPAD used to list for $150 with negotiable educational discounts. This was a relatively fast means of authoring hypertext since it has no graphics capabilities. The graphics ShowPartner software sold for $395 with available educational discounts. Both products had free runtime licenses unless runtime users also wanted printing capabilities. There were no graphics rescaling utilities or spell checkers. There was a runtime search capability.

(ALT - 7) Claris Corporation, 5201 Patrick Henry Drive, Santa Clara, CA 95052-8168 (408-727-8227). The popular HyperCard hypermedia software is no longer marketed by Claris (Apple Computer is now the distributor), although this Apple Corporation subsidiary offers other multimedia software such as ClarisWorks tools for outlining, color painting, and presentations. HyperCard has been improved by Apple Corporation so that it has larger screens and color, but HyperCard is no longer viewed as a serious competitor among modern authoring software vendors.

(ALT - 8) Cognetics Corporation, Everett Drive, Suite 103B, P.O. Box 386, Princeton Junction, NJ 08550 (609-799-8555). The software Hyperties is a hypertext and hypermedia system priced at $379. The Hyperties Professional is $579. For full-motion video under DVI compression technology, the Hyperties Professional price is $1,450. A demo disc is available. These software options are designed for PC users only although a Mac version is being planned. Hyperties is one of the easiest hypertext/hypermedia software packages to learn and one of the fastest for authoring, although more complicated scripting options are also available. A Windows version is still being developed. There is a runtime fee that varies with the number of users, which puts it at a disadvantage vis-a-vis such competitors as HyperWriter and ToolBook. There are no graphics rescaling utilities or spell checkers. Cognetics works closely with customers in designing customized software and user applications.

(ALT - 9) IBM Corporation, 4111 Northside Parkway, HO4LI, Atlanta, GA 30327 (800-772-2227 or 800-426-9402). The main authoring packages are Storyboard Live, LinkWay, Media Master, and Advanced Academic System. Other software options are also available. Nearly all IBM educational products are subject to discounting by dealers. Runtime versions are free and usually can be played back on PC clones unless the authored lessons use full-motion video compressions or
audio features requiring special hardware. IBM's educational system does not have course management features. Storyboard Live software will create animations and graphics presentations. LinkWay combines graphics, text, audio, and full-motion videos into hypermedia presentations. The latest version allows for capturing full-motion video frames without special hardware capture boards. The Advanced Academic System organizes and "scripts" lessons into complete courses for multimedia classroom presentations. This system is mainly intended for authors and users who invest in IBM's entire multimedia system which now competes with Apple Computer and Silicon Graphics in terms of desktop multimedia and video systems. The recently joint ventures between Apple, IBM, and other vendors will greatly level the multimedia playing fields of vendors who entered the competition at different points in time.

(ALT - 10) InfoAccess, Inc., 2800 156 Ave. SE, Bellevue WA 98007 (800-344-9737). The hypermedia software is called GUIDE (or Owl's Guide) and requires Microsoft Windows and facilitates "scripting" of presentations with icons and pop-up menus. The price is $198 to educators and $495 to others. This product is now limited primarily to massive databases in commercial applications. It is not the best option for authoring a course or academic textbook (partly due to a $95 per copy runtime fee). OWL provides free demonstration discs, although users must have Microsoft Windows. OWL's GUIDE is a pop-up menu system designed for multiple tasks and high volumes of text and tables linked by script maps to multiple documents. GUIDE is especially designed for presentation document linking and searching of large databases. Most applications to date use small fonts for masses of text such that the applications are more suited for CAL than classroom CAT projections. GUIDE has an integrated text editor allowing up to 32 documents to be accessed simultaneously. Although it does not have a spell checker and text wrapping around graphics, GUIDE does offer other features of a word processor such as text searching, automatic indexing, automatic formatting, read-only file protectors, and text import/export capabilities. Other features not available from most competitors include dynamic data exchange, dynamic link libraries, and applications programming interfaces. GUIDE includes an embedded programming (coding) language called LOGiiX (like Pascal) for arithmetic/logic operations, data entry, and string manipulations. GUIDE recognizes standard TIFF, PCX, and other graphics files. Graphics images can be resized. GUIDE does not have core CMS examination scoring, student tracking, and student response pad utilities, although macros for these could be coded in LOGiiX by technical programmers. Nor does it have a compression utility for authored files. Adding utilities for compression for runtime file storage would be a huge improvement since GUIDE is intended for high volumes of text presentation. The text search feature in its runtime software is a distinctive advantage for rendering lessons or databases with high volumes of text. However, a major consideration for commercial ventures, such as supplements to textbooks, is GUIDE's $95 per copy runtime fee is very high by industry standards. No accounting textbook publishers, to the authors' knowledge, have supplements using GUIDE. As mentioned above, GUIDE is especially suited for large databases such as corporate annual reports and CPA examination question/answer files. The vendor has a consulting division that will help generate GUIDE materials on contract.
The HyperWriter hypermedia package was named "Editors Choice" by PC Magazine, May 28, 1991, where it is described as having the "best navigational tools" as compared to its competitors. The hypertext and hypermedia combination HyperWriter sells for $495 subject to 40% educational discounts. A free demo disc is available. HyperWriter is better than many of its competitors' products in that it has full text searching and spell checking, dynamically linked graphics, and more graphics importing filters than most competitors. A somewhat unique accompanying piece of software is called HyperWriter! Autolinker that sells for $695 before a 40% educational discount. Autolinker can convert ASCII text, Ventura Publisher, WordPerfect, and Microsoft Word files into a HyperWriter format. HyperWriter is also one of the best options available for CD-ROM developers due to some of its CD-ROM development tools. HyperWriter has a spell checker. Graphics cannot be rescaled or changed in terms of aspect ratios, which is a drawback relative to some competitors such as Authorware. There is no accompanying scripting or computer coding software. Full-motion video compression is not yet available. An important consideration is that runtime is free to all users.

The authoring software is called Instant Replay Professional. A free demonstration disc is available upon request. The price is $795 for the authoring system with a 20% discount to educators. This does not have all of the CMS core features, but Instant Replay Professional has grown popular among corporate users for training courses. Instant Replay has no runtime license or royalty fees, thereby making it less costly and troublesome than CMS options for commercial ventures. It also has a high compression utility called Fractal Compression from Iterated Systems Corporation. This compresses full-motion video into hard drive or other storage cartridges. Instant replay has its own fonts and allows importing of commercial fonts. It also has a unique DOS keystroke memorization feature for switching back and forth between multimedia projection devices (e.g., videodiscs, compact discs, VCRs, slide projectors, and computers) in an electronic classroom. When authoring a presentation, Instant Replay will "memorize" keystrokes that shift the presentation into and out of other multimedia devices. Authorware took the early lead among its CMS competitors in multimedia control and full-motion video compression course authoring using Quicktime video compression in Windows. Instant Replay took an early lead for full-motion video compression for DOS users who obtain the Fractal compression board. A spell checker is scheduled for a forthcoming version. The new upgrade will also allow graphics resizing and aspect ratio alterations.

The main product is a hypertext and hypermedia package called ScriptX Language Kit retailing for $795 and the runtime version called Kaleida Media Players that costs $2,500 for every title (book, course, etc.) developed. This is a somewhat revolutionary authoring and scripting hypertext and hypermedia language. ScriptX from Kaleida Labs (in a joint venture with Apple and IBM corporations) will be the only option designed to cross between various operating systems (e.g., Unix, Windows, DOS, Apple/Mac, OS/2 Warp, and PowerOpen). ScriptX will also nicely compliment the Taligent (Pink) multi-platform operating system. As scripting languages go, ScriptX will be relatively due to the $2,500 fee for every title produced. Bove (1993, p. 56) asserts "ScriptX has no peer in scripting language, and it will one day dominate the industry as PostScript dominated desktop publishing." This is
controversial and somewhat questionable unless it comes down in runtime fees to developers and will play back hypertext and hypermedia on relatively inexpensive PCs that are widespread throughout the world. Also ScriptX requires that users become skilled in Unix programming. Its future market share also depends heavily upon what strides present scripting language software developers such as Asymetrix, Microsoft Corporation, Macromedia, and others listed in Chapter 3 do to make their own scripting languages cross platforms. A more recent account of ScriptX is given by Bove (1994b). See also Burger (1994a, p. 46) and Carlton (1994c).

(ALT - 14) MaxThink, 24225B Channing #592, Berkeley, CA 94704 (510-540-5508). MaxThink has several packages, one of which is a hypermedia package called HyperLAN. The price is a very reasonable $89 subject to a further reduction of 20% to educators. This is for DOS users only and requires considerable coding skills. The system is limited relative to more expensive options and tends to be more text than graphics oriented. It does communicate with MaxThink's hypertext packages called HyperBBS and HyperRez. It does not have graphics rescaling and spell checkers. Runtime versions are free. One of the Big Six accounting firms uses a Maxthink database for cross-referenced accountancy standards and rules. MaxThink has added several new products for multimedia (TranText, HyGEN, HyNet-CD, and Color-Tx), Windows (Hyper NotePad, HyGEN, and Perm), Groupwork (MaxThink, HyNET, HyGLOS, and HyperBBS) and personal thinking (Maxthink, Houdini, and Transtext). These options are more suited to skilled programmers than most of us who prefer object oriented point and click authoring. They are, however, inexpensive and suited for processing large text files.

(ALT - 15) Paul Mace Software Inc., 400 Williamson Way, Ashland, OR 97520 (800-523-0258). The software costs $349 with a $100 price for each added copy on a campus, and is called Grasp. Multimedia Grasp costs $1,195 and Visual Grasp costs $199. Runtime versions are free. Although Grasp has neither examination templates nor student tracking features of a core CMS system, it does interface with student files in dBase. Grasp is an excellent animation authoring package for DOS users and includes a delta-compression and run-length encoding to compress animation files. Grasp only has filters for PCX and GIF image files, but it will change sizes and aspect ratios of those images. It also has a paint program, image capturing (DOS and Windows), audio capabilities (for certain DOS sound boards but not Windows MPC standard). Until its Windows version is available, it will not run Windows Video. Grasp from Paul Mace has a 3-D animation capability in DOS. Grasp also has graphics generators and high level coding capabilities for simulations, string/math functions, etc. The new upgrade will also allow graphics resizing and aspect ratio alterations. There is no longer a runtime license fee for commercial applications, although there is not yet a Windows runtime version. No spell checker and text search utilities are currently available. As mentioned earlier, Grasp authoring requires computer programming skills. It is a DOS system and no Windows or Mac versions are available.

(ALT - 16) Pierian Spring, 5200 SW Macadam Ave., Ste. 250, Portland, OR 97201 (800-472-8578). This is a new authoring product for the Mac called The Digital Chisel. It is a multimedia authoring tool that requires no scripting and will aid educators in some CMS tasks such as use of a database for course records and student performance evaluations. The price is $99.95 to educators with a $995 site license price. There is no runtime fee, and for the price is relatively powerful with full-motion video and some graphics tools. There are also some CMS tools such as built-in question templates
linked to a database. In many ways it is unfortunate that this reasonably-priced alternative is not available in a Windows version.

(ALT - 17) Ridgewood Software, P.O. Box 409, Glenview, IL 60025 (800-243-4724). The software called **PC-Interact** costs $347 for educators and $495 for others. A demo disc is available upon request. PC-Interact is a DOS system and there are no current plans for writing a version for Windows. The newest version has hypertext capabilities and will allow authors to change scales and aspect ratios of graphics images. There are audio capabilities and limited examination grading utilities for examinations imported from a word processor. There are no course management features or remote control features. The brochure material lists grammar checker and spell check capabilities, but this turns out to be an ASCII import/export process where a word processor or other software must be used to do these operations. A new upgrade will also allow graphics resizing and aspect ratio alterations. There are no runtime licensing fees or royalties.

(ALT - 18) Informatics Group, Inc., 100 Shield Street, West Hartford, CT 06110 (Phone 203-953-4040). The DOS multimedia software is called **ACT II** sells for $495 and includes PC Paintbrush, an animation program, and a sound effects program. It does not have s scripting language like more comprehensive hypermedia options such as ToolBook, but it does have control macros for branching.

(ALT - 19) Interactive Image Technologies Ltd., 700 King St. W. #815, Toronto, Ontario, Canada M5V 2Y6. (Phone 416-361-0333). The DOS multimedia software is called **Authority** and sells for $249 to educators and $595 to others. This does not have s scripting language like more comprehensive hypermedia options such as ToolBook, but it does have control macros for branching and insertions of multimedia events. There is no runtime or royalty fee for commercial developers.

(ALT - 20) Strata, 2 W. St. George Blvd., Ancestor Sq., Suite 2100, St. George, UT 84770 (801-628-5218) offers the **StrataVision 3d** PC rendering system for 3-D sculpturing, shadowing, twisting, and bending. This software for PCs is quite good for professional graphics design but is not an authoring package in the context of authoring complete books or courses. The latest price notice on this product was $695.

(ALT - 21) HSC Software, 1661 Lincoln Blvd., Suite 101, Santa Monica, CA 90404 (Phone 310-392-8441). The Windows software called **HSC InterActive** is an icon based user-friendly multimedia authoring option that does not have scripting options such as ToolBook.

(ALT - 22) Educational Multimedia Concepts, Ltd., 1313 Fifth Street S.E., Suite 202E, Minneapolis, MN 55414 (Phone 612-379-3842). There are two multimedia offerings termed **MacPresents** for Mac computers and **PCPresents** for Windows. Both versions support text, graphics, videodisc material, Macromedia Director animation, and QuickTime movies. The educator price is $299 whereas others pay $349. This is a relatively low price and user friendly option for multimedia presentations. No utilities are available for coding scripts.

(ALT - 23) North Technologies, 180 King St., Suite 360, Waterloo, Ontario, Canada N2J 1P8 (Phone 519-570-9111). The Windows multimedia authoring package selling for $349 is called **ImageQ**. This is a hypermedia authoring package that also has a JPEG-
like proprietary graphics image compression utility. There are no runtime or royalty fees. There is no scripting language available.

(ALT - 24) Microsoft Corporation, 1 Microsoft Way, Redmond, WA 98052 (800-426-9400). A somewhat popular alternative to former Basic Language programmers is Visual Basic selling for $150 with a need for Competitive Upgrade Visual Programming selling for $200. This is a full-featured hypermedia option for Windows and Mac platforms that allows coding and has a utility known as Open Database Connectivity programming interface to gain access from PCs to mainframes and minicomputer systems. The software has become easy to use with buttons and menus, although code writing is usually required in applications. For developers not into Basic programming, Microsoft has another option termed Multimedia Viewer hypertext and hypermedia with a comparative advantage in text processing that closely resembles the text processing in Microsoft Windows Help utilities.

(ALT - 25) Macromedia Corporation, 600 Townsend St., San Francisco, CA 94193 (Phone 800-822-2527). The authoring package for educators is called Director Academic and for either the Mac version or the Microsoft Windows version is $150 for from Prentice-Hall at <http://www.prenhall.com/> or 800-811-0912. A review is also provided in Publish, July 1994, p. 33. Whereas the Macromedia Authorware discussed earlier is designed for education and training, the Macromedia Director package is designed more for communications applications with utilities for animation, high-fidelity sound, and video presentations. Both packages can, however, be used for interactive navigation authoring. Macromedia Director is probably the most popular authoring system by CD-ROM developers to date, especially among Mac developers. Macromedia Corporation claims over 250,000 developers have used the Director. Newer hypermedia engines have been added to the Netscape browser, notably Macromedia Director that will allow users to put hypertext, audio, animations, and other hypermedia works on the Internet so that users from virtually any platform (e.g., Windows, Macintosh, and UNIX) to view the materials authored in Director. Other engines with less hypermedia capabilities and bandwidth requirements are also available to replace HTML tagging. See NewMedia, August 1995, pp. 19-20. The Director was one of the first hypermedia systems available and now has no runtime or royalty fees. Director has a relatively easy to use scripting language called Lingo that can be used for interactive controls and nonlinear navigations. Director is one of the very few hypermedia authoring systems that has a utility for changing the scale and aspect ratios of imported bitmap pictures. Macromedia offers a variety of related multimedia packages including visualization and design MacroModel (Mac and Windows versions) and Mac versions of Macromedia Three-D, Swivel 3D Professional, ModelShop, and Life Forms. Presentation software is called Action! for Mac and Windows. The ClipMedia package contains clip media. Media creation and editing software for Mac computers includes SoundEdit Pro, MacRecorder Sound System Pro, and MediaMaker. In 1994, Macromedia teamed up with Microware Systems Corporation in Des Moines, Iowa to extend the Director into PC and Mac utilities for authoring interactive network television titles.

(ALT - 26) Passport Designs, Inc., 100 Stone Pine Road, Half Moon Bay, CA 94109 (800-443-3210). The hypermedia software is called Producer Pro for Mac computers. The unique feature of this option is the ability to synchronization to SMPTE allowing for productions in real-time computing. Another somewhat unique feature is a cross-platform, editable runtime player for playback on PC computers. All media can be
accessed directly from the "Cue Sheet." This is useful to professional developers of InterActive video. The price is $995. A $7 "Evaluation Kit" is available.

(ALT - 27) New Video Corporation, 1526 Cloverfield Blvd., Santa Monica, CA 90404 (310-449-7000). This company offers high-end software called EyeQ for Mac operating systems. The cost is $4,495 complete with over $2,000 value in bundled software of other vendors. The main comparative advantages of this software lie in real-time video and audio capturing and compression.

(ALT - 28) Sybase, 6475 Chrisy Ave., Emeryville, CA 94608 (800-879-2273). The Sybase GainMomentum is probably the top-of-the-line hypermedia alternative and the highest priced PC alternative at $20,000 per license. Features that justify this price include advanced networking capabilities, database utilities, and utilities for crossing platforms between UNIX, Windows, and Windows NT. GainMomentum sets various standards for the future. of open network databases as opposed to stand-alone titles. A very complimentary review of this package is contained in Morph's Outpost, September 1994, (p. 1 ff). GainMomentum contains most of the features found in lower-priced alternatives and still has some of the common drawbacks. For example, drawing capabilities are very limited and users will still have to export bitmap images to a paintshow program for re-sizing, changing of aspect ratios, and touchup activities. It lacks some of the pop-up viewer and property browser utilities of Multimedia ToolBook. And at a $10,000 price one would hope for and does not get text filters that retain formatting of imported text and data from Word Perfect, Word for Windows, Word Star, Excel, Lotus, etc. However, GainMomentum has network and database features not found in products of its competitors. Authors are advised to have coding skills in UNIX, C++, and HyperTalk. They should also be relatively advanced in database and network technologies. It takes more time and money for GainMomentum authoring than for authoring in most of the other alternatives discussed in this chapter. For authors seeking to be on the leading edge of hypermedia networking, GainMomentum is on this edge. An irritation for us has been trying to communicate with anyone at Sybase who knows the product. GainMomentum is marketed by third parties who know almost nothing about the software. They gave us phone numbers of Sybase technicians who never returned our calls. This does not seem like a good system for selling a product costing $10,000.

(ALT - 29) Software Express, 4128A South Boulevard, Charlotte, NC 28217. The hypermedia authoring software is called mPower. The price is $295. It is available for Windows and Mac platforms. Advantages are simplicity of use and pre-scripted utilities. Disadvantages are the lack of a scripting language for wider options of authoring and presentation. There is no spell check utility or other useful word processing utilities. This is not a good option if authors want to deal heavily in text.

(ALT - 30) In contrast to the Authorware, Apple Media Kit, Course Builder, Macromedia Director, Passport Producer Pro, and EyeQ high-end options for Mac users mentioned above, there are a number of lower-end options for Mac operating systems. These options are reviewed in Syllabus, November/December 1993, pp. 3-4. For only $59, InterText (originally called Annotator) is available for use of simple pull-down menus. InterText is distributed by Intellimation (see Appendix 6). For $99, Textbook Toolbox uses a spiral notebook template with built-in navigation buttons. Textbook Toolbox is distributed by Northwest Multimedia (see Appendix 6). Voyager, is a firm that is best known for some wonderful CD-ROM hypertext and
hypermedia CD-ROM books for Mac users, also sells for $295 its **Voyager Expanded Toolkit** electronic book templates. Commercial developers should be aware, however, that Voyager requires royalties of one percent of retail price per copy or 15 cents per copy, *whichever is greater*. See Appendix 6 for details on how to contact Voyager.

(ALT - 31) Glass Software, Inc., Inglewood, CA (310-348-8240). The new software option called **ViperWrite** is a hypermedia extension of the word processor known as HyperWrite. ViperWrite includes some of the nice features of a word processor plus it has audio, video, graphics, animation, OLE, and other features added to make it a hypertext/hypermedia option. Unlike most word processors, there is a runtime version that has no runtime or royalty fee. Viperwriter is mainly of interest to low-budget authors who want a low-cost alternative that does not offer the high-end options of other alternatives.

(ALT - 32) StoryVision (310-392-5090). The software package called **StoryVision** is designed for fiction writers and sells for $199 in the Windows version. It provides a graphical outline of multiple plot elements and organizes them into an interactive story. Authors can drag and link scenes with a mouse and map out a blueprint of scenic structure.

(ALT - 33) Publisher-developed software (e.g., "A.S.S.E.T." from Houghton Mifflin Company, "Electric" from Prentice Hall, "F.A.S.T." from Richard D. Irwin, and "What if?" from Harcourt Brace Jovanovich, and SPATS from Irwin) are often presentation electronic transparencies or spreadsheet-based-based options. These commonly provide problem solutions in computer spreadsheet templates. For its basic accounting text by Horngren and Harrison, Prentice-Hall dropped its CMS supplements in favor of the "ELECTRIC" slide show of electronic transparencies that only have small fonts and no animation. Unlike its former CMS supplements, authors cannot edit and add updated materials to the ELECTRIC slides. Slide show supplements are not as sophisticated as CMS supplements provided by publishers, but they do not require runtime fees and are less costly to prepare in times of cost cutting by publishing firms. A somewhat more extensive slide show is available for *Principles of Accounting* (New York: Houghton Mifflin) by Needles, Anderson, and Caldwell. The A.S.S.E.T. supplements include ASCII text files of the entire Instructor's Handbook, Lotus 1-2-3 templates of exercises and half of the text problems, and more than 60 figures from the text. A "Script Manager" is available allowing an instructor to choose selected pages to be displayed in customized sequence. Graphics are limited to flow charts and accounting forms. There are no animations. Instructors can obtain an authoring version for updating and modifying the materials. A disadvantage for CAT applications is a small font size that is almost impossible to read in classroom screen projections. A serious CAL disadvantage is the inability to author conditional branching where students are directed to different lessons depending upon their question responses or test outcomes. Other disadvantages include absence of artwork, pictures, and animations. It is not possible to use scanned or screen captured text and graphics. The program also does not have automatic features for remote control teaching and use of student response pads. The main advantage is economy for publishers wanting to provide simple electronic transparencies. In terms of quality, we prefer the HyperGraphics supplements that preceded A.S.S.E.T. supplements to the accounting principles text by Needles, Anderson, and Caldwell. Some publisher software comes in a runtime version that cannot be modified or updated by educators. **Ivy Learning Systems** (804-
293-7105) offers a variety of elementary accounting and computer learning discs. These are slide shows without animations. Fonts are too small for effective classroom projections. Ivy products, like most the publisher-supplied software to date, are designed for computer lab CAL rather than classroom CAT.

(ALT - 34) Arthur Andersen Worldwide Organization, Center for Professional Education, St Charles, IL. The software called Knowledge Executive Shell (KE Shell) provides facilities for integrating multimedia components of text, video, audio, and graphics. Details of the system are provided by Garland (1994).

(ALT - 35) Personally developed software coded by various instructors that is not actively marketed by corporate vendors but may be acquired, possibly for a fee, from the developer. For example, Professor Richard Fisher at the University of Texas at Dallas has a modified version of IBM Story Teller and some finance textbook slide shows. Fisher developed software allowing educators to add "slides," but both the font size limitations and the need to have a separate file for every slide make this a very limited CAT option.

(ALT - 36) Presentation electronic "slide show" options are extremely popular among educators. These include SPC's Harvard Graphics, Gold Disk's Astound, Asymetrix's Compel, Microsoft's PowerPoint, Macromedia's Action, Micrografx's Charisma, Just-Ask-Me, On-The-Air, Lotus Corporation's Freelance, Word Perfect's Presentations, Stanford Graphics, Special Delivery, Q/Media, Zuma Group's Curtain Call, Multimedia Design's mPower, and others listed in Appendix 6. These, in conjunction with spreadsheet software (Lotus, Excel, Quatro Pro, etc.), are the most widely employed aids currently employed by accounting professors according to survey results reported in Chapter 4. An extensive list of presentation software vendors and product attributes is provided in Appendix 6. For a review presentation software options also see NewMedia 1995 Tool Guide (pp. 09-12), McCraken (1994), and Green and Green (1994). Multimedia World (June 1994, p. 64) gives its highest rating to Astound from Gold Disk and the lowest rating to Word Perfect's Presentations. (The addresses and phone numbers of NewMedia, Multimedia World, and other periodicals are contained in Appendix 4.) Electronic slide show options usually allow for importation of computer spreadsheets and are commonly referred to as "presentation software." Robinson and Lee (1994) discuss the fine line between "authoring" and "presentation" software. Paintshow and photoshow options such as Micrographix PhotoMagic, MacPaint, Corel Draw, Publisher's Paintbrush, and Adobe Photoshop may be used for pictures but are cumbersome for group presentations. Accounting professors also use spreadsheet, database, word processors (e.g. Word Perfect, Microsoft Word, Word Star, ViperWriter, Learning Processor, and IslandWrite) and other packages intended for professional text writing, data analysis, graphics, slide shows, artwork, printing, spreadsheet computing, etc. Names of vendors, addresses, and phone numbers for such products can be obtained from word searches in Appendix 6. Some are only for PCs or only for Mac systems, while others have PC and Mac versions. In total, these widely used packages probably comprise the major proportion of materials currently used by instructors for computer-aided teaching. Most have or soon will have audio and video capabilities. For example, ViperWriter from Looking Glass Software is billed as a (limited) multimedia word processor. Some are separate packages from the word processing versions such as Word Perfect Presentations ($495) that lets users incorporate audio and video clips but does not have the full word processing capabilities as Word Perfect's word processing system. Word processors now have updated graphics or graphics-importing capabilities as well. These are great for authoring hard copy or files to be imported into hypermedia software, but they lack
core CMS features. Most of them lack free runtime options which greatly limits their flexibility among users who do not have software licenses. Some presentation software vendors (e.g., Microsoft Corporation's PowerPoint) now have runtime (viewer) software that does not require authoring licenses. Database software, desktop publishers, and word processors also have limited or no ability to modify scanned images, capture monitor screens, and animate colored graphics. Word processors and other software can be accessed or otherwise imported into CMS lectures having more flexible menus and presentation delivery controls. These software packages tend not to have runtime versions such that users have to obtain the authoring software licenses. Lotus Development Corporation (617-577-8500) announced a new ScreenCam Recorder that captures and compresses screen activity with audio tracks such that animations are easy to record for spreadsheet presentations. Astound is a presentation software for Windows users that now has Windows Video and Quicktime video capabilities as well as audio and 3-D capabilities and button navigation controls. Most presentation software competitors will soon have these features. However, none to our knowledge yet have nonlinear navigation controls and scripting capabilities along with text searching capabilities of hypertext and hypermedia options. New Photo CD Portfolio and Create-It software from Kodak (800-CD-KODAK) facilitate presentations such as classroom lectures and outside presentations to be pressed to Photo CDs. However, the Photo CD disc only stores graphics images (including text stored as a graphic) and will not store files that can be executed in computer software such as playing back a ToolBook book or Hypercard stack or storing a Lotus or Excel spreadsheet file. (In contrast, a CD-ROM disc will store computer files that can be read into execution files.) Reading of such discs requires special software. Also, CD-ROM drives have to be sufficiently fast (e.g., double or triple speed) to playback Photo CD discs. CD-I and related machines that play on television sets rather than computers will also play Photo CD discs. For a guide to Photo CD usage see Brannon (1993). For the Photo Factory software package see Multimedia Store in Appendix 6. A production guide is provided by Larish (1993). Green and Green (1994) discuss how presentation software is becoming closer to authoring software. They also discuss options for crossing platforms between operating systems such as between Windows and Mac operating systems. See Appendix 6 for a listing of software options.

(ALT - 37) Runtime software now available from most vendors of review courses such as CPA examination review courses from Convisor Duffy, Gleim Delaney, MicroMash, and TotalTape. These are useful in CAL computer labs and home desktop computers, but they are not designed for classroom projection. They will track student progress through lessons and record practice examination scores. There are no authoring versions which allow users to update and modify lessons. They have many CAT limitations, especially small font sizes, lack of graphics, and no animations. They cannot be updated and customized by users, and vendors probably will not allow their materials to be placed on campus networks without a negotiated network fee. In contrast, a professor's CMS materials can be freely networked campus-wide or world-wide for noncommercial purposes. During lectures, instructors may want to drop into and out of CPA review courses, but CPA examination review software packages are not designed for customized lesson programming and animated classroom projection.
Although not intended for hypertext or hypermedia, some mention should be made of accounting/bookkeeping software having increased popularity in accounting education and practice. To our knowledge, none of these options have free runtime versions. Alternatives include **ACCPAC Simply Accounting for Windows** (Computer Associates International, 800-225-5224), **BestBooks** (Teleware Inc., 800-322-6962), **DacEasy Instant Accounting and DacEasy Executive** (DacEasy Inc., 800-248-0305), **Essbase** (Arbor Software, 408-727-7140), **MICA Accounting Series** (Micro Associates, 800-448-MICA), **Microsoft Profit** (Microsoft Corp., 800-882-8080), **MYOB Accounting** (BestWare, 201-586-2200), **Peachtree Accounting** (Peachtree Software Inc., 800-228-0068), **Solomon III** (Solomon Software, 419-424-0422), **QuickBooks and Quicken CD-ROM** from Intuit (a vendor of personal finance and financial planning software), **SunSystems Financial Management** (BusinessVision Management Systems, 714-476-3770), and **Preferred Series in Accounting** (Parameter Driven Software, Inc., 313-335-7475). Newer accounting options are reviewed by Carey (1995). Latest software options for not-for-profit accounting institutions are reviewed by Stearman (1995). Newer personal finance options are reviewed by Furger (1995). A newer financial management system on the market is **Cashe** from Business Matters, Inc. (800-993-3600) listed at $1,995. A simple to use small business system that requires no prior accounting knowledge is the Microsoft Profit system. More sophisticated systems have inventory control utilities. The top-rated options according to to **PC Computing**, December 1994, p. 170 are **Quicken CD-ROM** (Rank 1), DacEasy Executive (Rank 2), and Peachtree Accounting (Rank 3). Many of the vendors now have Windows versions. To our knowledge, none of the above have yet become multimedia, although we anticipate multimedia innovations in the future. Some will soon be able to have audio verification (repeating) of typed in numbers such that users need not look at the monitor to verify correct coding of accounting entries. Glencoe (see Appendix 1) has textbook guides for Peachtree, DacEasy, and ACCPAC accounting software. A “calculator” for financial and cost accounting calculations is available to add into Lotus and Quatro Pro from AckLab for $79. Accounting forms software includes **FormsFlow** from Delrina Technology, Inc. in Toronto (Phone: 416-441-3676). See Appendix 6 for details.

Although they are not hypertext or hypermedia options, cooperative learning problem solving software may be useful in teaching. An example option is **Computer-Supported Cooperative Problem-Solving** software available from the Center for Technology in Accounting, P.O. Box 13677, College of Business Administration, The University of North Texas, Denton, TX  76203-3677. This software creates shared displays in computer labs and on networks and allows students to exchange/view/comment on materials in cooperative learning projects and simulations. The system also has course management and record-keeping utilities.

Although they are not separate authoring alternatives, clip files should be obtained by hypermedia authors to use with authoring software. Art, audio, animation, and video clip availability saves time and effort in authoring some learning materials using the above software options. Tens of thousands of clips that have no copyright restrictions or altered restrictions are commercially available and some of them are included in software packages. These reduce the number of times an author must resort to more troublesome screen capturing, scanning, audio recording, and video recording. For a listing of options and vendors, see Appendix 6. For a review of many of these options see Rubin (1993). Be careful to read the reproduction restrictions. Some clips allow you to reproduce items for non-commercial uses and distribution within your own organization (campus) but not commercial applications. Other clips may be freely reproduced in all commercial ventures.
The CMS and most related authoring software options are for "digital" rendering of course materials. These courses are played back (delivered, performed) from digital storage media such as CD-ROMs, auxiliary hard drives, floppy discs, Syquest cartridges, Bernoulli drives, or possibly rewritable optical discs. Course deliveries are usually from hard drive on a desktop or laptop computer. In recent years there are scan conversion alternatives for "analog" rendering and storage of course materials. These courses are played back from analog storage media such as videotapes and videodiscs. Quality in terms of resolution and ease of editing/updating are sacrificed for the analog advantages of massive amounts of cheap videotape storage. Another advantage is that courses rendered in analog form for videotape can be broadcast over television networks and cable TV. Drawbacks include difficulties in serving video from network servers. For a review of network complications, see Lauriston (1993). For a review of videoconferencing, see Merwin (1993).

Until recently it was only feasible to produce analog videographics in professional television studios costing $300,000 or more. Newer technology has reduced studio costs to $20,000 and higher depending on the level of professionalism desired in video support equipment and software. Early breakthroughs in "low-cost" analog videographics rendering arose with Apple Computer's video systems and NewTek's production of the Video Toaster workstations for home/office video productions. Similar video rendering options are becoming available for IBM compatible PCs. At higher levels of professionalism and cost, Silicon Graphics computers are probably the state-of-the-art hardware for academic videographics.

The main advantage of analog video is the virtually unlimited low cost storage options for full-motion video and ease of merging video camera inputs with computer-rendered videographics. Users do not even have to have a computer as long as they can play back lessons from videotape, videodiscs, or television signals. There are no runtime user fees since videos can be played back without requiring computers. Disadvantages include lower resolution and image quality that make it difficult to have small fonts, fine lines, and lots of text to read in analog video. Whereas computer displays are "non-interlaced" and draw the monitor's image in one pass from top to bottom at 60 to 90 times each second, analog video draw only 25 to 30 images per second such that thin lines and small fonts on television tend to flicker and tire a readers eyes. Also analog video software choices are much more limited than their counterparts in the digital worlds of DOS, Windows, Windows Chicago, Windows NT, OS/2, Unix, and Mac software options. It is very difficult and expensive to import animated computer graphics from Authorware, Grasp, HyperGraphics, Quest, and other digital rendering systems into high quality analog video. Whereas digital animations can be performed on traditional amounts of random access memory (RAM), full-motion rendering requires a greatly increased hardware investment in huge amounts of RAM. Upgrades to more than 50 Mb are recommended.

Since text and some graphics images are difficult to view on a television screen, videographic authoring requires some special considerations. For example, black lines on very light backgrounds are to be avoided. Pastel colors and grays should be used to avoid harsh contrasts. Lines and edges should be drawn thicker that needed for digital computing. Care should be taken to avoid some color combinations (especially red colors) that are more prone to "bleeding" effects. Computer images may be converted into analog video with scan converters. Cheap scan converters (less than $1,000) than do not have anti-flicker utilities may be suited to some purposes, but they usually are not suited to commercial video quality. Prices of good scan converters range from $1,000 to $20,000. See Waring (1994c) for a detailed review of options for scan converting and comparisons of vendor products. Although professional videographics authoring software such as Wavefront (301-571-9494) begins at around $30,000 in price, there are excellent lower cost alternatives suited to educational videographics. For a review of video capturing and recording hardware and software options also see NewMedia 1995 Tool Guide, (pp. 83-87). (The addresses and phone numbers of NewMedia and other periodicals are contained in Appendix 4.) Examples of lower priced alternatives are listed below:

(VIDEO - 1) The 3DO Company, 600 Galveston Drive, Redwood City, CA 94062 (415-261-3000). This company supplies workstations and developer licenses for CD-3DO disc authoring. At the moment, authors must have a Mac AV or better computer from
Apple Computer. In addition, a considerable amount of professional video support hardware is required. The following added items for a workstation can be purchased from The 3DO Company:

3D0 Station containing the 3D0 Interactive Multiplayer and cable for connection to a Macintosh Nubus expansion slot. The price is $5,000.

3D0 Toolkit for authoring and integrating of art, sound, music, and video. The price is $3,000, including the price for 3-D rendering software.

3D0 Interactive Multiplayer manufactured by Panasonic playback of CD-3DO discs. These are available from dealers around the world at prices under $700.

Software License Agreement that contains various contractual provisions including a $3.00 per disc reproduced royalty fee (subject to negotiation).

(VIDEO - 2) Apple Computer, Inc., 20525 Mariani Ave., Cupertino, CA 95014 (800-538-9696). For some time Apple has been producing relatively expensive hardware/software for production and editing of professional videos. Only recently have lower cost video computing options become available from Apple. For a review of these video computing options, see Birkmaier (1993). Playback, authoring, and video options are all available. In recent years, lower cost options have become available for home/office video productions. Apple works closely with video firms and other vendors to stay highly competitive in the exploding multimedia market. Options for Mac video productions are too varied and numerous to discuss here. Certainly, educators should investigate options available from Apple Computer, Inc. before investing in any office video production system. Mac video rendering systems are now in place in most college campuses, especially in some of the science and medicine departments within those colleges.

(VIDEO - 3) AT&T Global Business Communications Systems, 55 Corporate Drive, Bridgewater, CN 08807-6991 (800-VIDEOGO) products. The division of AT&T has a number of video transmission options. For example, the Picasso is a relatively low priced (under $4,000) alternative for transferring videocamera and other NTSC television still-frames) across regular phone lines. Computer images may also be transported world wide if the computer signals are scanned into NTSC conversions. The images can be viewed on any television screen or imported into computers that have video cards for NTSC signal inputs. This division also markets a variety of video conferencing alternatives to distance training, although present options are somewhat expensive both in terms of equipment cost and transmittal fees.
(VIDEO - 4) Macromedia, 600 Townsend, San Francisco, CA 94103 (800-248-4477). The best known software is called Macromedia Director which has utilities for creating animations and videos. There are added software options called Action, Magic, FilmMaker, Three-D, SwivelMan, Accelerator, and others. The Director lists for $995 and is designed for Mac computers. The Director can grab full-motion frames for digital editing and modification. It can do many of the same functions as the Video Toaster at a lower price of $995. To do other functions, however, software must be added at additional costs. Software versions exist for both Mac and Windows authors.

(VIDEO - 5) NewTek Corporation, 215 S.E. Eighth St., Topeka, KS 66603 (800-843-8934). There are several software and hardware combination options, the best known of which is called the Video Toaster and supplements for rendering three-dimensional video highlights commonly seen in television commercials. The base price of a complete computer equipped with the Toaster is less than $5,000. Optional accelerator boards range from $600 to $1,600 to speed up 3D rendering. The Toaster has multiple video input ports such that videotapes can be customized and improved to the quality of television commercials and it is now commonly used by the major networks. A free Video Toaster demo videotape is available from NewTek. Although the base price is $5,000 to $6,600, support video hardware such as a professional tape recorder and support monitors may raise the price to $12,000 or much more. The Toaster has become a very popular product that makes professional videographics more affordable. Video production studios that used to cost hundreds of thousands of dollars are reduced to less than ten percent of former costs with the Toaster. Relative to PCs and Macs, however, software choices for Toaster computing are extremely limited. For example, there are no word processing, spreadsheet, hypertext, hypermedia, CMS, or database software options.

(VIDEO - 6) SuperMac, 485 Potrero Avenue, Sunnyvale, CA 94086 (408-245-2202) offers DigitalFilm, Thunder, and Spectrum video production systems that capture video and sound to disc at 30 frames per second and output edited versions to tape. The company also carries color graphics cards, accelerators, large-screen displays, color printers, and digital editing systems.

(VIDEO - 7) Videographics Corporation, 414 E. Erie St., Suite 1804, Chicago, IL 60611 (312-642-6652) offers video rendering software for both Mac and IBM systems. Their specialty is video animation. They also have a 3-D rendering system for videographics effects.

(VIDEO - 8) VideoLogic Corporation, 245 First Street, Cambridge, MA 02142 (617-494-0530). This company, headquartered in the U.K., sells the DVA4000 board for bringing (not necessarily storing) analog video into either a PC or a Mac. It also sells the Mediator for conversion of digital computer images into analog video, although at a $2,400 Mediator price, the manufacturer makes no claim that the converted video will be of broadcast quality. Software available with DVA4000 hardware makes it possible to either capture analog frames for digital processing or to impose "still" borders and text around full-motion video. VideoLogic has very competitive prices for desktop computer video processing. The software is very limited relative to higher priced options such as the Video Toaster and the Macromedia menus of software choices.
Philips Consumer Electronics Co. (615) 521-4438 and Optimage (515-225-7000) offers the OptImage MediaMogul ($14,995) and CD-I Emulator ($11,795) that can be used by instructors to author their own interactive compact CD-I discs onto "write once, read many" (WORM) optical disc recorders. These or related options allow authors to avoid the time delays and bother of having to send materials off for mastering at professional labs. Such options are not available for rendering of videodiscs. Educators wanting to put lessons on videodiscs usually send videotapes to professional service firms for mastering and disc production. Recently options became available for desktop recording of videodiscs. For example, Panasonic (201-248-7834) offers the LO-3031T model starting at $12,500. However, most videodiscs mastered in professional labs from high quality videotape produced in a video workstation. A major drawback of videodiscs is that they cannot be previewed prior to being mastered. The Education Labels Group of Philips Media (800 945-4061 or 310-444-6613) under the direction of Bernard Luskin, a pioneer in TV education materials, works with educators to develop CD-I discs for education. Optimage Interactive Services, 1900 N.W. 114th St., Des Moines, IA 50322-7077, Phones: (515) 225-7000, (800) CDI-5848, FAX: (515) 225-0252 offers the following options for CD-I developers:

- **CD-IT** software for CD-I and CD-ROM recording (Mac)
- **MediaMogul** 1.2 (CD-I authoring) for $5,000
- **Balboa** CD-I hypermedia CD-I for $4,000
- **Script2disc** imaging software for $2,500
- **MediaStockroom** Windows-based graphics, video, and audio asset database and conversion ($2,500)
- **Delta-V** Windows version of VideoCD CD-I real-time MPEG video & audio encoding $50,000
- **Delta VX** Unix version of VideoCD CD-I real-time MPEG video and audio encoding $50,000

Panasonic Corporation (800-365-1515) offers the TQ-3031F Optical Videodisc Recorder. This is neither a computer nor software to run a computer. It is, however, designed to format and process analog video inputs into a format that is easily pressed into a videodisc in professional optical mastering labs such as the 3M and Pioneer labs. Recently options became available for desktop recording of videodiscs. Panasonic (201-248-7834) introduced the LO-3031T model starting at $12,500. Videotape interactive controls and random access software developments were almost nonexistent due to the painfully slow access time in locating individual frames in hundreds of thousands of frames on a videotape. Newer hardware such as the "Sixth-Generation" VCRs having over 30 times the previous search speed, 3D-type TBC with full memory, built-in time code generators and readers, freeze-frame utilities, four-channel audio output, color framing control, 16:9 aspect ratio transitioning to wide-aspect ratio television, and many other attractions are now bringing this long-awaited option for hypermedia authoring. Videotape will never equal videodisc performance in random access speed, but videodisc recording will never be as cheap and simple as videotape recording, especially home and office
recording outside professional video studios. For education purposes, we anticipate seeing more and more videotape hypermedia authoring, especially desktop authoring by educators who are developing their own videotapes to use in conjunction with hypermedia controls. An example of a sixth-generation videotape recorder/player vendor is Panasonic Broadcast & Television Systems Co. (800-524-0864).

(VIDEO - 11) TouchVision Systems, Inc. (312-989-2160) offers the D/Vision-Pro software that facilities editing videotapes from a PC. The system is designed for use with Intel's Real Time Video and the IBM/Intel ActionMedia II board that utilizes DVI compression technology. Since this system utilizes the PC, it is a lower priced option than most competitive tape editing systems.

(VIDEO - 12) Abate Video, Inc., 14 Ross Ave., Millis, MA 02054 (800-283-5553) provides VideoToolKit HyperCard program to edit videotape from a Mac computer and options for making QuickTime video files. The firm also sells QueTrack software for logging contents of videotape.  

(VIDEO - 13) Pioneer Electronics, 2265 E. 220th St., Long Beach, CA 90801 (213-746-6337) is the premier manufacturer of videodisc players. For multimedia systems we recommend the $2,400 Pioneer V8000 model or better. We also recommend investigating the Pioneer LaserActive videodisc player as a multistandard playback unit.

(VIDEO - 14) Compression boards (cards) for PCs come in a variety of prices and features. We highly recommend the Intel (Indeo) Indeo Video Interactive capture board that has great compression ratios and quality with new features discussed on Page 17 in NewMedia, November 1995. Trends are toward MPEG and Indeo hardware options. MPEG systems boards and standards (e.g., MPEG-2 and MPEG-1) for the most popular emerging form of compressed full-motion video standard for computer file storage. MPEG compression requires MPEG playback boards and/or MPEG authoring boards such as the Optibase MPG-1000 digital video codec (compression/decompression) board (800-451-5101). Although MPEG-2 is superior to MPEG-1, MPEG-2 requires at least quad speed CD-ROMs that, thereby, limits the use of MPEG-2 in the commercial market. However, even MPEG-1 is considered a better video compression alternative than its competitors. MPEG encoders are reviewed by Sauer (1996). The are still relatively expensive in the $4,000 to $25,000 range for hardware plus software ranging from $89 to $1,000. Until there are millions of computer users with enough computer hardware capacity to decode MPEG digitized video, Microsoft Video for Windows and Apple QuickTime will probably remain more common in authoring of education materials. MPEG video files have an .mpg file extension and will not run on computers that do not have special MPEG playback hardware/software installed. The main difference between JPEG compression and MPEG compression is that JPEG still compresses on a frame-by-frame bases that makes editing frame-by-frame much easier. However, MPEG allows for much more high-density compression of video. MPEG video cannot be edited frame-by-frame in a traditional manner. The first editable MPEG authoring system was the REALmagic Producer ( from Sigma Designs at 800-845-8086). Sauer (1996) gives the highest rating of “awesome” to MPEGWorks encoding (recording and editing) software on PrimeView II hardware from FutureTel (800-658-
5868 or <http://www.futuretel.com/>). The combined cost is presently in the $7,000 to $10,000 range from FutureTel.

(VIDEO - 15) QualTech Inc., 10116 Walker Lake Dr., Great Falls, VA 22066 (703-759-4472). The VCR-Commander from QualTech Inc. is an interactive VCR controller system for PCs that includes time-coded calibration utilities. Videotape interactive controls and random access software developments were almost nonexistent due to the painfully slow access time in locating individual frames in hundreds of thousands of frames on a videotape. Newer hardware such as the "Sixth-Generation" VCRs having over 30 times the previous search speed, 3D-type TBC with full memory, built-in time code generators and readers, freeze-frame utilities, four-channel audio output, color framing control, 16:9 aspect ratio transitioning to wide-aspect ratio television, and many other attractions are now bringing this long-awaited option for hypermedia authoring. Videotape will never equal videodisc performance in random access speed, but videodisc recording will never be as cheap and simple as videotape recording, especially home and office recording outside professional video studios. For education purposes, we anticipate seeing more and more videotape hypermedia authoring, especially desktop authoring by educators who are developing their own videotapes to use in conjunction with hypermedia controls. An example of a sixth-generation videotape recorder/player vendor is Panasonic Broadcast & Television Systems Co. (800-524-0864).

A tidal wave of the future is visible in the frenetic activity of vendors to develop and market newer multimedia hardware/software. A major component of this will be full-motion video compression technology allowing multimedia video to be efficiently stored in digital rather than analog form. The process of digitizing video facilitates computer processing and editing. Another major component of multimedia will be rewritable optical (laser) discs used in conjunction with newer compression technology. Hardware/software requirements for filming and authoring multimedia lessons are now, and will remain, relatively expensive. This is heavily due to the professional quality of video hardware needed for videographics. With a budget of less than $10,000, an educator is advised to confine authoring aspirations to CMS or related computer graphics options where video equipment is less of a necessity. Videographics rendering is and will remain far more expensive even with the latest emerging technologies. Multimedia course development might lead educators into more sophisticated software such as The Teacher's Living World IMRI (415-383-2878) interactive multimedia interfacing and course development for Mac systems.

In the future, educators' authoring and course delivery software may be located in central network servers thousands of miles from where educators author lessons and deliver courses. Expensive software and hardware may then be shared for digital and analog productions of multimedia courses. In other words, educators on relatively low budgets may, in the future, obtain access by network to authoring systems that would otherwise be outside their funding limits. For authors now connected to Internet, Drapeau (1992) explains that the "MAEstro Hypermedia authoring Environment" at Stanford University is currently available free at any location connected to Internet. This greatly reduces the hardware and software investments required to render professional quality multimedia learning materials. It does, however, require a relatively large investment beginning at around $25,000 for a desktop computer that is both connected to Internet and compatible with the MAEstro system. Details and illustrations are contained in Drapeau (1992).

**CMS Licenses for Authoring and Runtime**
There are two types of CMS licenses: (1) CMS authoring-runtime licenses allowing instructors both to author lessons (using authoring software) and to deliver lessons (using runtime software); and (2) CMS runtime-only (delivery, playback, reading) licenses allowing students or other users to play back lessons without having to invest in authoring licenses. Prices and other terms of authoring and runtime licenses of software depend upon the vendor, type of use, number of authors, networks served, and options desired. Publishers generally provide free CMS runtime-only licenses to adopters of their textbooks. Normally, only the faculty textbook adopter has the runtime license; his or her students are not licensed individually without special arrangements with the publisher or CMS vendor. Typical of some of the runtime license fees is that of Apple Media Kit from Apple Computer. The runtime AMK module is $5,000 for unlimited use within an organization whereas runtime fees must be negotiated (two to three percent) for commercial sales items. Some royalty fees must be paid for each item (e.g., disc) reproduced whether the item is sold or given away for free to students and friends. For example, The 3D0 company discussed above charges a $3.00 royalty fee for each disc reproduced.

Competitive pressures have forced most CMS and hypertext vendors to drop runtime fees. Aimtech still clings to high negotiated runtime royalties for Icon Author. Some like Quest increased authoring license fees and then dropped runtime fees. American Training International charges an author $1,000 for a lifetime of free runtime for any materials developed by that author. Tencore still charges $1,200 on each commercial item produced, although this fee is waved for items used within the author's organization and items distributed at no charge to users. Authorware, HyperGraphics, Cognetics, and some other vendors still negotiate commercial-use runtime fees with each licensed author or textbook publisher.

Commercial authors should certainly investigate each vendor's runtime policy and fee structure before choosing authoring packages. There may be added license fees for wide area networking of training courses and other materials from or within business firms and governmental agencies. The ALT software options listed earlier in the paper that have free DOS runtime software include HyperPAD, Hyperties, HyperWriter, Instant Replay, PC-Interact, and IBM software (Storyboard Live, Linkway, and Advanced Academic System). Most hypertext/hypermedia vendors now have free runtime, but there are exceptions. OWL’s GUIDE has a very high runtime user fee of $95 per item (e.g., per copy of each book) sold.

Unless instructors and students have their own authoring licenses, they are not allowed to update or otherwise modify lessons supplied by publishers, colleagues, or any other authors. With authoring licenses, they do not need permission from CMS vendors to modify any materials, but copyrights of authors and publishers must be respected. Most vendors allow instructors to distribute free runtime (but not authoring) software as long as all educational materials and their presentations are nonprofit both to the instructors and to the distributors. Most publishers allow textbook adopters to add to, update, or otherwise modify any supplemental textbook materials for use in courses taught by those adopters, provided rights of authors and other vendors, such as CMS vendors, are not violated. Usually authoring licenses are required by any educators seeking to modify publisher supplements.

Authored materials legally converted into analog videos avoid needs for runtime software and licensing. Video conversions, however, lose some of the course management and other CMS core features mentioned earlier in the chapter.

Database Authoring Packages

Some educators may prefer to author teaching and research materials in database software. These options have some key advantages when database features are of particular interest. They are typically not
well suited to graphics and hypermedia authoring. They have another drawback in that most database software options do not offer free runtime utilities such that students or other users of the authored materials must purchase full authoring licenses to use the authored works. Examples of database authoring software that may be of interest are shown below (more are listed in Appendix 6):

(DB - 1) ACI US Inc., Cupertino, CA (408-252-4444). The database software called 4D First is a simplified version of the more complete relational database called 4th Dimension. The simplified version sells for $295.

(DB - 2) Approach Software Corporation, 1 Penobscot Drive, Redwood City, CA 94063 (415-306-7890). This is now a Lotus affiliate. The software is called Approach for Windows and is an elementary Windows-based software that is quite easy to use for novices. The price is $399.

(DB - 3) Borland International, Inc., 1800 Green Hills Road, P.O. Box 66000, Scotts Valley, CA 95067 (408-461-9000). Borland's dBASE for DOS at $795 is probably one of the best known database alternatives. Some hypertext/hypermedia options (such as ToolBook from Asymetrix Corp.) are designed to dynamically link with dBase. Borland also offers a relational database product known as Paradox at $795 that is better suited to customized programming.

(DB - 4) Claris Corporation, 5201 Patrick Henry Drive, Santa Clara, CA 95052 (408-727-8227). The FileMaker Pro for Windows at $399 is a database option which does offer better graphical tools than most other database options. It is an elementary option that is quite easy to learn.


(DB - 6) DataEase International Inc., Trumbull, CT (800-243-5125). The software called DataEase has database features plus the DataEase Query Language for applications development.

(DB - 7) Folio Corp., 2155 North Freedom Blvd., Suite 150, Provo UT 84604 (801-375-3700). The Folio database program for DOS is more suited than most other options for hypertext authoring in a database program. The price is $495. Folio is especially suited for situations where multiple users are allowed to make changes in the database.

(DB - 8) Micro Data Base Systems Inc., Lafayette, IN (317-447-1122). The database software package is called KnowledgeMan and sells for $1,495. The system includes modules for asynchronous communications and business graphics.

Chapter 3
Page 53

(DB - 10) Microsoft Corporation, 1 Microsoft Way, Redmond, WA 98052 (800-426-9400). The best known database offering of Microsoft for DOS or Windows is called FoxPro. The price is $495. FoxPro has graphics capabilities. Another database software option for $495 is called Microsoft Access that features compatibility with Oracle data and various Microsoft packages such as Excel and Word for Windows databases. Microsoft Access has various built in utilities called "Wizards" that help to automate report generation and other aspects of click and drag authoring.

(DB - 11) Oracle Corporation, 20 Davis Drive, Belmont, CA 94002 (415-598-8000). The Oracle relational database that may account for half of the Unix database market before the end of the century (see Information Week, December 1993, p. 72).

(DB - 12) Software Publishing Corp., Santa Clara, CA (800-772-2225). The software costing $795 is called Superbase. This is oriented to the Basic programming language.

(DB - 13) The various multimedia database alternatives reviewed in the NewMedia 1995 Tool Guide (pp. 27-31).

Optical Compact Disc and Laserdisc Rendering

Many professors who author multimedia learning materials will want to transfer these materials into a medium such as a videodisc, CD-ROM disc, CD-I disc, CD-MM disc (or MMCD from Sony), CD-TV (or CDTV from Commodore), or other optical disc which has a market that enables these materials to be sold to users who have the playback equipment. The more playback equipment in the market, the greater the chances of making sales of learning equipment. Optical discs presently have the advantage of large storage capacities holding over 16,000 full-size pages of text or pictures per disc. With newer compression techniques such as zip, JPEG, and MPEG, the amount of capacity can be increased to the equivalents of over 100,000 pages. Recently, GAAP guides and GAAS guides have begun to emerge in database form on CD-ROMs (see Appendix 1). At this point in time, videodisc and CD-ROM players tend to dominate the market (relative to other CD players).

The market is rapidly expanding for CD-ROM players relative to all other alternatives at the moment. Television optical discs such as videodiscs, CD-I discs, CD-MM discs, or CD-TV discs are played back through standard (NTSC) television sets connected to optical disc machines that are relatively low cost machines (often under $500). Videodiscs require video workstations such as SGI workstations, NewTek Video Toaster work stations, or special Mac Computer video workstations. Professional video workstations may cost over $100,000 for all the production and support equipment. Professors are more likely to turn to CD-ROM production than production of television optical discs. One reason is poor quality of text presentations on any television screen. Videodiscs have the added drawbacks of high production costs and poor performance in terms of hypertext and hypermedia nonlinear interaction (due to slow random access time). Videodiscs also suffer from image quality loss when scan converting computer images and the inability to see an emulation of the videodisc before the disc is actually produced (what looks great on videotape sent for videodisc mastering may turn out to be disappointing after the disc is mastered). CD-I and CD-MM have better interaction and emulation capabilities, but there aren't yet enough users of CD-I discs in the education market. Both CD-I from Phillips and CD-MM from Sony are competing to get their platforms into homes and video arcades. The discs offered for these television platforms are dominated by games and other forms of...
entertainment rather than education. Some educational CD-I discs are now available from Amped (404-242-2626).

Professors and publishers are now aggressively entering the read-only compact disc (CD-ROM) market for computer users. One reason is the explosive growth in the numbers of CD-ROM players in both homes and schools. A second reason is the relatively high quality of text presentation on computer screens vis-a-vis television screens. A third reason is that often a professor’s existing desktop computer can be used (with some relatively low cost hardware and software additions) without having to obtain access to expensive work stations typically required for videodisc and CD-I productions. The main drawbacks of CD-ROM productions are that, not only do users have to have a computer with a CD-ROM player, but there is no "generic" CD-ROM disc that will play on all PC, Mac, Sun, and other platforms. For example, CD-ROM discs for PCs will not run on Mac computers and vice versa. Furthermore, graphics images, animation, and full-motion video prepared for, say, a Mac computer are not easily converted into discs for other platforms. Newer technology being developed may, in the future, overcome these incompatibility problems, but at the time of this writing authors must carefully consider their targeted markets (i.e., what computers do most users in the selected market tend to prefer) before developing CD-ROM discs for that market. This can vary a great deal by discipline. In the natural sciences, Mac CD-ROM players tend to be very popular, whereas in business and accounting studies our research reveals that PCs dominate the market. In terms of the total worldwide market, especially outside the United States, CD-ROM players for PC computers greatly exceed the CD-ROM players on all other platforms. Several publications for tracking CD-ROM technology are listed in Appendix 4. Popular software used in the past by CD-ROM developers is reviewed in Victor (1993a). For a review of alternative hardware and software options see Biedny (1993), Spanbauer (1993a), and NewMedia 1995 Tool Guide (pp. 98). An excellent review is contained in PC Computing, November 1994, 140-152, where the highest marks among all vendors were given to the Pinnacle Micro RCD-202 (800-553-7070) and the Yamaha CDE-100 (800-543-7457). Other references of desktop recording of CD-ROMs include Udell (1993), Weiman (1992), and the Apple CD-ROM Handbook: A Guide to Planning, Creating and Producing a CD-ROM distributed by Apple Computer.

Even though compact discs hold over 680 Mb of data (including text), hypermedia discs have severe storage limitations due to the amount of storage required for high quality graphics, sound, animation, and motion video. There are many tradeoffs to consider in advance. For example, high quality stereo sound requires much more space than lower quality monaural sound recordings. Recording narration, for example, may be wasted space in many types of educational discs, whereas in music discs it may be more important. Tropea and Romerthel (1994, p. 85) complain about storage limitations of CD-ROM discs and propose that plug and play hard discs become more of a standard in education. This may change somewhat with the new Compact Disk - Digital Video Disk standard that extends CD-ROM capacity to 4.7Gb or 9Gb capacity without turning the disc over in the machine. Beyond 9Gb the standard supports the Toshiba two-sided standard having up to 18Gb capacity. DVD-ROM players are expected to emerge on the market in 1996 and recorders in 1997. At this point it is not clear that recorder prices will be low enough for desktop recording that is now possible for less than $1,000 on older CD-ROM standards. An announcement of a CD-DVD standards agreement appears on Page 18 of NewMedia, November 1995.

The amount of disc storage required for graphics images varies a great deal with size, resolution, compression, and number of images. Compression usually sacrifices some image details, but often in education materials many details are not necessary for the purposes at hand. Full motion video at 32 frames each second is generally not practical on a CD-ROM disc except in compressed form that sacrifices detail in order to save on storage space. To save on disc space it may also be necessary to reduce the size of the video screen down to a smaller video window imbedded within the larger computer screen.

Another exciting innovation in CD-ROM technology is networking such that CD-ROM files may be played at remote locations from a central server. For example, various Opati-Net options are available from Computer Systems, Inc., 20251 Century Blvd., Germantown, MD 20874 (800-922-9204).
Multimedia Hardware Needs and Options

A comprehensive source guide to multimedia options is provided in the Multimedia Source Guide issued in 1994 as an annual supplement the T.H.E. Technological Horizons in Education and the NewMedia 1995 Tool Guide (see Appendix 4). The NewMedia Toolguide is also available at <http://newmedia.com/>. Some magazines such a PC World have CD-ROM versions that facilitate search of current and back issues for hardware and software information. At the moment, hypermedia technology is in a greater state of change, especially with respect to the new P6 Pentium Pro and related fast chipsets having 150 Mhz and higher clock speeds. The fastest PC at 275-MHz performance is the BTG Action Systems (phone 703-641-1200) ACTion AXP275 priced slightly under $10,000. This computer runs Windows at lightning speeds. DOS software runs slow on a 286 emulator. This is probably the top of the line choice for users that can afford such computing power. This machine is described in PC World, February 1995, p. 80. It is not recommended at the moment for Windows and Windows 95. However, a new joint venture between Microsoft and Digital Equipment may make it the machine of choice for Windows 95. A survey of hardware and software preferences of practicing accountants is given by Khani and Zarowin (1995).

The PowerPC is a revolutionary new desktop computer emerging from a joint venture between Apple Computer, Motorola, and IBM. Rupley (1994, p. 129) writes that: “PowerPC will remake the computer industry at its foundations.” What is revolutionary is the ability of the PowerPC to run under Apple, OS/2, DOS, Windows, and Unix operating systems. This is a remarkably fast and cheap CPU using RISC chip technology. Indeed it looked like the PowerPC would indeed capture market share from Intel until Intel introduced its even more remarkable 90-MHz and 100-MHz O54C CISC versions of Pentium processors. With the new Pentiums running cooler than old versions and faster than PowerPC processors, it appears that PowerPC will have a tough time selling to users other than Mac users who want faster processors for the Apple operating systems. Later versions of Pentium processors such the P54C overcame all doubts about Intel's ability to produce a cool running CISC processor at speeds up to 100 MHz and plans produce even faster Pentiums. These newer versions dispel all doubts about "Intel's aim to crunch the PowerPC" according to Information Week, February 21, 1994, p. 60. The comparative advantages, and they are serious advantages in the market, are the ability of Pentium processors to run DOS and Windows applications in direct rather than emulation form in Pentium processors. The main drawback of the PowerPC is that PowerPC users can only run DOS and Windows applications in emulation form such that all speed advantages of the PowerPC are lost. For this reason, the "PC" part of the tradename "PowerPC" is somewhat misleading since most PC users run under DOS and/or Windows operating systems. Certainly users who prefer to stay in a DOS and/or Windows operating systems are advised to stick with the 486, Pentium, or other some other CPU alternative that does not require emulation. When applications vendors bring applications to market in PowerOpen, Pink, and other PowerPC operating systems, Intel may lose some market shares to PowerPC, but this probably will not happen to a major extent in this Century largely due to the fact that PowerPC requires replacement of existing computers with new PowerPC computers. Worldwide, this will not happen for years. The largest market share for the rest of the 1990s will probably remain with 486 and Pentium processors, with new buyers seeking P54C Pentiums from Intel. The most popular operating systems will be Microsoft Windows and Windows Chicago largely because of the immense popularity of Windows among over 50 million users around the world. Apple, IBM, Hewlett-Packard, and other competitors will do their best to cut into Intel and Microsoft holds on the market, but it will be a tough sell for PowerPC hardware favoring Apple, PowerOpen, and UNIX operating systems.
Change is rarely easy for anyone, and both students and faculty will experience frustrations when first attempting computer-aided teaching (CAT). Frustrations arise first and foremost from lack of hardware. Many, if not most, accounting educators do not have access to classrooms that have three-beam projectors or computer monitors that are visible to all students in the classroom. Such educators have to make do with what they can acquire on very limited budgets.

For multimedia PC authoring and delivery, the current state of the art is VGA, Super VGA, or equivalents on a Mac. Color projections will cost between $2,500 to $20,000 depending upon options for computers and projection hardware. For a review of some of the leading vendors and their prices, see Sherman (1995). Mac hypermedia authors will probably prefer the Quadra 840 AV or PowerPC options. PC users will prefer 486DX2, P54C Pentium, or PowerPC processor options. We recommend that readers send for "Introduction to Multimedia Equipment" (TPR-04) and "Digital Multimedia" (TPR-09) from the Intstitute for Advanced Technology, P.O. Box 12017, RTP, NC 27709 - 2017 (919-560-5031). Also, readers should refer to Spanbauer (1994a and 1993b) and Farrance (1993). If consultants are used, always seek the advice of more than one consultant and use care to clearly state what your objectives are (e.g., authoring of in-class presentations, authoring of computer lab learning materials, authoring of computer network learning materials, authoring of commercial CD-ROMs, data imaging, recording of videographics, etc.). If commercial materials authoring is a main objective, consider size and needs of the target market (e.g., in the CD-ROM world there are twice as many PC users and Mac users in general, but in specific disciplines such as music or science the market may be better for Mac CD-ROMs). Also consider timing goals. In the short run, there are many more customers on DOS, Windows, and Apple/Mac processors. In the long run, newer processors such as those on PowerPCs will become more prevalent.

The PowerPC is a revolutionary new desktop computer emerging from a joint venture between Apple Computer, Motorola, and IBM. Rupley (1994, p. 129) writes that: "PowerPC will remake the computer industry at its foundations." This is a remarkably fast and cheap CPU using RISC chip technology. Three major advantages over its Pentium competitor are speed, low-temperature performance, and price. It will be much easier, for example, to build portable computers using PowerPC chips than Pentium chips due to the low-temperature comparative advantage. What is even more revolutionary is the ability of the machine to run under Apple, OS/2, DOS, Windows, and Unix operating systems. The main drawback is that PowerPC users can only run DOS and Windows applications in emulation form such that all speed advantages of the PowerPC are lost. For this reason, the "PC" part of the tradename "PowerPC" is somewhat misleading since most PC users run under DOS and/or Windows operating systems. Certainly users who prefer to stay in a DOS and/or Windows operating systems are advised to stick with the 486, Pentium or other some other CPU alternative that does not require emulation. When applications vendors bring applications to market in PowerOpen, Pink, and other PowerPC operating systems, Intel may lose huge market shares to PowerPC, but this probably will not happen to a major extent in this Century largely due to the fact that PowerPC requires replacement of existing computers with new PowerPC computers. Worldwide, this will not happen for years. In the meantime, it is not clear what innovations Intel will announce to maintain its market share in light of serious competition from PowerPC. It is still uncertain whether Windows NT will eventually be an option. IBM is also working with Apple to develop the PowerOpen operating system for the PowerPC. At the time of this writing the full line of PowerPCs is not available. Taligent is also developing the Pink operating system for the PowerPC. It will be some time before portable (e.g., Tadpole) and multimedia PowerPC lines are produced. Also it will be several years before software developers offer PowerPC lines anywhere close to the present Windows product lines.
Churbuck (1994) discusses options ranging from $12,000 and up for multimedia authoring workstations. Workstations require more than just a desktop computer. Since Churbuck’s article, the 275-MHz ACTion AXP275 was introduced. The fastest PC at 275-MHz performance is the BTG Action Systems (phone 703-641-1200) ACTion AXP275 priced slightly under $10,000. This computer runs Windows NT, which in turn runs Windows and Windows 95 software at lightning speeds. DOS software runs slow on a 286 emulator. This is probably the top of the line choice for users that can afford such computing power. This machine is described in PC World, February 1995, p. 80For authoring and delivery of CAL materials and other hypertext/hypermedia materials. One of the most interesting servers for technology in education is the MIT university “MIT EVAT Report-Models for the Future” at <http://www-evat.mit.edu/report/>. We provide the following highly subjective opinions on hardware:

1. Desktop PCs in VGA color are available starting at around $800 and up depending on the amount of RAM, hard disc capacity, speed, and other features. Multimedia playback computers can be purchased for under $2,000, but multimedia authoring computers realistically are going to cost $5,000 and up do to added RAM and SCSI hardware needed for authoring. At this juncture in 1995, we recommend not purchasing a PC having less than 120 MHz of speed under options reviewed in PC World, January 1996, pp. 214-215. The top-rated PCs at this point in time are Micron Millenia models (Ranks 1, 3, 5), Dell Dimensions (Ranks 2, 4, 6), Gateway models (Rank 8, 9, 15) and Austin Power Plus (Ranks 10, 12, 16) according to PC World. Having the SCSI on the motherboard is a desirable feature that has numerous advantages, but it is not an advantage if connections are limited to auxiliary hard drives of less than 2 Gb capacity. Also 2Mb or more of video RAM in addition to 64Mb or more of RAM are becoming essential for hypermedia authors. Multimedia authoring also requires auxiliary hardware such as video cameras, VCRs, auxiliary hard drives (usually in minitowers), tape drives, etc. Workstations with added DAT tape drives and minitower hard drives start around $10,000. Add approximately $1,000r a CD-ROM recorder, although one workstation with a CD-ROM recorder can serve multiple authors who use that workstation only to record their CD-ROMs. At this point in time, it is advised that PCs be purchased with no less than the P166 Pentium. Fully equipped multimedia PowerPCs are price competitive with similar PC models. For desktop Mac systems from Apple Computer Inc., the prices are somewhat higher than comparable PC options, although Apple Computer tends to include hardware and software that may have to be added to PCs at extra cost (e.g., sound boards, QuickTime video boards, and speakers). If you plan to record video and audio from multiple sources such as a video camera, television, VCR, radio, audio tape player, CD-ROM, etc., you should by a mixer that can take in multiple cables and then output a single cable to your computer sound board and a single cable to your full-motion video board. We recommend a mixer that is small enough to be portable.

Most present CMS packages require very little RAM, but for graphics authoring 32 Mb of RAM and 1 Gb of hard drive are recommended. Auxiliary hard drive having two or more gigabytes connected through a SCSI is a must for serious hypermedia authoring. At a minimum the computer should have 2 Mb of video RAM, although two or more megabytes are recommended for graphics authoring. Serious authors will also want computers with at least 166 MHz speed for both graphics authoring and full-motion video capturing. It is best these days to also purchase a computer with a “PCI bus.” The older VL local busses are not as good as the Peripheral Component Interconnect (PCI) brainchild of Intel that is a better choice according to Desmond (1993).
Some vendors now offer fully equipped multimedia computers with sound cards, video cards, and CD-ROMs factory installed. This has some major advantages, but there are also drawbacks if these installed versions are not what you want or the type of audio or the video capture card of your choice does not come factory installed by the vendor. Video options for the PC with particular stress upon Intel's Indeo Video and Smart Video Recorder are analyzed by Liebman (1994). Doyle (1994b) calls several options “awesome,” including the $940 Fast Electronic’s Movie Machine Pro (415-802-0772) with M-JPEG and Avi file capturing options. Similarly, he calls the $570 Intel Smart Video Recorder (800-538-3373) and the $890 Micro Computer microVIDEO DC1 tv (800-249-6476) awesome. Before purchasing and installing any Windows video capture board, carefully read Doyle (1994b). He also has some good advice for capturing and storing video files.

(2) CD-ROM drives are essential to multimedia computing at the present time. It is uncertain whether these will be quickly overtaken by CD-DVD drives. The newer CD-DVD standard extends CD-ROM capacity to 4.7Gb or 9Gb capacity without turning the disc over in the machine. Beyond 9Gb the standard supports the Toshiba two-sided standard having up to 18Gb capacity. DVD-ROM players are expected to emerge on the market in 1996 and recorders in 1997. At this point it is not clear that CD-DVD recorder prices will be low enough for desktop recording that is now possible for less than $1,000 on older CD-ROM standards. An announcement of a CD-DVD standards agreement appears on Page 18 of NewMedia, November 1995. Much depends upon whether the higher capacity CD-DVD discs will be recordable on desktop recorders at reasonable prices. Such recorders will not even be available until 1997. We recommend purchasing the fastest available small computer system interface (SCSI) card pre-installed when you purchase your computer. Portable CD-ROM drives are now available to connect to laptop and notebook computers, but these will not work on computers not having appropriate SCSI or related hardware. In general, SCSI hardware on computers allows authors to link into fast CD-ROM drives, auxiliary hard drive storage, Syquest drives, Bernoulli drives, computer tape, or re-writable laser cartridges. We recommend an auxiliary tower containing at least two gigabytes of high speed (approximately 10 ms) hard drive and a data tape drive. Watch for changed standards in CD-ROM hardware. At present, customers have the standard 680 Mb version. The most important happening that will keep CD-ROM technology alive into the next century are the forthcoming developments that will increase data storage capacities per disc five to ten times the present 680 Mb standard capacity. Shorter laser wave lengths and new angle reading and silver coating technologies greatly enhance the future of CD-ROM playback and CD-R recording technologies. Newer technology CD-DVD drives will eventually have to be added to computer systems in order to obtain forthcoming titles that contain hours of full motion, full screen video. We doubt that CD-DVD high-density drives will quickly replace the 680 Mb drives, however, since there are millions of CD-ROM users in the market who may be slow in replacing CD-ROM drives with CD-DVD drives. At present, costs of CD-R recorders (including software) have fallen below $1,000. Hence, for the same reason videodiscs never came close to replacing videotape players in homes and offices, high-density CD players will not come close to replacing desktop-recordable 680 Mb CD-ROM discs. When CD-DVD discs become rewritable at reasonable costs on desktops, both CD-ROM and videodisc technology will probably become history. The end is in sight and may be as early as 1997.

(3) A portable (laptop, notebook, or subnotebook) computer is highly desirable for presentations in class and on trips off campus. We recommend purchasing an option that has a docking station with at least two expansion slots (e.g., for an Ethernet
board and a video capture board). *PC Computing*, August 1995, pp. 72-73 ranks the newer portable Pentium computers. Beware, however, that some options do not have built-in CD-ROM and/or docking stations for adding additional boards such as video capture boards. Laptop rankings change somewhat in the next-generation multimedia portable options reviewed in *PC Computing*, January 1995, pp. 124-144 and September 1995, pp. S1-S17. MPEG 1 and MPEG 2 full-screen and full-motion video is here for projection in class and on the road. MPEG video encoding and editing software is also available, but prices are around $5,000 and higher. MPEG 1 places videotape quality full-motion, full-screen video on computer screens. MPEG 2 extends this the forthcoming HDTV quality. MPEG requires special playback (decoding) and recording (encoding) hardware. Now is not a good time to purchase an expensive multimedia laptop computer for MPEG, but the time is will probably be sometime in 1996. The reason to wait is that the manufacturers have all the pieces for state-of-the-art video but have not yet put them into a laptop computer. The pieces (options) that I am referring to are as follows: (1) a PCI bus plus PCI expansion slots in a docking station; (2) MPEG on the motherboard; (3) a SCSI port that will connect to large (e.g., more than 2 Gb) hard drives; (4) at least a four-speed internal CD-ROM drive needed for MPEG 2 video, (5) at least 64 Mb of EDO RAM, and (5) the new MMX chip capable of 133 Mhz and higher clock speeds. Options (5) and (6) are now available on desktop computers and will be available on some portable computers in 1996. The Toshiba Tecra 720CT has 133 Mhz speed, EDO RAM, 65,000 colors on 1,024 by 768 pixels, and the HiQVideo accelerator chip. By the time you add extra RAM and a docking station, the price is very close to $10,000. The IBM 760CD is a great laptop that offers Options (2) and (4) at a combined price of nearly $10,000 with 32 Mb of RAM and a docking station. But the IBM 760CD fails on Options (1), (3), and (5) and offers Options (2) and (4). The Toshiba Tecra 720CT offers Options (1), (3), and (5) but fails on Options (2) and (4). Why a $10,000 IBM laptop still has local bus older technology instead of a PCI bus is a mystery. Texas Instruments offers lower prices, but the audio is really inferior, and TI does not offer truly high-end machines like the Tecra line from Toshiba. Dolch computers offer five expansion slots and offer more options than all other portable computers, but the Dolch multimedia portable computer is a briefcase-sized machine that as yet does offer an MPEG playback option. In my viewpoint, however, having five expansion slots makes the Dolch the most attractive option for high-end portable computing. Unfortunately, Dolch and most other vendors have not yet announced the MMX or P6 Pentium Pro options.

Following IBM’s lead, two computer vendors now have MPEG 2 on the motherboard. To date, these include NEC’s Versa 6030X, and Kiwi’s OpenNote 680TX. MPEG 2 is out of reach for desktop encoding however, since MPEG 2 recorders start at about $20,000 and quickly work their way up to nearly $50,000 for all that is needed for MPEG 2. MPEG 1, however, is high quality full-screen, full-motion video that can be encoded for less than $5,000.

Note the problems with PCMCIA slots in portable computers. PCMCIA slots are common in printers, and notebook/laptop computers, but these "slots" have been troubled technologies from the start. Before buying a computer with PCMCIA slots, readers are advised to read Doe (1994) regarding the problems and hopes for improvements in the future. Doe (1994, p. 172) states that: "User outrage about this incompatibility has scared many people away from PCMCIA. The Type I slots are 3.3 mm thick and serve mainly as memory cards. The Type II slots are more input/output compatible with fax modems and LAN adapters. The Type III slots are 10.5 mm thick and can be used for porting to some auxiliary storage devices such as external hard drives. One problem is that some vendors who claim to have Type III slots are really manufacturing with only Type II slots stacked on top of each other giving rise to a .5
mm incompatibility difference. There is also some doubt whether PCMCIA technology can be expanded to 32 bit and 64 bit processors of the future. Although the best video capture hardware is still contained on video boards added into computer expansion slots, laptop and notebook computer users can capture video with PCMCIA capture cards such as that available from Centennial Technologies for $399 (phone 800-942-0018).

(4) Color LCD panels or self-contained data projectors are priced at $1,000 and higher. Cheaper models will not run full-motion video files from computers or analog television signals. Older technology color LCDs are much cheaper, but they are very disappointing in terms of lighting, color, and refresh rates. Instructors need to inquire as to whether the LCD is "active matrix" color or something technologically equivalent! Most LCDs sit on an overhead projector, but some newer models have their own light source. For example, the LitePro (800-327-7231), the BoxLight All-In-One Projectors (800-762-5757), and the NEC MultiSync Multimedia Theatre (800-366-0476) projectors have their own light sources. Newer versions will also project full motion video, although the quality is not quite what appears on television screens. This makes it possible to switch between a computer and a videotape/videodisc player during a presentation. LCD panels differ as to whether they can display full-motion video as well as computer images. For a review of some of the leading vendors and their prices, see Sherman (1995). The latest technology for brightness is the Digital Light Processing (DLP) microchip from Texas Instruments that will soon find its way into more projectors from various vendors. Most LCD panel vendors have newer models that accept either digital or analog signals. Conventional "passive matrix" panel technology is now giving way to "active addressing" developed by Focus Systems. Whereas passive LCDs can display animated computer graphics, they cannot display full-motion video signals from computer sources such as compressed video discussed earlier in the chapter. Active systems are intended to project any images, including full-motion video, that can be displayed on a computer monitor. Also, LCDs are becoming even more portable. Proxima now has a hand-held multimedia projector. Greenfield (1992a) lists 20 LCD vendors and discusses the latest developments in LCD technology. Three-beam projectors are the best for computer and video projections in classrooms, although these are not conveniently portable and cost from $10,000 to $40,000. These also require frequent (e.g., weekly) maintenance and adjustments by experienced technicians. Nevertheless, three-beam projectors are the center point of multimedia classrooms. Key advantages over LCD panels are brightness and full motion video quality. For LCD panels that sit on overhead projectors, it is much better to obtain the new metal halide bright light overhead projectors. UNIX users may also have portable projection LCD panels. For example, Solsource Computers (619-929-7810) offers a variety of Presenter LCD panels.

(5) A flatbed optical scanner at $400 or higher accompanied by scanned text converter software are both desirable but not essential. The top-rated scanners at the end of 1994 were SanJet IIcx (Rank 1) from Hewlett-Packard (800-722-6538), Apple QuickTake 100 (Rank 2) from Apple Corporation (800-538-9696), and Canon IX-4015 (Rank 3) from Cannon (800-848-4123) according to PC Computing, December 1994, p. 152. Color Scanner options and prices are reviewed in PC World, September 1995, 149-154. Scanners allow authors to copy graphics and text into computers without having to draw or type documents from scratch. If text is to be scanned, various software options are available for conversion of scanned text into word processors and spreadsheet programs. We have had great results (after trying
several text conversion software packages) with OmniPage Direct from Caere Corporation (800-462-2373). Color scanners are also available, but these require considerably more RAM and hard drive capacities. Authors should beware of hand-held scanners. Even the good ones are hard to operate. Note that it is rare to import any scanned graphic image or text paragraph that does not have to be improved upon later on by the author. Scanners may save time, but they rarely provide images that are satisfactory without tedious added work.

(6) A hand-held remote control device for classroom delivery controls. For Windows users, the best deal we know of is the Mind Path IR90 remote control (phone 800-634-7424 or 214-233-9296) that is both a hand-held mouse and more. By simply pushing a button, instructors can magnify the view, place a spotlight on the view, make check marks and sound effects as points are made in presentations, and draw on screen. The price at present for hardware and software is $129. Most remote controls connect to a computer through a serial port and can be used with most any projection device. This is not true of some products like the Cyclops. Ovation's Cyclops mentioned earlier in the chapter allows for limited wireless mouse controls. The price, however, is much higher and requires the purchase of an Ovation LCD from Proxima. The Cyclops cannot be used with three-beam projectors in an electronic classroom since it can only be used with the Ovation LCD panel. Also beware of really cheap wireless mice, however, since they tend not to be responsive at distances of more than a few feet from the computer.

(7) Wireless hand-held response pads for students require one receiver to be connected to the presentation computer in a classroom. The receiver costs approximately $1500. Each wireless response pad will cost in the $250 to $275 range, although volume discounts are negotiable. Equipping large classrooms can become expensive but doing so is far cheaper than providing each member of the audience with a computer. Response pads provide only limited response options and are not equivalent to full keyboards. Readers interested in finding out more about the use of response pads with ToolBook lessons may want to contact Professor Barry Rice at Loyola College of Maryland.

(8) A television receiver, videodisc player, and VCR should be attached to your desktop computer. Videodisc alternatives are discussed by Waring (1994). Since the date of the Waring article, Sony introduced its education market MDP-1700AR. One of the best buys for less than $1,000 is the MDP-1700R Multi Disc Player from Sony that plays different size discs and has an auto reverse feature that allows viewing and searching on both sides of the disc without having to turn the disc over in the playback machine. There are currently four levels of interactivity for videodisc players. Level "one" is controlled with an inferred or wired remote control or bar code reader. Level "two" players have programmable memory. Level "three" is controlled by an external computer which greatly improves interactive controls with hypermedia software. Level "four" is a high speed computer interface videodisc player that accesses each side of the videodisc. Level four is more useful for using a videodisc as an external storage device for computer data. For a short discussion of levels of interactivity see Lynch (1994, p. 19). Sources of educational videodiscs are given in Appendix 6. For capturing and playback of digitized video into and out of computer files, a full-motion video frame grabber (digitizer) of some type allows authors to capture selected full-motion video (camcorder, videotape, videodisc, cable TV, satellite dish, etc.) images and convert those analog frames into digital graphics files on the computer. Video boards (cards) and frame grabbers start at around $200, but
prices vary a great deal with vendors and options, including options under Microsoft Windows Video MCI standards, Apple Quicktime standards, IBM M-Motion (MM) standards, MPEG standards, and Intel Indeo standards. Virtually every major computer brand on the market has multiple options for video (multimedia) devices. Many of those devices also have accompanying frame grabber software. For example, readers may consider Pioneer’s LaserActive system (213-746-6337). Compression boards for PCs that come in a variety of prices and features. Although the best video capture hardware is still contained on video boards added into computer expansion slots, laptop and notebook computer users can capture video with PCMCIA capture cards such as that available from Centennial Technologies for $399 (phone 800-942-0018).

(9) Before long, educators will want MPEG video playback and capture hardware. MPEG stands for Moving Pictures Experts Group systems boards and standards (e.g., MPEG-2 and MPEG-1) for the most popular emerging form of compressed full-motion video standard for computer file storage. MPEG compression requires MPEG playback boards and/or MPEG authoring boards such as the Optibase MPG-1000 digital video codec (compression/decompression) board (800-451-5101). Although MPEG-2 is superior to MPEG-1, MPEG-2 requires at least quad speed CD-ROMs that, thereby, limits the use of MPEG-2 in the commercial market. However, even MPEG-1 is considered a better video compression alternative than its competitors. MPEG encoders are reviewed by Sauer (1996). The are still relatively expensive in the $4,000 to $25,000 range for hardware plus software ranging from $89 to $1,000. Until there are millions of computer users with enough computer hardware capacity to decode MPEG digitized video, Microsoft Video for Windows and Apple QuickTime will probably remain more common in authoring of education materials. MPEG video files have an mpg file extension and will not run on computers that do not have special MPEG playback hardware/software installed. The main difference between JPEG compression and MPEG compression is that JPEG still compresses on a frame-by-frame bases that makes editing frame-by-frame much easier. However, MPEG allows for much more high-density compression of video. MPEG video cannot be edited frame-by-frame in a traditional manner. The first editable MPEG authoring system was the REALmagic Producer (from Sigma Designs at 800-845-8086). Sauer (1996) gives the highest rating of “awesome” to MPEGWorks encoding (recording and editing) software on PrimeView II hardware from FutureTel (800-658-5868 or <http://www.futuretel.com/>). The combined cost is presently in the $7,000 to $10,000 range from FutureTel.

(10) If you want to transfer your computer images to videotape or live television, you will need a scan converter. Scan converters can be small and cheap or bulky and expensive. Unfortunately small and cheap (e.g., $200 to $1,000) usually are disappointing in terms of clarity, color bleeding, and reduced flicker. We use a $300 ProPC/TV Plus from AI Tech (408-946-3291) and consider it a good buy for the price. Even the most expensive scan converters can be somewhat disappointing for computer images having fine lines, small fonts, and color combinations unsuited for analog viewing. If you are scan converting, it is better to connect the scan converter to a professional videotape recorder recording on one-inch tape. Apple Computer has computer models with reasonably good scan converters built into the computer. See Waring (1994c) for a review of scan converter hardware options.
(11) A converter that will transform 35 mm slides into graphics files on the computer allows authors to get their photos into computer presentation. For example, the ScanMaker (800-654-4160) will convert slides into digital computer graphics, and the RasterOpps (800-SAYCOLOR) will convert into analog video. On the other side of the coin is the 35 mm slide maker that will make slides of computer screens. Newer options are listed in Appendix 6, two of which are discussed in NewMedia, January 1994, p. 102.

(12) Large classroom monitors or three-beam, ceiling-mounted or back-mounted projectors eliminate the necessity of classroom LCD panels, although backup LCD hardware is a relief when electronic classroom hardware is not in working order. LCD self-contained data projectors are rapidly replacing three-beam projectors that internally convert digital streams to analog streams. One of the brightest and most flexible alternatives in 1996 is the Boxlight ProColor 3080 at 250 lumens (Phone: 800-762-5757). Electronic classrooms often have multimedia equipment booths containing videodisc players, CD-ROM players, videotape players, film projectors, slide projectors, etc. Major vendors of three-beam projectors include Barco, Electrohome, NEC, and Sony. Because three-beam analog conversion projectors require frequent technician adjustment and maintenance, it is becoming more popular to mount LCD data projectors in classrooms.

(13) It is helpful to have the local-area networking capability to connect to a mainframe computer or other server. This has a number of advantages for both authoring and runtime tasks. Some servers connect to only selected desktop computers on campus. Others have network connections in electronic classrooms. Modern connections are usually unsatisfactory due to the time it takes to transmit graphics images over a modem. A campus network makes it easy to update lessons and make them available to students wanting to replay CMS lectures, cases, and problems. Students can access the network any day of the week and any time of day. They can study network lessons and take notes at their own learning paces. A CMS runtime package allows instructors to track each student's progress in each lesson. Classrooms, labs, and offices also may be equipped, at considerably higher costs, with access to satellite dishes and wide-area networks such as Internet that connects users to major libraries and learning centers of the world. A newer technology termed PDA (Personal Digital Assistant) for portable recording of handwritten messages that can later be ported to networks in the Newton from Apple Computer and similar emerging PDA products such as AT&T's EO, Tandy's Z-PDA, Sharp Expert Pad, Psion Series, Amstrad PDA 600, and Casio's Z-7000. Such devices may include notepads, address books, clocks, calculators, personal finance utilities, language translators, dictionaries, games, modems, etc. The AT&T option is the most expensive, but it is also a telephone, fax, and planner. For a review of options, see Kantrowitz (1993). Although the initial version of the Newton has some bugs that have been played up in the press and omitted features (such as scanning) in the original design, Newton-type technology is on the way. Soon linking to computers from remote locations will be as simple as communication by cellular phones.

(14) It is very convenient if a department or media center can supply work stations for making (burning, mastering) CD-R (e.g., CD-ROM and CD-I) and videodisc optical blank discs. Hardware and software for such purposes are reviewed in PC Computing, August 1995, pp. 183-186. Prices range from $1,500 to $15,000 for desktop mastering devices. Pinnacle Micro has its RCD-1000 model priced at $1,295. Realistically, however, laser disc recording requires auxiliary SCSI hard drive adding, say, $1,500 to the cost of a work station. Beware of low cost recording
systems such as the Matsushita “Phase Change Dual” PD selling for under $1,000. This is an inexpensive recorder that records up to 650 MB per disc and has a wonderful feature allowing for rewriting on a previously recorded disc. The drawback of the Matsushita recorder and other rewritable CD recorders at this point in time is that the recorded CD discs will not play back on standard CD=ROM players. CD-I mastering also requires added hardware from Philips costing over $10,000. Videodisc mastering requires relatively expensive video studio hardware and software. Videodisc blank recording discs are available from Optical Disc Corporation (800-350-3500).

(15) For videographics production of analog materials for videotapes, videotdiscs, television broadcasting, and CD-I interactive compact discs, there are recent options that greatly reduce the cost of video production studios. You will still need professional-quality (at much higher prices than consumer products) video support equipment such as Hi-8 videocameras, video editors, tape recorders, multiple monitors, mixers, etc. that require thousands of dollars before you even begin to think about video computing, however. Both Apple Computer (Mac video systems) and NewTek Inc. (Video Toaster workstations) have lower cost (starting at $5,000) video rendering hardware, but most serious videographics work stations start at around $50,000 with support hardware/software and become much more costly for professional quality videographics. Higher cost videographics computers (such as those from Silicon Graphics) generally cost in the vicinity of $25,000 with options for increased investment in hardware and software. Silicon Graphics has reduced the prices for some models to less than $10,000 but added video hardware required for videographics workstations more than doubles this price. The main point here is that rendering full-motion videographics not only takes more time and professional training, it requires more hardware investment than simple rendering of animated computer graphics using present CMS software in a low-cost desktop or laptop computer. It is one thing to capture short pieces of full-motion video into the computer versus producing hours of professional quality video for, say, videodiscs.

(16) Videoconferencing hardware and software may be required to reach out to off-campus students. Low-cost videoconferencing systems are compared and reviewed in NewMedia, July 1993, p. 82. A great deal has happened since then, however, with newer inexpensive desktop computer video conferencing technologies.

(17) Professors will probably want to get "online" with selected national and international networks via modems or ethernet cards on their computers. Cambell and Helm (1993) review various online services, including the "Big Four" CompuServe, GEnie, Prodigy, and America Online. Certainly, college students should be aware of options available online.

(18) For networking, sophisticated graphics, and full screen videos, higher capacity workstations are required at speeds of 120 megahertz or higher. New machines to consider are the PowerPCs from the joint venture of Apple Computer and IBM and the Silicon Graphics XZ, both of which are quite reasonably priced. One problem to consider, however, is the delay in time before software vendors have versions for these high capacity work stations. In the meantime, users may have a whole lot of computing power but no software comparable to, say, the number of software options in Windows. For a review of these issues, see Auchard (1993) and Baron (1993).
Conclusions

If we can do it, you can do it! This chapter provides readers with a range of options that vary in terms of dollar cost, rendering (authoring) time, and technical skills required for authoring and delivery of CAL lessons. The CMS options and most related ALT options are relatively inexpensive, require only low-cost hardware, and can be learned in a few hours of lessons for beginners. Authoring software is generally at a similar level of difficulty to that of word processing software. Code writing options such as ToolBook OpenScript, Quest Authoring System, Tencore Author, GUIDE's LOGiiX, ScriptX, and C++ are both more difficult to learn and more time consuming in terms of lesson rendering time. Videographics rendering systems are normally more difficult to learn than CMS options. In the future, interactive learning and multimedia CAL materials will probably overshadow videotapes, CD-ROMs, and other media with which learners passively watch lessons without actively participating in the presentations. Vendors around the world are feverishly developing multimedia hardware and software in anticipation of new networking and video compression technologies. Their main, and somewhat conflicting, goals are to make their products both more effective for interactive learning, versatile in a variety of CAL environments, and more user friendly to authors and learners. Both multimedia technology and networking will make educators less dependent upon a single CMS option. In the future, switching into and out of different packages will be quick and efficient.

In the future, educators' authoring and course delivery software may be located in central network servers thousands of miles from where educators author lessons and deliver courses. For authors now connected to Internet, the "MAEstro Hypermedia Authoring Environment" at Stanford University is currently available free at any location in the world connected to Internet. This greatly reduces the hardware and software investments required to render professional-quality multimedia learning materials. It does, however, require a relatively large investment in a computer that is both connected to Internet and is compatible with the MAEstro system. Details and illustrations of MAEstro are provided by Drapeau (1992). The point here is that networking may reduce cost of authoring and delivery of lessons, because hardware and software may be shared by multiple users on network.