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# Project CLEAR's Paper Choice: A Hypertext System for Giving Advice About Legal Research

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## **Project CLEAR's Paper Choice: A Hypertext System for Giving Advice About Legal Research\***

I. Trotter Hardy\*\*

*Project CLEAR—Computers in Legal Education: Assistance with Research—applies computer techniques to teaching and advising students about legal research. "Hypertext" is a software technique appropriate both for creating information structures that users can browse through, and for creating question-and-answer decision trees that provide specific advice to users. These two hypertext techniques have been put together in Project CLEAR's Paper Choice, a computer program that provides knowledge and gives advice to law students about legal research.*

### **I. Background**

The complexity of legal authority and commentary has brought into being hundreds of research tools or finding aids over the last century. These aids include indexes, digests, encyclopedias, the *American Law Reports* series, Shepard's Citators, computerized citators like Auto-Cite and Insta-Cite, and computerized full-text search systems, as well as countless other sources that often serve as finding aids, such as periodicals, treatises, hornbooks, and nutshells. The number of these aids and other sources is so large that reference librarians spend much of their time answering questions about which of several aids in the library will most efficiently solve a patron's research problem.

Teaching legal research is also a continuing challenge to law schools. Students find the subject dry and difficult. Consequently, teaching research is not as satisfactory an experience for most teachers as teaching the substantive law, which makes it difficult to find personnel to teach legal research.

Project CLEAR—Computers in Legal Education: Assistance with Research—began at William and Mary College in 1987 in response to these difficulties. The objective of the project is to investigate the use of

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computers in teaching and advising lawyers and law students about legal research. The first results of the project have been software systems built with the "hypertext" technique of information storage to run on IBM-compatible machines.

The remainder of this article will: (1) explain the hypertext technique; (2) describe an early version of an all-graphics "browsing" hypertext system for legal research, the Paper Choice/graphics edition, emphasizing the conceptual model of the research process that arose from it; (3) describe the current Paper Choice/text edition system, which contains both a decision-tree component and a browsing hypertext component; and (4) offer some informal conclusions about developing educational software using the hypertext technique.

## II. The Hypertext Technique

Hypertext is a software method for the storage and retrieval of information.<sup>1</sup> In that sense, the term "hypertext" is similar to the term "database," though hypertext methods for storing and accessing information are different from typical database methods. The hypertext method depends on dividing information into discrete units, usually called "nodes" but referred to in this paper as "topics," and establishing links among the various topics. Topics can be of any size, though for readability they are usually kept to a page or two of text or a single computer-screen-sized picture. Unlike the information stored in a database system, the information assigned to a topic in a hypertext system need not be in any special format. That is, it does not appear as a "record" containing "fields," but is just some amount of text or a picture.

The salient characteristic of hypertext systems is that each topic of information is linked to one or more other topics. "Linking" means that a user looking at a given topic on the screen can, by a key press or "mouse" click, quickly cause any other topic linked to the displayed topic to appear on the screen. From that second topic, any further topics linked to it can quickly be made to appear, and from that topic, further topics can be made to appear, and so on.

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1. Hypertext has lately been getting a lot of attention in the computer science community and in the computer industry. For a good background summary of efforts in research labs on hypertext, though slightly out of date in its product descriptions, see Conklin, *Hypertext: An Introduction and Survey*, COMPUTER, Sept. 1987, at 17. A less detailed, but still useful overview appears in Smith, *Hypertext—Linking to the Future*, ONLINE, Mar. 1988, at 32. The Association of Computing Machinery (ACM) puts out a computer science journal called *The Communications of the ACM*. Volume 31, number 1, of that journal is devoted to papers on hypertext. For a more informal discussion, see *Hypertext Software Helps Users Weave Complex Data Webs*, PC WEEK, Mar. 1, 1988, at 42.



With computer storage, large amounts of information can be made accessible more quickly than would be the case with paper-bound volumes. Interest in hypertext for legal applications has been growing: West Publishing Company, for example, now offers several CD-ROM databases of legal information that allow linking from, say, a statutory citation directly to the text of the statute itself.

The advantage of this information structure over others is both the speed of access and the fact that users can display and read only those topics they want, without having to bother with other topics. This advantage usually leads to hypertext systems being conceived as "browsing" systems. Such systems allow users to browse at will among various topics, as their interest directs them.

Hypertext has other uses, however, that are less obvious but equally interesting.<sup>2</sup> In particular, hypertext can be used to set up hierarchical links among topics that are questions and answers. The resulting hierarchy represents a decision tree and can be used to answer specific questions or diagnose certain problems.

Hypertext systems structured as decision trees can thus be used as "expert systems"—systems that respond to a user's indication of a problem with advice on how to solve that problem.<sup>3</sup>

### III. CLEAR: The Paper Choice/Graphics Edition

Project CLEAR began with the development of an experimental hypertext system called the Paper Choice/graphics edition. The graphics edition relied on simulating the appearance of legal research materials on the computer screen.

By moving an on-screen pointer with a mouse device, the user could indicate which of several volumes was of interest. Clicking a button would bring up an explanation of what the book was for and how it was organized. Additional pointing and clicking by the user would bring up selected sample pages of the book or further instructions on how to use it.

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2. For a discussion of the use of hypertext systems for information retrieval in general, see Marchionini & Shneiderman, *Finding Facts vs. Browsing Knowledge in Hypertext Systems*, *COMPUTER*, Jan. 1988, at 70.

3. The phrase "expert system" usually denotes a different type of software: one that can make logical deductions from a lengthy series of rules about some area of knowledge. Hypertext is not conventionally thought of as a mechanism for developing expert systems, but, because it can be structured to give advice in response to a user's answers to questions, it seems to fit within a broad, common-sense notion of what "expert systems" are. For more information on legal expert systems within the narrower sense, see R. SUSSKIND, *EXPERT SYSTEMS IN LAW: A JURISPRUDENTIAL INQUIRY* (1987). For a description of another expert system that apparently relies on hypertext, see Pallatto, *A Hypertext System Means Hyperservice at Ford Motor*, *PC WEEK*, Oct. 17, 1988, at 51.



Structured this way, the original Paper Choice version relied on the "browsing" technique of hypertext. Nothing would direct the student users to any part of the system; they would be free to browse through whatever information about legal research aids they chose. This is a typical use of hypertext packages aimed at end-users like students, rather than at professional searchers like reference librarians.<sup>4</sup>

Figure 1 shows one screen from roughly two hundred such screens in the Paper Choice/graphics edition.<sup>5</sup> Each of the volumes—a legal encyclopedia, an A.L.R. volume, a case digest, a case reporter, a periodicals index, and a Shepard's citator—was linked to further

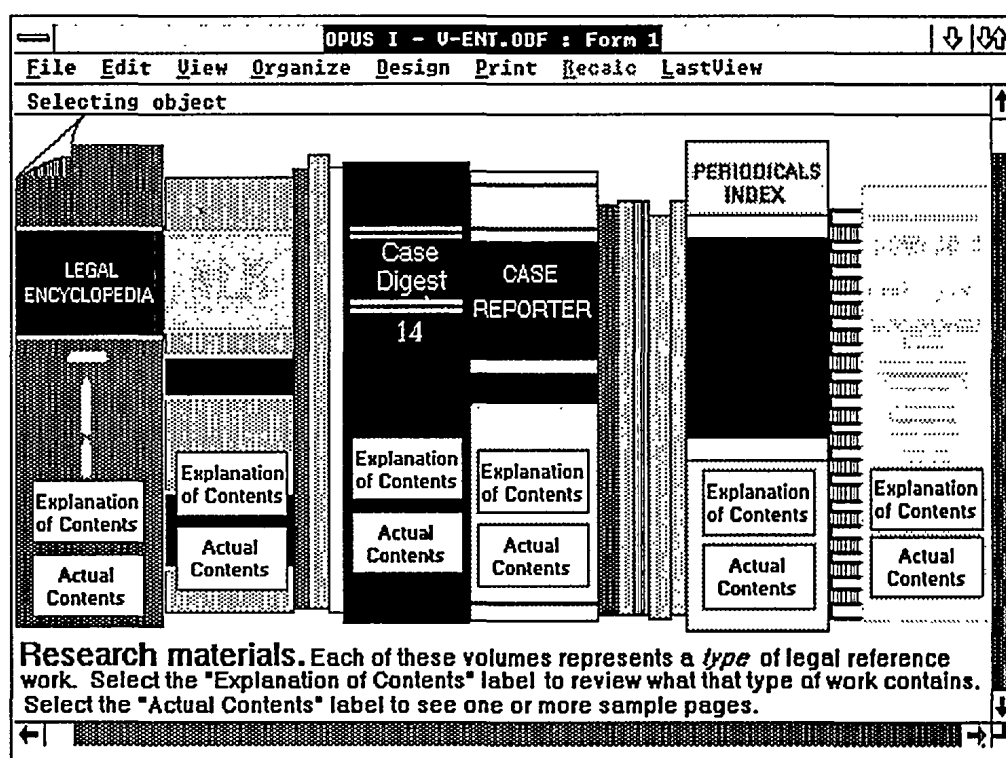


Figure 1

Screen from the Paper Choice/graphics edition showing the research aids for which information is available.

4. See Marchionini & Shneiderman, *supra* note 2, at 71.

5. Credit for the artfulness of these graphic images, drawn using Opus I, goes to my law student research assistant, former graphic artist and advertising executive John Field.



information. For example, if the student user pointed to the legal encyclopedia volume and clicked on the "Explanation of Contents" label, the screen display would shift to that shown in figure 2.

If the student looking at figure 1 chose instead to point and click on the volume labelled "Case Reporter," the screen in figure 3 would appear. From this screen the user could obtain additional information by pointing and clicking on either one of the two reporter volumes.

From any screen a mechanism was also provided for users to progress back through all screens previously viewed, or to jump directly back to the beginning screen shown in figure 1.

Although this approach to teaching legal research has a great deal of potential, two practical problems arose. The commercial software used to construct the images and links, Opus I,<sup>6</sup> was designed for use by those who

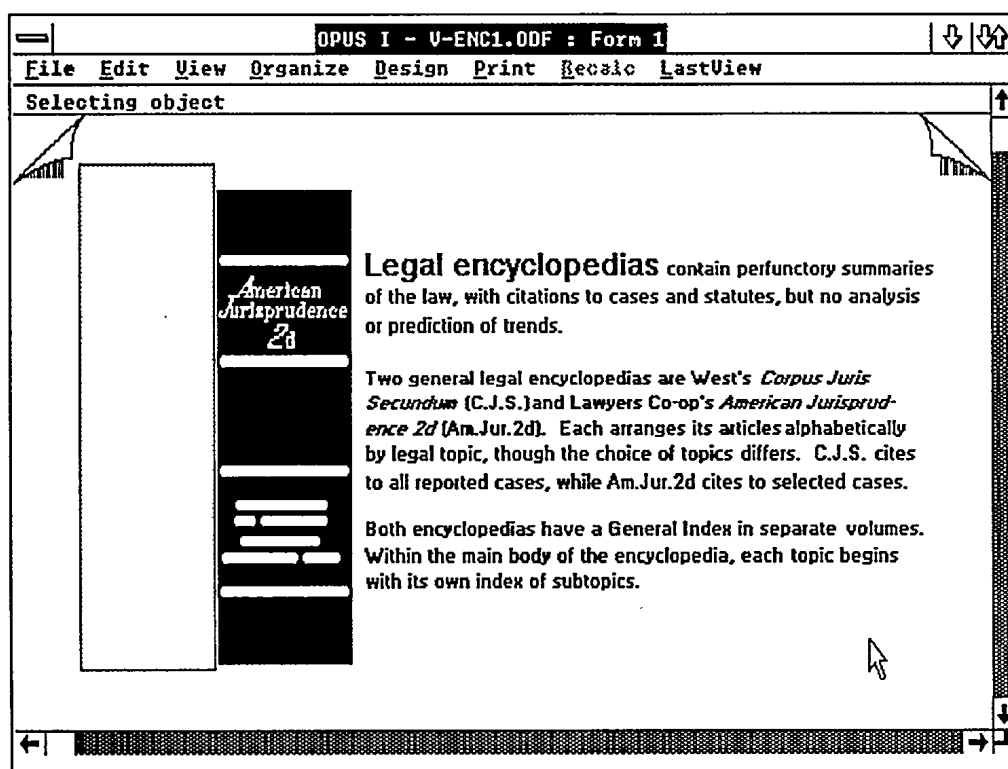


Figure 2

Screen from the Paper Choice/graphics edition explaining what a "legal encyclopedia" is.

6. Opus I was available from Roykore Software (San Francisco) as a package running under



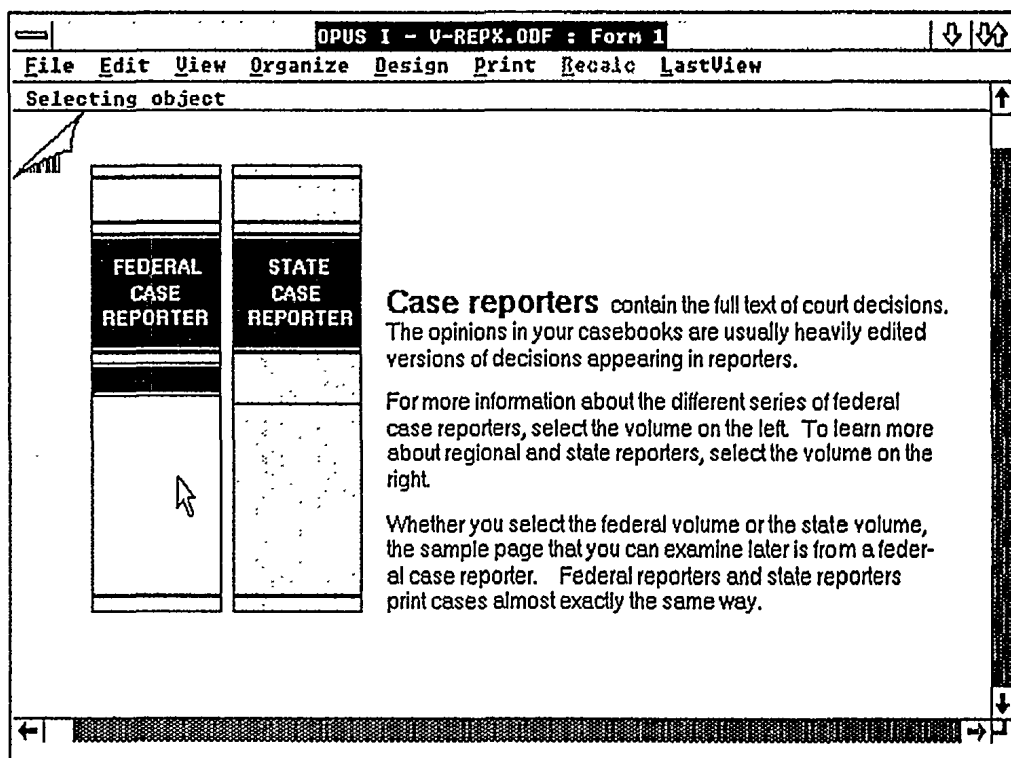


Figure 3

Screen from the Paper Choice/graphics edition explaining what a "Case Reporter" is.

are familiar with the commands and conventions of the program. It was very easy for a beginning user to press the wrong buttons or function keys and cause unexpected results. For use in law schools by students with no previous training on the Opus I package, this was a serious drawback.

Second, few law schools in the 1987-88 academic year had computers that were capable of running graphics programs. Continued development of an all-graphics system with Opus I therefore became impractical.<sup>7</sup>

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Microsoft Corporation's Windows operating environment for IBM-PC and compatible computers. The company no longer markets the package.

7. The first problem, that of a software package which lets users do the wrong thing, can now be overcome. Several newer hypertext packages are available that are designed to allow a developer to produce hypertext systems for third parties. The best-known hypertext package is probably the Macintosh product, HyperCard, distributed by the Apple Corporation. The Owl Corporation distributes another well-known package, available for both the Macintosh and IBM compatibles, called



### A. *An Expert System*

Despite its impracticality, the graphics version of the Paper Choice led to much thought about how to present a computer screen of choices to users so that they could indicate what they wanted to learn about.

Pointing at a book on a screen and getting an explanation of it was an approach similar to existing textbooks on legal research, with the addition of computerization. Although students may pay more attention to an eye-catching graphic display than to a book, this advantage presumably will wane over time as computerized graphics become more and more routine.<sup>8</sup>

As an instructional technique, browsing through research aids one book at a time suffers from too much of a bibliographic orientation. Research is a skill based on knowledge. Students have the most trouble when they first try out their skills—when they apply the knowledge they gain from classroom lectures, textbook reading, or from a system like the Paper Choice to solve a research problem.

Students need more than information about digests or encyclopedias or other aids; they need help in deciding which research aid they should use for which research problem. Most students start their research projects with information about a lot of new materials—digests, Shepard's, encyclopedias, the *Blue Book*, etc.—swirling around in a sea of mental confusion. Even with the best of instruction, many students will start their research by going to that part of the library where they remember being given a tour, and by selecting a volume whose color they remember from seeing a librarian hold up a volume in front of class.<sup>9</sup>

It was this realization that brought home the need for a system to give advice, not just knowledge. Thinking about giving advice on research aids to students led to thinking about the process of selecting the proper research aid for a given research task. That in turn led to the formulation of a simple, but very helpful, model of research.

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#### Guide.

Other systems for IBM-compatible computers include Hyperties, which originated from research conducted at the University of Maryland and is distributed by the Cognetics Corporation of Princeton Junction, New Jersey, and KnowledgePro, distributed by Knowledge Garden of Nassau, New York. A recently released Macintosh product is Intermedia, from the Institute for Research in Information and Scholarship at Brown University, Providence, Rhode Island.

The second problem, that of law schools lacking the computer "horsepower" to handle sophisticated graphics applications, is not so easily overcome, except with time.

8. I think that computer graphics have been oversold in any event: books offer graphics at far higher resolution and are more portable. Only if a computerized application can do something that a book cannot do as well is it worth undertaking.

9. Lawyers who remember their own legal research classes will know how little this statement exaggerates.



### B. Legal Research as Input, Process, Output

This model of research characterizes research as a system with three parts: an input, an output, and a means of getting from the input to the output.

The "input" is the knowledge that a user already possesses. To find out whether a specific case has been overruled, for example, the user must already know the citation for the case. The citation is the input. To find the citation for a case from its name, the user must already know the case's name. Here, the name of the case is the input.

The "output" is the information desired by the student or other library user: whether a particular case has been overruled, for example, or what the citation is for a case whose name is the only thing known.

The appropriate research aid can thus be conceptualized as the "means" or "process" that connects the input knowledge already possessed by the user to the output knowledge sought. For example, a Shepard's case citator is one means for getting from the citation of a case to the knowledge of its subsequent history. Similarly, a digest's Table of Cases is one means of getting from the name of a case to its citation.

This model of the research process suggested that the whole concept could be diagrammed as a two-dimensional table or matrix. Down the left

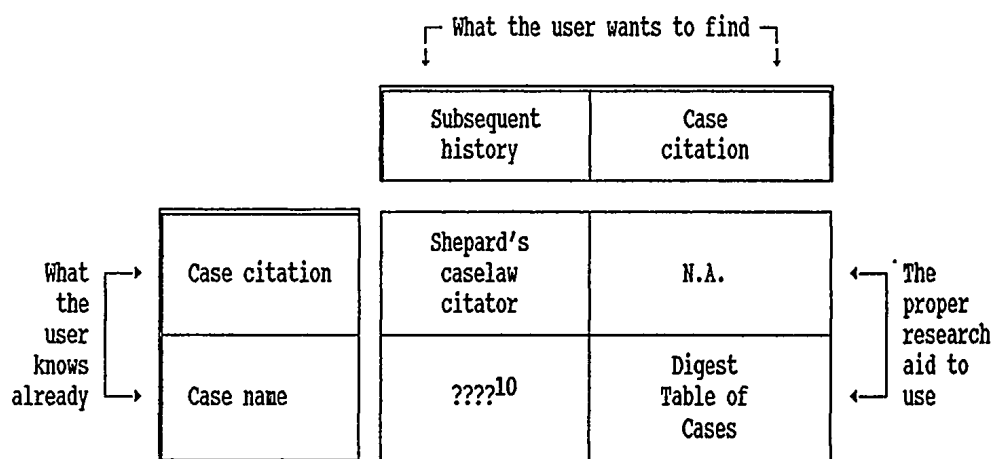


Figure 4

A simple matrix showing, in each cell, the research aid that takes the researcher "from" what is known "to" what is wanted.

10. The question marks in figure 4 mean that there is no way to get from the name of a case directly to the case's subsequent history. This problem will be addressed shortly.



side could be listed the inputs—the things that users might come into a library already knowing. Across the top could be listed the outputs—the things that users might want to find out. The intersection of these two would be a cell that contained the name of the research aid or aids that would most efficiently take the user from the input to the output knowledge. Figure 4 shows a very simple matrix in this form; alternative research aids are omitted for simplicity. The Paper Choice/graphics edition incorporated an explicit matrix like this to help give a limited amount of advice about research aids. Figure 5 shows the original screen.

As Figure 5 shows, users would identify the information they sought on the top row, and the information they already knew down the left column, and then click a mouse pointer on the “book” located at the intersection of the two. The result would be a screen of advice about which research aid would serve their purpose. Clicking on the last book in the bottom row in figure 5, for example, would bring up the screen shown in figure 6.

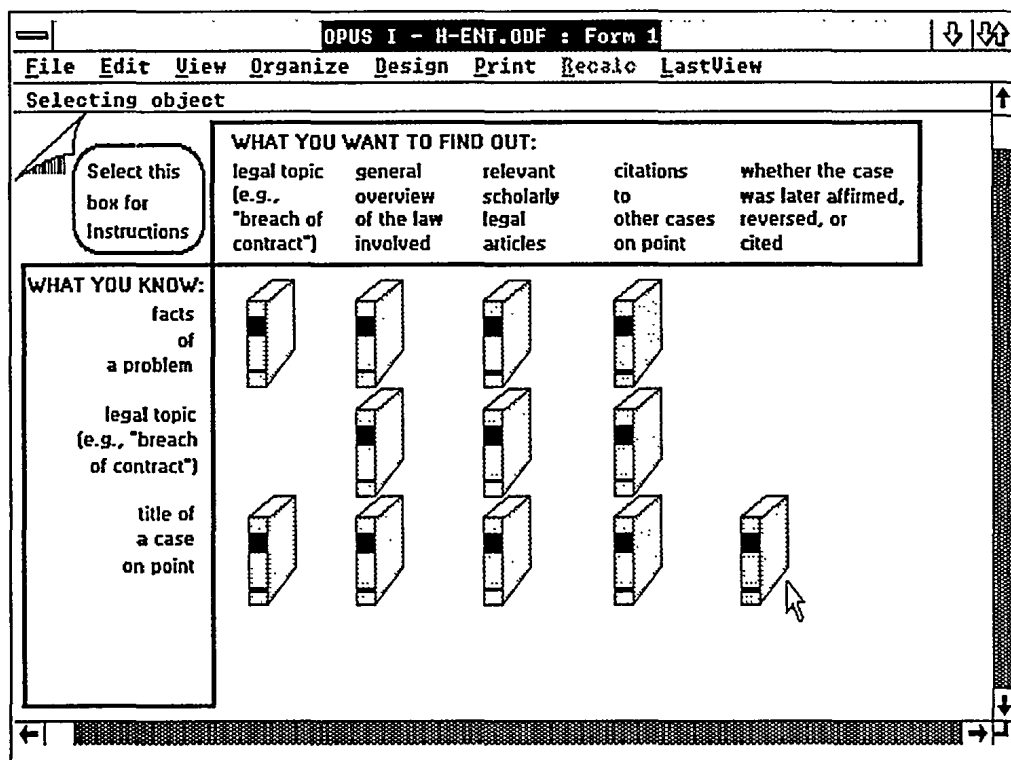


Figure 5

Screen from the Paper Choice/graphics edition showing the matrix diagram for finding a legal research aid.



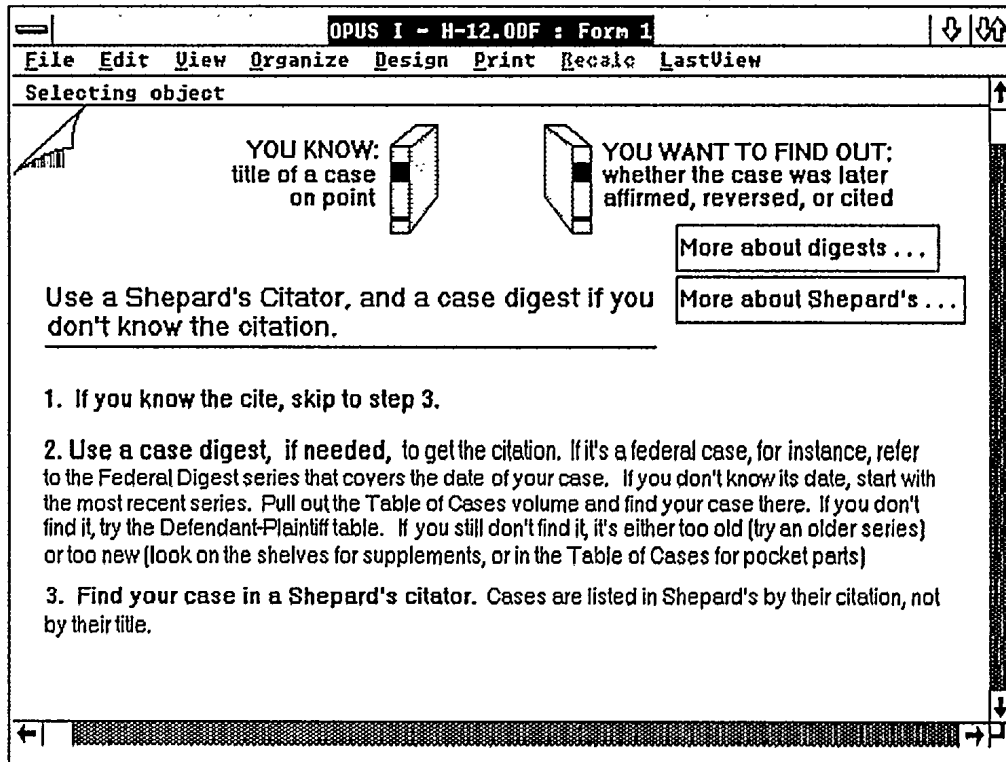


Figure 6

Screen from the Paper Choice/graphics edition showing information that follows from a selection of one of the "books" in the matrix in Figure 5.

Showing students a matrix of books seemed a promising technique, but at the same time, it was severely constrained by the available space on a computer screen. Fitting all the possibilities for users' research problems and all that they might know into a single area of about seven by nine inches was obviously not practical. There needed to be some way to "fold" the matrix onto several screens, to break it up.

Fortunately, a matrix can be transformed into a tree diagram, represented by having the input connected to the process, and the process connected to the output, as shown in figure 7.

Picking one path through the simple matrix of figure 4 and putting it in the tree form results in the diagram shown in figure 8. Figure 8 models the research process as I have indicated: the case citation is an input to a citator, which is the process, or means, for arriving at the output information sought by the user: the subsequent history of the case.



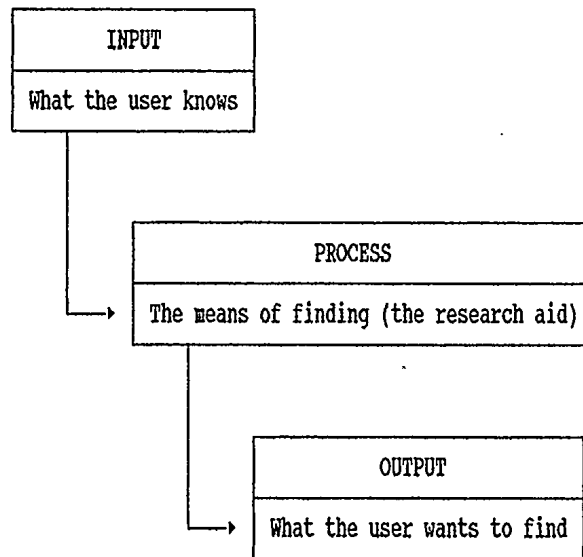


Figure 7

Diagram showing part of the matrix of legal research transformed into a tree.

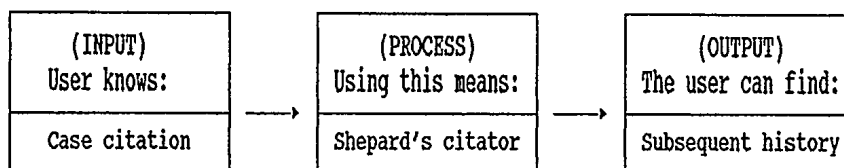


Figure 8

Diagram showing a research task modelled as an input-process-output system.

### C. *Inverting the Tree Branches*

The order of the three topics along the tree branch makes intuitive sense for understanding the research model. If the tree structure is to function as an expert software system to give advice about research aids, however, this diagram must be inverted: the process or means (i.e., the research aid) is actually the output of the advice-giving system. Users get into the system by describing both the information they are starting with and the information they want to find in the library. The output would be the name of a research aid that they could use.

This need for inversion means that the diagram of the software as an advice-giving system would begin with what the user knows, branch to what the user wanted to know, and then branch from there to the means



for getting from one to the other. The result appears in figure 9. Converting the entire matrix of legal research choices shown in figure 4 into the tree form produces the diagram shown in figure 10, which takes the form of a decision tree.

#### *D. Complications*

One problem with the matrix concept, and hence with its reformation as a tree structure, is that a matrix does not directly indicate what to do for a whole category of research questions. This is the category of questions for which there is no single research aid that will get users from what they already know to what they want to know in one step.

Suppose, for example, a user knows only the name of a case and wants to find out the subsequent history for that case. What is the proper research aid?

No single aid will do the job; it is a two-step process. First, the user must use a digest table of cases (or something similar) to look up the case name and find the citation; then the user can take the citation and use a citator to look up subsequent history. This two-step process corresponds to making two passes through the matrix and is the reason that the matrix and the tree diagram show only question marks where a second pass is required to obtain the name of the proper research aid.

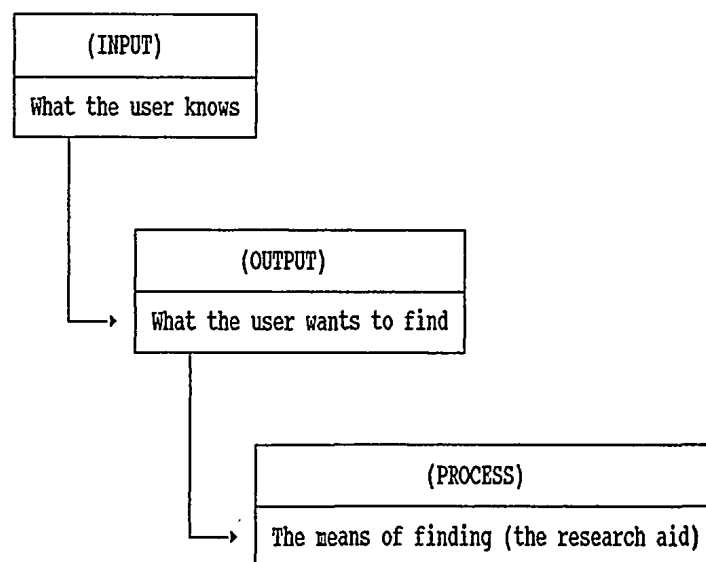


Figure 9

Diagram "inverting" the input-process-output model of research so that it can be used as an expert system.



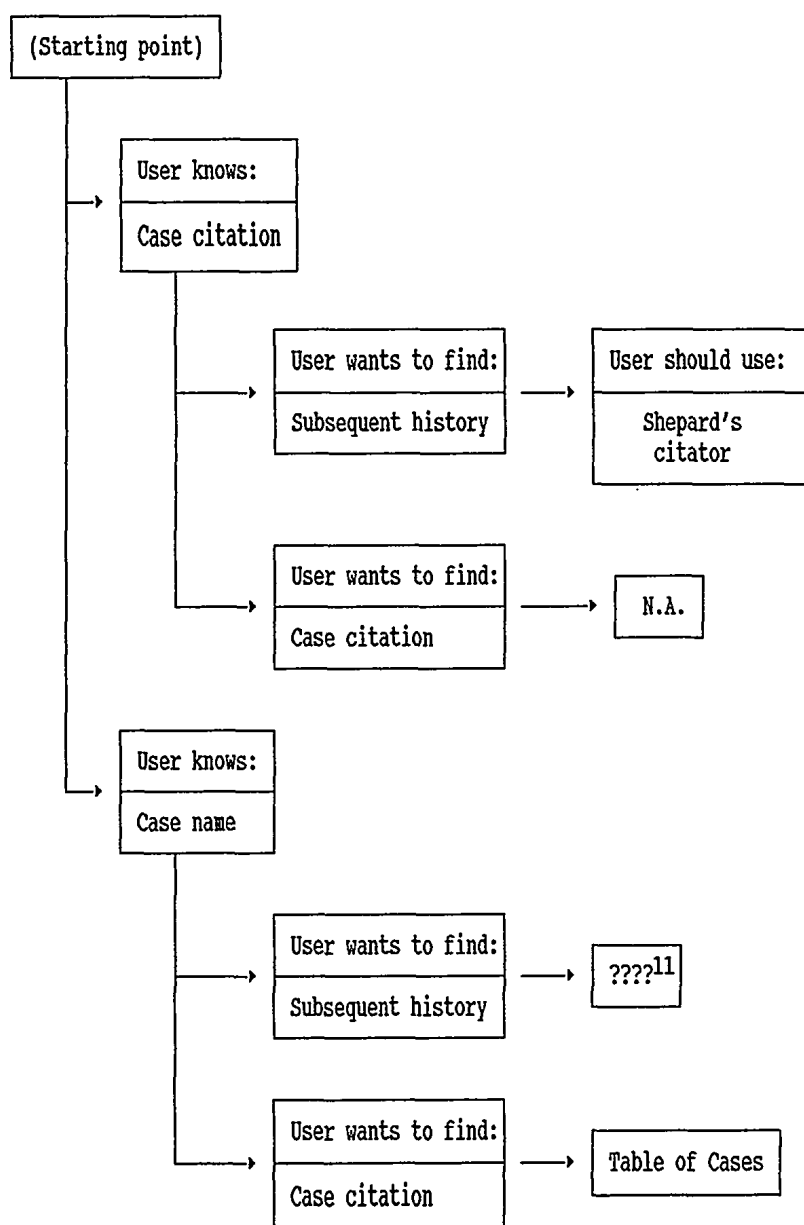


Figure 10

Diagram showing the matrix model of the research process in Figure 4 transformed into a decision tree.

Two passes through a matrix cannot be represented easily on a two-

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11. *See id.*



dimensional matrix diagram<sup>12</sup> but can be represented with the tree diagram. The tree simply acquires longer and more complicated branches. Figure 11 shows the structure for getting a user from a case name through the case citation to the case's subsequent history.

The user who knows a case name must first find the citation; this can be done, as the diagram shows, by using a table of cases. Once that information is known, it becomes the information that the user is starting with. Then the diagram shows that the user wants to get from the knowledge of a case citation to the subsequent history of the case. For that, the tree branches to the means for doing subsequent history research, a citator.

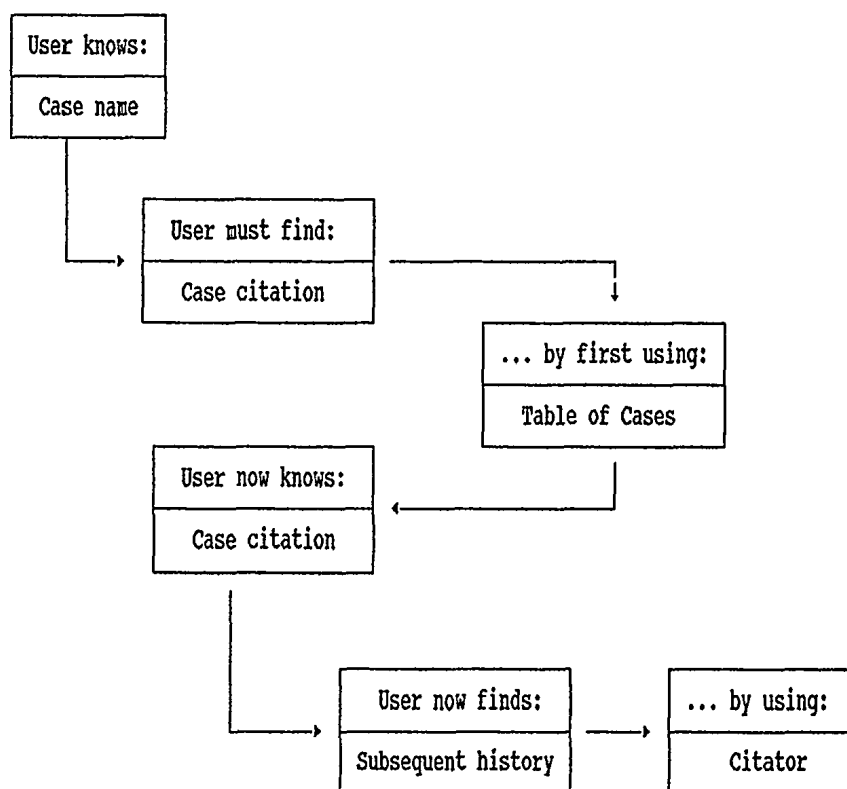


Figure 11

Diagram showing that some research problems require two research aids for a solution, requiring an extra branch in the decision tree.

12. Mathematically minded readers will recognize that matrix manipulation techniques (closure algorithms) do exist that allow matrices to be manipulated in the appropriate fashion, but these techniques do not lend themselves to an easy on-screen representation.



This tree structure emerged, then, as a useful representation for an arbitrarily complex matrix because it could be spread out across a number of screens more easily than a matrix.

#### **IV. Decision-Tree and Browsing Hypertext for Legal Research: The Paper Choice/Text Edition**

Once it was apparent that some sort of decision-tree format would best handle the input-process-output model of research, and that an all-graphics system was impractical because of hardware requirements, the problem became finding software that would allow the creation of a decision tree without requiring graphics hardware.

One package, Houdini, from MaxThink,<sup>13</sup> is designed to cope with networks of information that contain links and loops. Houdini is like a software "outliner" that allows one to enter information in outline form, with higher levels linked to the next lower level.

Houdini itself is not designed as a package to be distributed to end-users by developers, but it does have a kind of "run-time" version created for distribution by software developers; this version is called PC-Hypertext. A utility program comes with the hypertext version that translates a Houdini file of information into a binary file of the same structure that can be read and processed very quickly by PC-Hypertext but still displayed as readable text.

The only limitation to expressing a linked structure of topics in this way is the amount of text that can be displayed on-screen at one time. For that and other reasons, PC-Hypertext also allows the binary file to contain links to ASCII text files<sup>14</sup> stored externally to the binary file. This twofold display mechanism—links between short topics in a single binary file, and links from the binary file topics to external ASCII text files—turned out to dovetail with the tree-structure model of legal research. The binary structure could be used for all the decision branches of the tree; the ASCII files could then form the "leaves" of the tree that deliver lengthier descriptions and advice about research aids to the user.

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13. MaxThink, Inc., is located in Kensington, California. I have no connection with MaxThink or any other software company mentioned in this paper, though I license a version of the Paper Choice/text edition software to law schools. License fees are used to support Project CLEAR.

14. "ASCII" stands for American Standard Code for International Interchange. An ASCII file is one that contains text or other characters without any formatting information. Most word processor files, such as those created by WordPerfect and Microsoft Word, are not plain ASCII because they are full of formatting codes. They look strange when typed from the DOS prompt on the screen because of the presence of these special codes for indenting, margins, typeface, and so on. Many of the files that DOS itself must use are plain ASCII: CONFIG.SYS, AUTOEXEC.BAT, and other .BAT files are all ASCII, for example. Though they appear formatted on-screen, the Paper Choice files are plain ASCII because all formatting is done with blank spaces and lines; there are no special formatting codes.



### A. The Decision-Tree Component

These concepts will be clearer with illustrations.<sup>15</sup> Figure 12 shows the opening screen in the Paper Choice/text edition system, the software built on the model described above, for use principally by first-year law students.

This is the first screen in the binary file that contains the decision tree. Decision tree screens all appear as two windows, a smaller one on the left, a larger one on the right. Below the two windows appears a list of

**PAPER CHOICE**

For instructions on using this program,  
Press **R** , then **ENTER**

1 I need:  
\_\_\_\_\_

2 To do some research.

3 To learn about particular research aids such as ALRs, digests, Shepard's, etc.

4 To learn something about this library, such as where materials are located.  
<usr-info>

CMDS: **Current** Goto Help Marked  
Option Quit Ref-Index Version

↓,↑,→,← for menu choices; space-bar or letter for CMDS.

Figure 12

Opening screen from the Paper Choice/text edition, showing the decision tree's first set of branches in the right-hand window.

15. The tree-structure diagrams shown in figures 9 to 11 illustrate a tree that branches from "What the user knows" to "What the user wants to find," to "The means of finding." That order is convenient for explaining the model in this paper, but in the actual software, it is more logical for the user first to choose what is wanted, and then to specify what is already known. The Paper Choice/text edition therefore uses the latter order, as will be apparent from the remaining illustrations. The concept is the same in either case.



commands that need not concern us here. The windows actually represent two "generations," or levels, of the tree branching structure. On the left is the upper- or first-level topic; on the right are the lower- or second-level topics. The very first topic, or "root," of the tree is just the large letters that spell out "Paper Choice" and tell the student how to get instructions.

Whatever is in the left window branches out to the topics shown in the right-hand window; in figure 12 the right window contains the choices that students must make to characterize their research problem. As the figure shows, the first listing is just a heading that prefaces each of the remaining choices: "I need:". <sup>16</sup> The choices that follow consist of "To do some research," "To learn about particular research aids," and "To learn something about this library."

Students indicate which of the right-hand choices they want to pursue by moving a cursor with the up- and down-arrow keys. When the desired choice is highlighted, they press the right-arrow key. This causes the highlighted choice to move from the right window to the left and a third level of choices to appear on the right.

For example, in figure 12 the highlight in the right window has been moved down to indicate that the student wants "To do some research." If the student now presses the right-arrow key, that topic moves to the left and a new level of choices appears on the right, as shown in figure 13. <sup>17</sup>

These choices ask the student to classify the research problem as one of four types. These types are not by any means exhaustive, but they are designed to include most of the things that first-year law students are likely to do. The choices begin with the most important, "Finding legal

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16. Putting the choices in the first person, "I need . . .," was deliberate. Putting them in the second person, "Do you need . . ." is of course easily possible. I decided, however, that the software should seem more "invisible" or "transparent" to the user, and not appear to be directing or controlling the session. Because many of the choices are followed with a series of even more choices, the repetitions of "Do you need," "Do you need," "Do you need" would get to be oppressive. With all choices put in the first person, the user is put in a position of agreeing with statements, not responding to questions. That seemed preferable.

17. Readers may want to know what lies behind the other choices. If the branch for "need . . . To learn about particular research aids" is selected with a right-arrow press, the words "To learn about particular research aids" move to the left window and a new, third level of choices appears on the right. The set of choices is simply a list of the different aids about which the Paper Choice contains some explanatory information.

Though this screen is not illustrated in the figures, the list of choices includes A.L.R.s, citators, descriptive word indexes, digests, encyclopedias, headnotes, hornbooks, key numbers, law reviews, LEXIS and WESTLAW, Shepard's citators, treatises, and Words and Phrases.

If the last choice about "this library" is selected, the user gains access to whatever information about the library is put into the system by that library. The Paper Choice, in other words, can be customized to contain maps of materials, lists of sources, hours of operation, or whatever else individual libraries want to include.



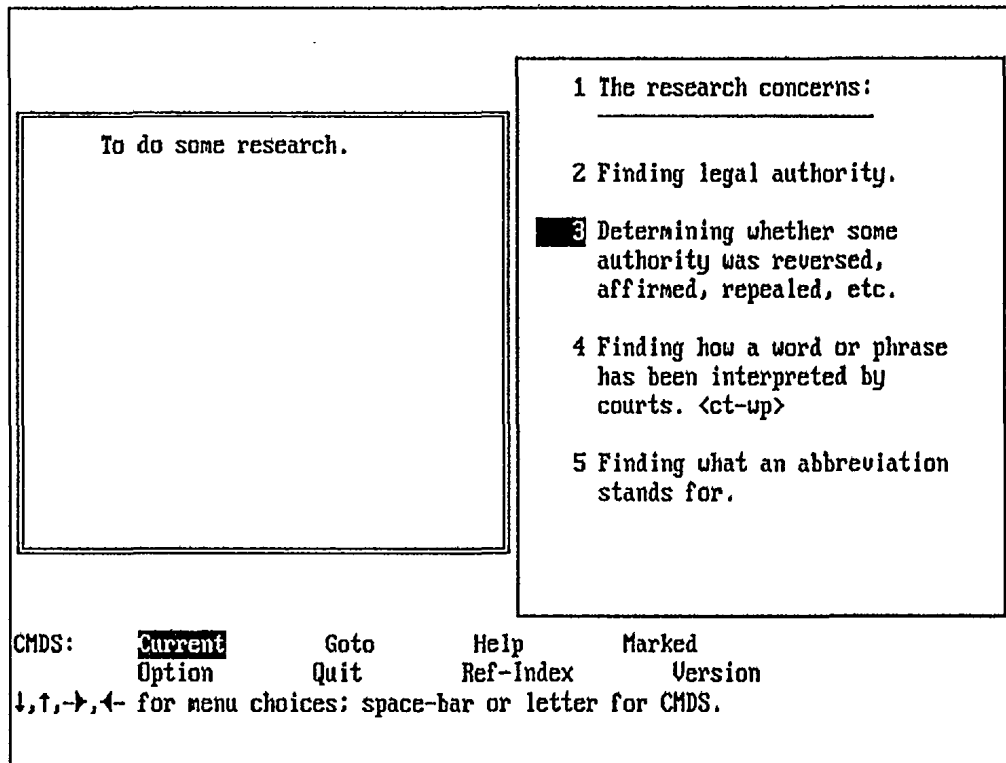


Figure 13

Screen from the Paper Choice/text edition showing a second set of decision branches after the opening screen.

authority," and proceed through other choices indicating a need to learn the subsequent history of an authority, how a word or phrase has been interpreted, and what an abbreviation stands for.

Students repeat the process of selecting choices until all branches along the path they have been pursuing are exhausted. This happens when there are no more decisions for the student to make, and the Paper Choice system then "knows" what the research problem is about. At that point, the screen displays a file of information—a "leaf"—giving advice to the student about the best research aid to use.

In this way a software system can refine a student's questions to any desired degree of precision. Notice in figure 13, for example, that the student has moved the highlight down to indicate that the research task is "Determining whether some authority was reversed . . . ." A press of the right-arrow key then brings up another level of decision tree choices, as shown in figure 14. These choices ask what kind of authority the student is



starting with: a federal case or statute, a state case or statute, an A.L.R. annotation, or something else.

If the student then moves the highlight to "a Federal Statute" and presses the right-arrow key, the end of this line of decision-tree branches is reached and the display brings up an ASCII text file that suggests the use of any of three citators, as shown in figure 15. Other decision branches are longer and require more decisions, but this short one makes a convenient illustration.

### B. The Browsing Hypertext Component

The Paper Choice is thus a simple expert system, containing a decision tree component that determines, based on the student's choices, what the student's research problem consists of, and an ASCII file display component to give narrative advice in response. The information displayed

<p>Determining whether some authority was reversed, affirmed, repealed, etc.</p>	<p>1 The authority is:</p> <hr/> <p>2 a FEDERAL CASE.      &lt;wor-fc&gt;</p> <p><b>3</b> a FEDERAL STATUTE.      &lt;wor-fs&gt;</p> <p>4 a STATE CASE.      &lt;wor-sc&gt;</p> <p>5 a STATE STATUTE.      &lt;wor-ss&gt;</p> <p>6 an ALR anotation.</p> <p>7 Something else.      &lt;wor-gen&gt;</p>
<p>CMDS:      <b>Current</b>      Goto      Help      Marked</p> <p>         Option      Quit      Ref-Index      Version</p> <p>↓,↑,-&gt;,-&lt; for menu choices; space-bar or letter for CMDS.</p>	

Figure 14

Screen from the Paper Choice/text edition showing a third set of decision branches after the opening screen.



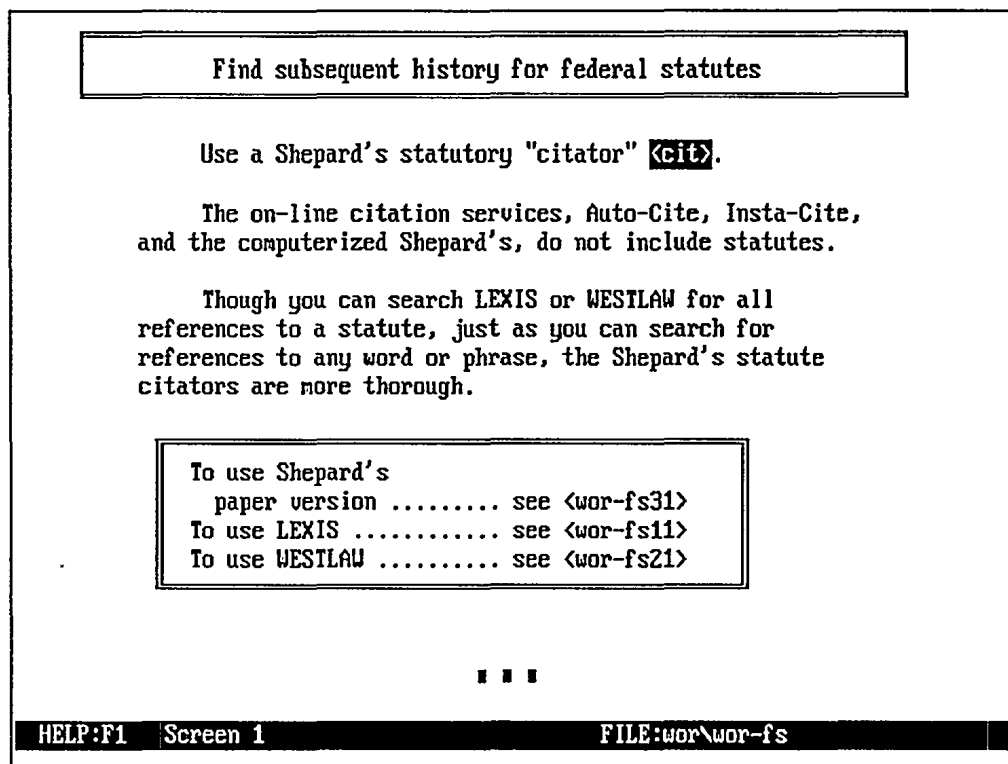


Figure 15

Screen from the Paper Choice showing a "leaf" from the decision tree: a file of advice responsive to the student's research question.

in the ASCII files also contains links to other ASCII files, so that once the student gets some advice, further browsing is possible.

This means that when students get to an ASCII file leaf at the end of a decision-tree branch, they have the option of returning to the beginning of the branch; of initiating a new sequence of question-and-answer refinements; or of browsing further among the ASCII leaves by pursuing links to other files for further or more detailed information.

In figure 15, for example, there are four additional links by which the student can learn more about citators or about how to use Shepard's, LEXIS, or WESTLAW to find subsequent history. These links in the Paper Choice are shown as file names in angle brackets, like this: <cit>. Pressing the up- or down-arrow keys causes first one, then the next, bracketed file name to be highlighted. Pressing the right-arrow key then brings up the linked topic for display as a new screen of information. Other



hypertext systems might underline, flash, or reverse-highlight the linked words or phrases.

Notice that in figure 15 the word "<cit>" appears in a reverse highlight. That means that students who do not know what a "citor" is can press the right-arrow key and receive more information. If they do so, they will see the screen shown in figure 16.

Students looking at the screen in figure 15 who know what a citator is need not bring up the screen in figure 16. They may, however, want to know more about using either LEXIS or WESTLAW or the paper version of Shepard's. Whenever their browsing process has satisfied them, repeated presses of the left-arrow key will cause each of the previously displayed ASCII files to appear in reverse order, followed by the various branches in the decision tree in the binary file, until the opening screen is reached. As with most hypertext systems, users also have the option of bypassing these

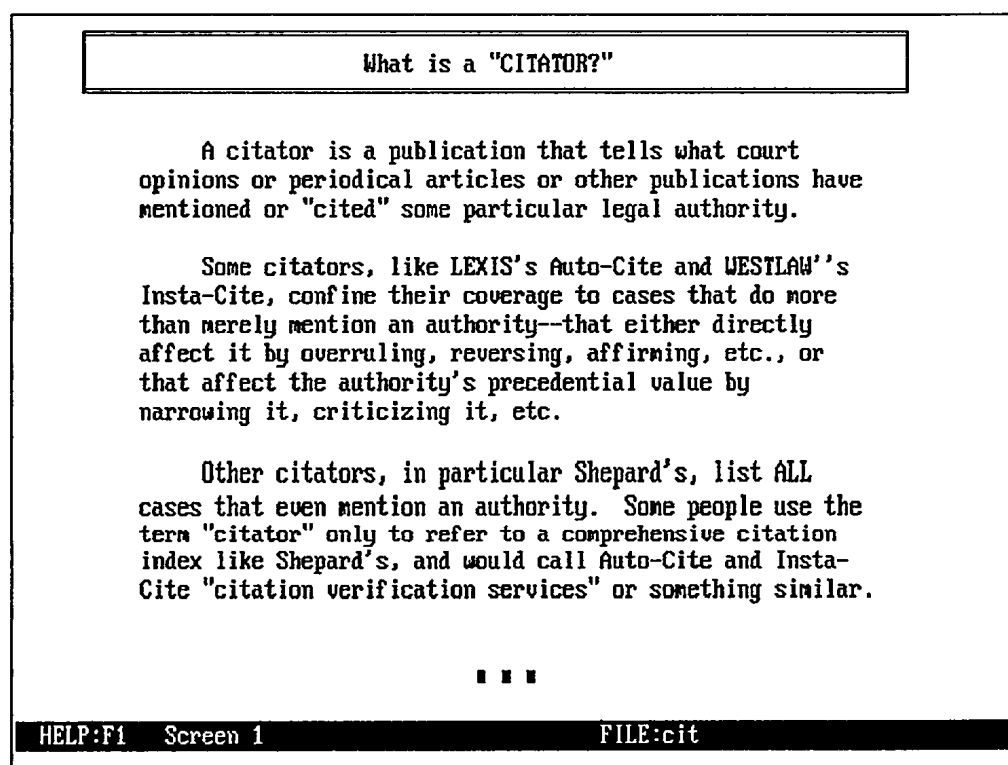


Figure 16

Screen from the Paper Choice/text edition appearing in response to the student's desire for more information about citators from Figure 15.



intermediate points by pressing a special key and jumping directly back to the opening screen.

## V. Some Lessons for Developers of Software for Legal Education

Developing a combination decision-tree and hypertext information system for law students' education has brought to light several problems and possibilities of educational software design. One problem is a general one for any educational software; the other problems and possibilities are specific to hypertext information systems.

### A. *The Need for Graphic Design*

First, an informal assessment of the responses of users to the old graphics edition and the current text edition of the Paper Choice shows that people like to look at graphics. Although users will claim that they care most about the functions of a software package and least about "good design" in appearance and interface, the motivation to buy software seems to come mostly from the looks of a program.<sup>18</sup>

If students are offered a chance to use a computer as an aid, but not as a necessary or fundamental part of their education, the software must be interesting visually or it will not be used. In fact, studies show that, given a choice, people much prefer reading paper documents to reading computer screens.<sup>19</sup> Hypertext, because it allows a measure of "interaction" with a body of text, can make that reading more appealing, but the fact of interaction alone does not guarantee that the software will be used.

This observation does not dictate that only graphics applications can be made attractive, for it is certainly possible to make screens interesting even with character-based software.<sup>20</sup> What it means, rather, is that a developer

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18. This observation has been attributed to Dan Bricklin, the developer of VisiCalc, the spreadsheet program that boosted the personal computer to prominence. Certainly the trend in software interface design is toward more pleasing graphic interfaces as evidenced in IBM's Presentation Manager software, Microsoft's Windows, the Apple Corporation's Macintosh, and Steven Jobs's NeXT computer.

19. See, e.g., Brown, *Viewing Documents on a Screen*, in CD-ROM: THE NEW PAPYRUS 175 (S. Lambert & S. Ropiequet eds. 1986). See also Brown, *Interactive Documentation*, SOFTWARE: PRACTICE AND EXPERIENCE, Mar. 1986, at 291.

20. Indeed, text-only systems have dozens of possible variations in layout and design. Research suggests that the crucial design elements for legibility are "structure, simplicity, and spaciousness." Structure refers to text that is physically arranged on the screen in a way that suggests the meaning of the text or the association of parts of the text with one another. Simplicity refers to a structure that is not complicated. Spaciousness refers to text that is uncluttered in appearance. See R. Grabinger & D. Amedeo, CRT Text Layout: Prominent Layout Variables (paper presented at the Annual Conference of the Association for Educational Communications and Technology, Research and Theory Division, Anaheim, California, Jan. 1985) (available through ERIC: IR 011 636).



of educational applications must give a great deal of thought to the design of the layout and arrangement of all the screen displays in the application. I found in creating the Paper Choice, for example, that I spent more time arranging the text of a topic on the screen than in writing the text in the first place. Those applying computers to legal education who lack interest in visual design work will find their applications used less frequently than they might be.<sup>21</sup>

### *B. Keeping Users Oriented*

Second, the technology of hypertext easily allows a developer to create a tangled mass of links and loops and cross-references and back-references so complicated that users lose track of where they are and what they are trying to find. This problem is a recognized one in the industry;<sup>22</sup> techniques exist to mitigate it, but the problem remains a substantial one.

The software underlying the Paper Choice, PC-Hypertext, uses the technique of allowing users to "mark" a screen of text and return quickly to it later. This allows fast browsing through many screens with a direct return to only those screens that were marked as being of interest. This is a helpful technique, though it does not give students a picture of where they are at any given time.

Other techniques are used by other hypertext packages. Many hypertext systems display the information at each "leaf," or topic, inside a rectangular window on the screen. When the user moves further and further along a branch of inquiry, each succeeding window overlaps, but is offset from, the previous one. The result looks like a deck of cards skewed slightly to one side. This gives the user a visual reminder of how many levels "down" into the hypertext system the user has gone. Still other packages may offer a "map" that, when displayed on demand, shows in some schematic way the path the user has taken among the various hypertext branches.<sup>23</sup>

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21. The Paper Choice/text edition has by no means solved the visual design problem, but I tried to be aware of its existence in creating the various screens. Screen layout and design is a technical specialty just like programming. Developers who lack expertise in that area should consider hiring someone who has it.

22. See Conklin, *supra* note 1, at 38. Hypertext creates: the problem of having to know (1) where you are in the network and (2) how to get to some other place that you know (or think) exists in the network. . . . Of course, one also has [this] problem in traditional linear text documents, but in a linear text, the reader has only two options: He can search for the desired text earlier in the text or later in the text. Hypertext offers more degrees of freedom, more dimensions in which one can move, and hence a greater potential for the user to become lost or disoriented.

*Id.*

23. See, e.g., Smith, *supra* note 1, at 39 (where illustrative "maps" from a graphics hypertext system are shown).



Hypertext, in short, though less structured than linear text in a book, must still adhere to some sort of logical structure, or users will not be able to cope with it. This means in practice that topics should be linked in a primarily hierarchical fashion.

### *C. Over-Reliance on Linking*

Third, hypertext can suffer from overreliance on linking as the mechanism for finding information. Users may remember that a piece of information is somewhere in a hypertext system but not be able to find it quickly because they cannot remember the precise chain of forward and backward links that led them to the information in the first place.

One aid for this problem is to allow users, if the software supports it, to perform string searches throughout the entire system. The Paper Choice cannot make use of that technique, so it incorporates a standard technique from the world of print—an index. Figure 17, for example, shows one screen out of many from the Paper Choice's indexes.

Use of a computer enables a rough index to be generated automatically. Of course, text in a book can be automatically indexed as well, but the result of automatic indexing in both instances is a list of entries that consist of words and phrases but not concepts, and perhaps an overwhelming number of entries as well.

Automatic indexing of hypertext documents does not solve the problem of needing to index concepts, but it does make the presence of a large number of index entries more tenable. That is because automatic hypertext indexing also generates the links to each file in which a term is used. The resulting links provide fast access to the text containing these terms, so that users can look up the index entries much more quickly than they can in a book.<sup>24</sup>

### *D. Dividing Information into Appropriate "Chunks"*

A fourth problem with the development of hypertext is that hypertext packages offer no tools and not even a good theory for how to divide information on a subject into the right sized "pieces" to be contained in each of the system's information topics. Nor do they offer any help in deciding which topics should contain links to which other topics.

The Paper Choice/text edition's breakdown of legal research questions and narrative discussions, for instance, is largely ad hoc. Decisions about

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24. I do not want to overstate the case here. Automatically generated indexes, even for hypertext, still leave a lot to be done. I had to "touch up" substantially the Paper Choice indexes to make the format pleasing and to change words and phrases into sensible topics for an index.



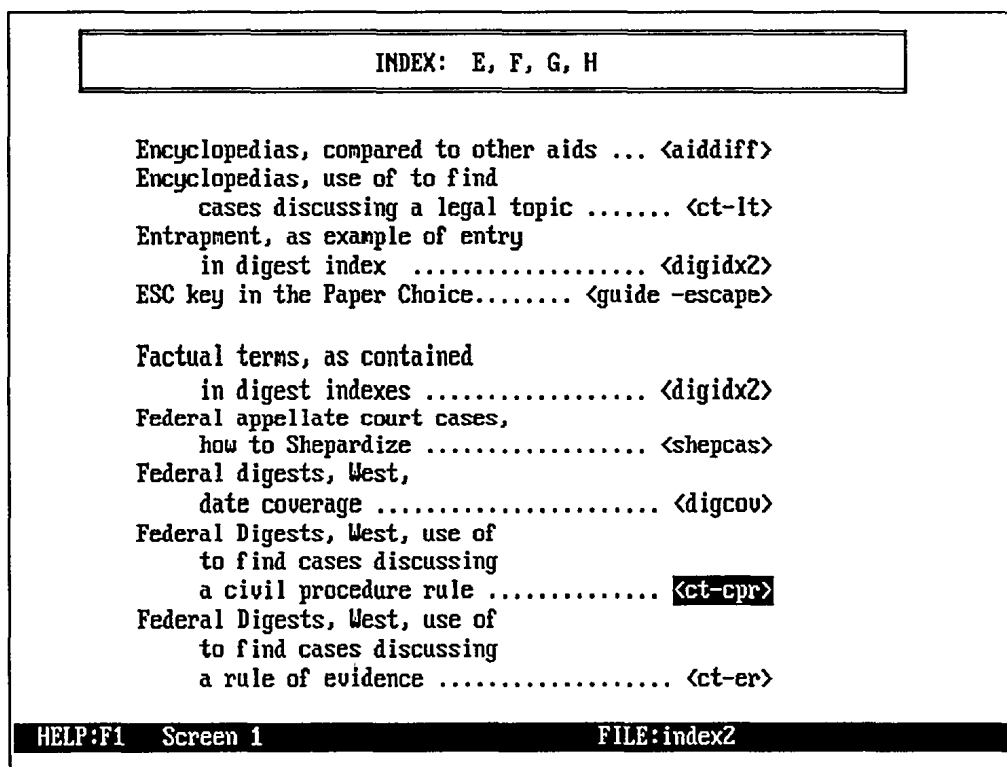


Figure 17

Screen from the general index to the Paper Choice/text edition.

the amount of text that belonged in a given topic were very much a matter of guesswork. The legal research model of a matrix of choices is a useful guide, but it does not tell what ASCII files of advice should be cross-referenced to what other files. Nor does it govern how much or how little information should be presented to users at a time. Any given file in the Paper Choice system, for example, could be broken down into two or more smaller files, or combined with other files to make a single larger file. The question is: How much should be presented to the user as a single "chunk" of information?<sup>25</sup>

25. For example, the Paper Choice generally separates information describing the purpose or definition of a research aid from information describing how the aid is used. These two concepts form separate Paper Choice topics, would be stored in separate physical files on disk, and would therefore have to be displayed as two separate screens of information by the user. Yet for some short discussions of particular research aids, the most natural thing to do seemed to be to include both a general description and how-to-do-it instructions on the same screen of information. These decisions have to be made constantly in developing hypertext systems, and with little guidance.



This problem also arises with a standard textbook: How big should each chapter be? each paragraph? each sentence? But when a reader reads through written material designed to be absorbed in a straightforward linear sequence, the size of each information chunk is not critical: readers will see the same material however it is arranged or divided up.

A browsing hypertext system, however, allows any given topic of information to be bypassed. That makes the question of exactly what information should be contained in each topic a significant one. The hypertext "author" cannot be sure, when writing any given topic, how much of the other information in the system the user will have seen already.

The advantage of hypertext systems in allowing users to travel through information in a nonlinear way is thus a two-edged sword: it allows users to bypass unneeded information, but it forces hypertext developers to think about designing the system so that the information makes sense when read in a nonlinear, nonpredictable way. That is not a trivial task, nor one for which the literature on human factors in information systems offers much help.<sup>26</sup>

The rule of thumb I use in the Paper Choice is to structure the links so that users are not offered an opportunity to browse too far afield at any one time. The fact that a term is referred to in passing in one place does not justify linking that term to every other place where the term is discussed. In figure 15, for example, links to further information appear for four topics: what a citator is, and how to use Shepard's, LEXIS, and WESTLAW for research into the subsequent history of statutes. It would be possible to add additional links for the terms "Shepard's," "statute," "LEXIS," and "WESTLAW." That much linking would invite confusion, however, so it is omitted. In general, just which links to include and which to omit are, under the present state of the hypertext art, matters of judgment.

### *E. The Need for Good Development Tools*

Hypertext development requires good hypertext management tools. Anyone developing an interconnected set of topics for browsing quickly

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26. Research on the human factors of information handling does exist, of course. The problem is that it generally offers good guidance only on the design of information systems that replicate the psychological research study done to derive the guidance. It is fairly clear, for example, that a human being can absorb into short-term memory only about seven chunks of information at a time. See Miller, *The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capability for Processing Information*, 63 *PSYCHOLOGICAL SCI.* 81 (1956), cited in B. SHNEIDERMAN, *DESIGNING THE USER INTERFACE* 724-76 (1987). But outside the studies from which that conclusion was drawn, how does one determine what a "chunk" is?



reaches a point of needing to see and manage those interconnections in some overall way. It becomes necessary, for example, to know how many topics are linked to a given topic, or by means of how many different paths a user can arrive at a particular topic. Trying to determine this information manually—by pursuing all possible links to all possible topics—is impossible in any hypertext system of more than trivial size. PC-Hypertext is better than most hypertext systems in this regard, though far from perfect; other commercial hypertext packages offer little help with link management at all.

A checking mechanism is also necessary to avoid such rudimentary errors as hypertext “widows” and “orphans.”<sup>27</sup> A hypertext widow is an information topic that has links going out from it, but the links lead nowhere and produce an error message when the user tries to traverse them. In the Paper Choice, for example, this could happen if a link is set up in one ASCII file to another file name in angle brackets like this: <filabc>, but the file called “filabc” is later deleted.

A hypertext orphan is the opposite problem: a topic is created that contains certain information, but no other topic in the system has links that lead to it, so that the information can never be seen by the user. These mechanical problems can be solved, but to date most hypertext systems force developers to keep track with paper and pencil of the links among topics.<sup>28</sup>

### *F. What's Good About Hypertext?*

On the plus side, using hypertext for the Paper Choice system provides students with quick access to a large amount of information about legal research.<sup>29</sup> The decision-tree component of the system allows jumps from

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27. These terms come from the world of print publications. A “widow” in print is a single line, the first line of a paragraph, appearing by itself at the bottom of a page. An “orphan” is a single line, the last line of a paragraph, appearing by itself at the top of a page.

28. Of the various hypertext software packages looked at before beginning the Paper Choice in its current version, only the PC-Hypertext package offered any tools at all for solving these kinds of problems, and they were not spectacular. Within the binary file that constitutes the decision-tree part of the Paper Choice, the PC-Hypertext system has very good methods for checking the presence of both widows and orphans, and for ascertaining the paths by which users could arrive at a particular branch in the tree.

Within the external, ASCII file part of the system, it has always offered acceptable tools for finding widows, but only recently (Spring 1989) has it offered any tools for finding orphans or tracing different paths to a given file. Other hypertext packages seem to concentrate almost exclusively on allowing the creation of visually attractive interfaces, which, as I have indicated, is a necessary component, but not nearly sufficient by itself for serious hypertext development work.

29. The present configuration (as of September 1989) includes about three-fourth's of a megabyte of text spread through some 200 files. This roughly corresponds to 600 double-spaced pages of text.



branch to branch almost instantaneously. Retrieval of the ASCII text file leaves at the ends of the decision branches is also quick, even with first-generation computer hardware. Students can travel down a branch of the decision tree and get to a file of information in a matter of seconds. If that information is unhelpful, they can bring up more or different information in a few additional seconds.<sup>30</sup>

A second plus for hypertext is that it allows combining an expert system (the decision-tree component) with browsing techniques. The combination provides, in one package, advice for specific problems and more extensive discussion and cross-references, if needed. Use of hypertext as a technique does not require that both functions be present, but the technique readily lends itself to both.

Third, the concept of topics containing links to other topics is a simple one, and the keystrokes required to browse among the connections can therefore be simple. Most of the hypertext packages with which I am familiar do have a fairly simple command structure that makes learning the basics of the system straightforward.

Ease of learning is especially important for a system that is designed for quick advice-giving. Few people will invest even fifteen minutes into learning a package for the few occasions when they want to know whether they should be using a digest or a citator to look up summaries of case law. Nearly all of what students will want to do in the Paper Choice, for example, they can do with the four cursor-movement keys.

#### IV. Conclusion

Three things have converged in the Paper Choice system: the problem of teaching legal research to law students, a matrix model of the process of research, and the technical developments of computerized decision trees and hypertext.

Using the hypertext technique to build decision trees is a satisfactory means of providing advice to students (or anyone). Simple decision trees can be quickly assembled with the Houdini and PC-Hypertext packages.<sup>31</sup>

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30. Speed is not, however, a function of the hypertext technique in general. It happens that the hypertext engine used in the Paper Choice is simple and fast; other packages may trade off speed for more functions. A hypertext system relying on graphics, such as the Paper Choice/graphics edition, for example, will necessarily have slower performance than an all-text system such as the Paper Choice/text edition.

31. If you know ahead of time a little bit about what the right questions are, you can create a hypertext decision tree of thirty to forty topics with the Houdini package in a day or two. I have recently discovered that using another product from the MaxThink company, MaxThink (same name as the company), makes the creation of decision trees faster than Houdini. MaxThink is an outliner program, and its files can be converted to hypertext networks with a utility program supplied by MaxThink.



The hypertext browsing technique is also helpful, notwithstanding that assembling a more than trivial system is an exacting task. Developers of browsing systems should be prepared to do a lot of hard thinking about the structure of links and the breakdown of topics. The reward is convenient and rapid access to large amounts of information.

Future gains in developing educational software with the browsing hypertext technique will come from better software development tools that make the creation of hypertext faster and more reliable, and from better theories about encapsulating and interconnecting information in the most appropriate ways. Eventually we should see progress on both fronts. In the meantime, useful hypertext systems such as the Paper Choice can be developed for legal education with today's tools.<sup>32</sup>

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32. Project CLEAR will continue to expand on the Paper Choice to add information about a greater variety of research aids. The project's research focus will broaden in the future to a greater use of artificial intelligence technology: software that can absorb a large body of rules and principles and make deductions from them. The next phase of the project will investigate whether an artificial intelligence programming language like Prolog or an expert system shell can automate some of the process of creating a decision tree for more complex advice-giving about research tasks.