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HYPERMEDIA: OUR ENTRY INTO THE INTERTWINGLING ZONE

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DAITC/TR-89/8 ✓

Allan D. Kuhn

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY UNCLASSIFIED			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release, distribution unlimited		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) DAITC/TR-89/8			5. MONITORING ORGANIZATION REPORT NUMBER(S) DTIC/TR-89/19		
6a. NAME OF PERFORMING ORGANIZATION Defense Applied Information Technology Center		6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Defense Technical Information Center		
6c. ADDRESS (City, State, and ZIP Code) 1800 N. Beauregard Street Alexandria, VA 22311-1784			7b. ADDRESS (City, State, and ZIP Code) Cameron Station Alexandria, VA 22304-6145		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
			WORK UNIT ACCESSION NO.		
11. TITLE (Include Security Classification) Hypermedia: Our Entry into the Intertwining Zone					
12. PERSONAL AUTHOR(S) Allan D. Kuhn					
13a. TYPE OF REPORT		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) 8907	
				15. PAGE COUNT 17	
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
5	2		hypermedia, bitmap systems, artificial intelligence,		
12	5		networking, media, DoD Gateway Information System, DGIS,		
			Scientific and Technical Information Network, STINET		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
Hypermedia is the merging and well-designed interaction ("intertwining" - Ted Nelson, Computer Lib, 1974, 1987) of technologies and media information sources through bitmap systems, networking, artificial intelligence, and electronic media. The bitmap system, with its graphics, multiwindowing, and multitasking capabilities, is the primary vehicle for entry into hypermedia. Networking, from peripheral drives, through internal local area networks, to external wide area networks and communication networks, provides access to the plethora of local and world-wide electronic information sources. Artificial intelligence serves as the interface engine between the user and the information source to overcome the complexities and diversities of networking, accessing and retrieving. Media is comprised of the multiplicity of diverse sources of information, ranging from online, through optical disc, to varying sources such as floppy disks, electronic mail, wire news, digitized voice, etc. (continued on reverse)					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Allan D. Kuhn			22b. TELEPHONE (Include Area Code) (703) 998-4600		22c. OFFICE SYMBOL DAITC Hyp Lab

19. Abstract (continued)

Hypermedia, in treating information in a nonlinear manner, is creating a dramatic change in the handling and processing of information. The Defense Technical Information Center, through its Hypermedia Laboratory, has stepped across the threshold of hypermedia by beginning the integration of these technologies. In the integration process, hypermedia processes and programs will be developed and implemented to act as power tool adjuncts to the current DoD Gateway Information System (DGIS) and the eventual Scientific and Technical Information Network (STINET). Those hypermedia programs will be networked as shared resources for bitmap system users in the information community of the Department of Defense.

There are a number of coalescing agents needed to create a hypermedia supported network system. One such agent is interoperability of systems, another is identification of user needs. Another agent is the capability to collect and handle information, from all sources, in a contextual manner. Context handling of information is the reason for implementing hypermedia systems.

HYPERMEDIA: OUR ENTRY INTO THE INTERTWINGLING ZONE

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NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
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A-1	

DAITC Hypermedia Laboratory Report Number 5

The Hypermedia Laboratory

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Alexandria, VA 22304



HYPERMEDIA: OUR ENTRY INTO THE INTERWINGLING ZONE

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Hypermedia Laboratory
Defense Applied Information Technology Center (DAITC)

Keywords:

Hypermedia, Bitmap systems, Artificial intelligence, Networking, Media, DoD Gateway Information System, DGIS, Scientific and Technical Information Network, STINET.

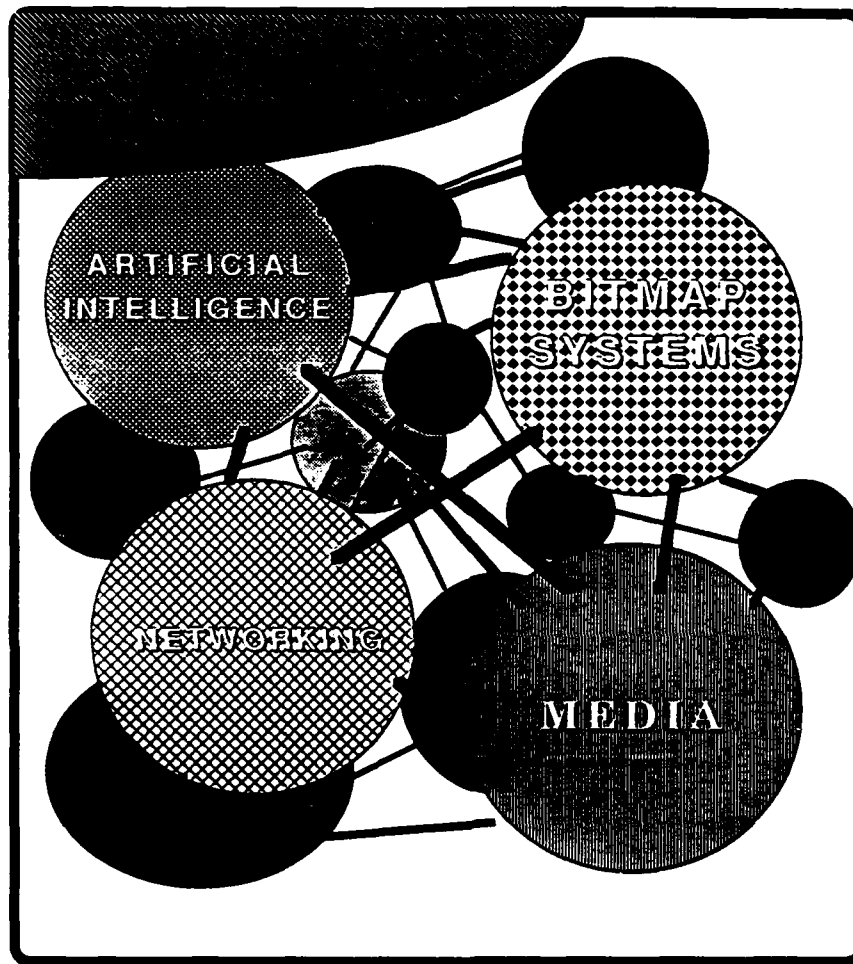
Abstract:

Hypermedia is the merging and well-designed interaction ("intertwingling" - Ted Nelson, Computer Lib, 1974, 1987) of technologies and media information sources through bitmap systems, networking, artificial intelligence, and electronic media. The bitmap system, with its graphics, multiwindowing, and multitasking capabilities, is the primary vehicle for entry into hypermedia. Networking, from peripheral drives, through internal local area networks, to external wide area networks and communication networks, provides access to the plethora of local and world-wide electronic information sources. Artificial intelligence serves as the interface engine between the user and the information source to overcome the complexities and diversities of networking, accessing and retrieving. Media is comprised of the multiplicity of diverse sources of information, ranging from online, through optical disc, to varying sources such as floppy disks, electronic mail, wire news, digitized voice, etc.

Hypermedia, in treating information in a nonlinear manner, is creating a dramatic change in the handling and processing of information. The Defense Technical Information Center, through its Hypermedia Laboratory, has stepped across the threshold of hypermedia by beginning the integration of these technologies. In the integration process, hypermedia processes and programs will be developed and implemented to act as power tool adjuncts to the current DoD Gateway Information System (DGIS) and the eventual Scientific and Technical Information Network (STINET). Those hypermedia programs will be networked as shared resources for bitmap system users in the information community of the Department of Defense.

There are a number of coalescing agents needed to create a hypermedia supported network system. One such agent is interoperability of systems, another is identification of user needs. Another agent is the capability to collect and handle information, from all sources, in a contextual manner. Context handling of information is the reason for implementing hypermedia systems.

In our view, hypermedia is the merging of technologies and media information sources through



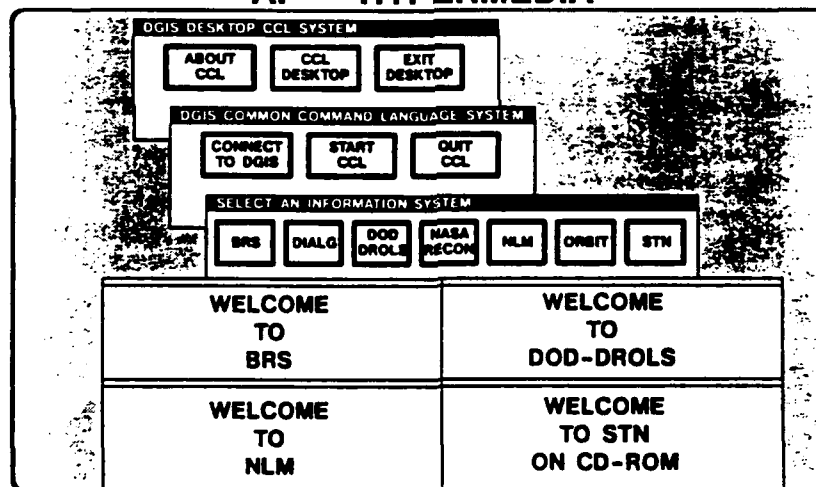
The convergence and integration of these technologies allow the user to acquire and organize comprehensive information, including stimuli information such as sound, color, and images, in a nonlinear manner that begins to approach the way the mind organizes information. Hypermedia implementation is creating a dramatic change in the electronic handling and processing of information. As an expression of these hypermedia concepts, the melange of Hypermedia Laboratory interests includes desktop environments, object-oriented environments, hypertext, voice, knowledge base and blackboard architectures, and the emerging genetic algorithm environment with its ramifications for involving connectionist modelling.

Bitmap systems are becoming popular and are proliferating throughout the Department of Defense (DoD). These systems encompass not only workstation-size systems but also desktop size units, which are the "new" personal computers. These systems, regardless of their physical size, have capabilities that now permit the integration of media, and therefore open the door to hypermedia implementations.

Imagine sitting down at your workstation or personal computer, and initiating simultaneous displays of information from an online database, a CD-ROM database, a file that you have created yourself that includes figures and graphs, and a high density video disk that is a general comprehensive reference such as an encyclopedia. Further imagine having this set of displays include color, text information, static images, motion imagery, and music or verbal information that supports the visual information. On top of all this, all interactions and interfaces have been invoked and are controlled through icons, some of which are programmed into the central DoD Gateway Information System (DGIS), some of which come with media peripherals (such as the CD-ROM on its player), and some of which you create yourself on your workstation . . .

Our entry into hypermedia began with looking at a bitmap system desktop environment for the DGIS Common Command Language System (CCLS), which is PROLOG-based. With CCLS as the vehicle, we found ourselves integrating bitmap system capabilities with a search assistant that is driven with an AI engine, which accessed remotely distributed online information systems over communications networks.

AI — HYPERMEDIA



Using a SUN 3/260 workstation, we made use of icons, windowing, simultaneous database search session displays, and color. We foresaw also a hypermedia link to CD-ROM information bases as an inclusion in this hypermedia system; of immediate application to the DoD information community is the prototype DTIC DROLS Technical Report Database on CD-ROM.

We feel that getting into the hypermedia environment and looking at the multitude of possibilities will keep us ahead of what is already coming down the road in the DoD community: bitmap systems and hypermedia peripherals in the enduser environment. What we see taking place immediately are:

- o Icon drive - creating iconic systems to invoke DGIS operations.
- o Multiple window displays - using the windowing technology of the bitmap system.
- o Simultaneous tasking - parallel and disparate tasks operating concurrently.
- o The use of color - a stimulus medium which is a part of the information message.
- o Multimedia accesses - online, CD-ROM, video disc, other storage media.

- o Intermedia accessing - simultaneous access of disparate media.
- o Simultaneous disparate window displays - text, static images, motion.
- o Sound - verbal and musical information supporting the visual information.

Our goal is to create an integrated hypermedia linkage that serves as an adjunct to DGIS, does not replace ASCII-based DGIS, but co-exists with it as one of its power tools for the users who desire the capabilities.

Hypermedia is the convergence, therefore, of information technologies which, in their interfacing, allows you to organize text, pictures, and sound by association or by context on a machine system. Hypermedia offers new possibilities for accessing large or complex information sources. The already well-developed bitmap system technology allows the user to organize information in a visual manner through simultaneous window displays. This visual representation lets the user adapt the data to what he needs in greater or lesser detail, depending on his level of knowledge, expertise, or interest. Hypermedia allows the user to organize text, pictures, and sound by association or by context in the manner humans organize information in their minds. Contextual and spatial cues supplement the user's model of which nodes he is viewing and how they are related to each other and their neighbors in that model. Hypermedia is the portal on the worlds of text, imagery, and sound. It is a technology that can surmount the barriers among the existing media and provide ways of coping with massive amounts of information.

alpha

The primary vehicle for entry into hypermedia applications and implementation is the **bitmap system** with its graphics, multiwindowing, and multitasking capabilities. The lowering cost of these systems (or workstations), resulting from the ever-evolving development in the technology, is making these systems just as affordable for the DoD technical library and enduser communities as traditional character-based microcomputer and workstation systems. The concurrent technological developments in storing and accessing information in various media, such as floppy disks, CD-ROM, video disks, in addition to online systems, are the other components that create the hypermedia system. The popularity of bitmap systems is rapidly expanding in the DoD enduser community, such as office staffs, researchers, and engineers; information in all its possible formats (text, images, sound) stored in high-density media (CD-ROM, etc.) is now widely and easily available on the open market.

beta

An adjunct entry to hypermedia activity is integration into **networking**. Networking ranges from local area internal networks to accessing wide area external networks having wide geographical communication. These networks and their communications links in turn range from village to global. Networking provides access to and retrieval from the plethora of both internal and external sources of information. With the rapid development of technologies, we are not only talking of accessing character-based systems, but also remote graphics information and programs. This will be possible with the emerging *X-Windows* development coming out of the Athena Project at the Massachusetts Institute of Technology.

gamma

Because of the complexities of networking, accessing, and retrieving from the vast multiplicity of information sources, **artificial intelligence** serves as the engine that drives the interfaces between the user and the information source. DTIC's first step into this area is the development of a Common Command Language System which is PROLOG-based. The purpose of this AI interface is to provide a universality in searching all systems, including in a manner that helps the searcher to search unfamiliar systems. The dream of developers in

incorporating AI is to create machine systems that communicate with humans on an intelligible level.

delta

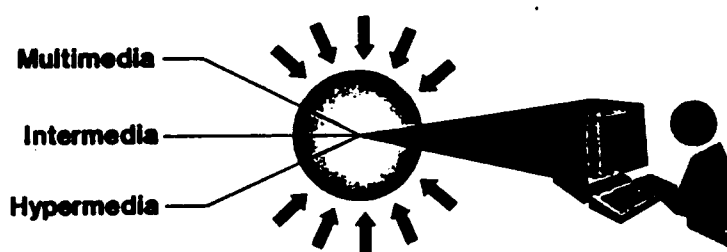
Media serves as the multiplicity of sources of diverse information. We now can access online information systems, CD-ROM information bases, and information on other types of optical disks such as WORM (Write Once, Ready Many), CD-Audio, analog video disks, CD-Interactive, and the emerging DVI (Digital Video Interactive). The controversial digital audio tape (DAT) will become a media resource. Furthermore, *any* electronic source serves as a source of information; floppy disks, electronic mail, digitized voice, video conferencing, *usw.* Media also involves the human senses, based on cognition, of hearing (speech, music, cacaphony), vision (color, still and moving images, *trompe-l'oeil*), and touch and smell are being worked on. Media is further matrixed through *multimedia*, *intermedia*, and *hypermedia*. Each is a progression to the other in terms of branching, linking, integrating. I would suggest that:

- o Multimedia -- is the body of media, whether electronic or paper, each medium treated and handled separately.

- o Intermedia -- recognizes that information is stored in a range of disparate media, that each medium should have access established to it in order to acquire a comprehensive set of information, and that no medium should be excluded from accessing because of its type of medium. Paper media, with its text and graphics, can be scanned into graphics form.

- o Hypermedia -- encompasses the range of information in view of human cognition, and its purpose is to allow the user to arrange a set of selected information views in a contextual manner.

TECHNOLOGY CONVERGENCE



The Defense Technical Information Center (DTIC), in having sponsored and worked through the Hypermedia Laboratory and the DoD Gateway Information System, is at its initial stage in its entry into hypermedia. Because the business of DTIC is information, there is a vast opportunity for looking at hypermedia applications, assessing their relevance to the handling and processing of information in the DoD community, and developing hypermedia-based implementations for doing so. Additionally, as DTIC explores this area more intensively, we find a more critical requirement

to coordinate and interface all hypermedia development designs to aid the DoD user in the quest for information.

If DTIC is to take the lead in establishing a unified Scientific and Technical Information (STI) network for the DoD information worker, there are several coalescing agents needed to create such a network system, all having equal importance. For example, one is the assurance of interoperability. Another is the identification of user needs. Another such agent is the capability to collect and handle information, from all sources, in a contextual manner.

Context handling of Information, regardless of its source and form, is the reason for implementing hypermedia systems.

Extract References; CCL in Hypermedia:

Kuhn, Allan D., and Gladys A. Cotter. "The DoD Gateway Information System (DGIS): The Department of Defense Microcomputer User's Gateway to the World;" *Microcomputers for Information Management: An International Journal for Library and Information Services*, v5 n2, June 1988, pp.73-92. NTIS AD-A203 351.

Kuhn, Allan D. "The DoD Gateway Information System (DGIS): The Development Toward Artificial Intelligence and Hypermedia in Common Command Language." *Proceedings, ONLINE INFORMATION 88, 12th International Online Information Meeting, London, 6-8 December 1988*, pp.691-704. NTIS AD-203 674.

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Gladys A. Cotter, Defense Applied Information Technology Center, December 1988; NTIS AD-A201 902. Also published in *Proceedings, ONLINE INFORMATION 88, 12th International Online Information Meeting, London, 6-8 December 1988*, pp. 611-618.

Discusses technologies for worldwide networking and information accessing.

Hypermedia Laboratory, Defense Applied Information Center: Review for 1988.

Allan D. Kuhn, Duc T. Tran, Randy L. Bixby, and Brenda S. Edleson; Defense Applied Information Technology Center (DAITC), December 1988; NTIS AD-A209 318.

Covers the developmental and exploratory activities of the Laboratory, integrating elements from the general technologies of bitmap systems, artificial intelligence, networking, and media.

"Knowledge Gateways: The Building Blocks." *Information Processing & Management*, Volume 24, Number 4, pp. 459-468, 1988.

Donald T. Hawkins, Louise R. Levy, AT&T Bell Laboratories, and K. Leon Montgomery, School of Library and Information Sciences, University of Pittsburgh.

Discusses the technologies required in getting the user to the multiplicity of information systems; corresponds to the needs of hypermedia.

Networking and Interoperability Laboratory.

Judy F. Hunter, Defense Applied Information Technology Center, [November 1988]. In *Hypermedia Laboratory ... Review for 1988*, above.

Discusses the DAITC areas of interest in internal and external networking.

The Scientific and Technical Information Network (STINET): Foundation for Evolution.

Gladys A. Cotter, Defense Technical Information Center (DTIC), September 1987; NTIS AD-A189 750.

Discusses the uses of technology modules such as artificial intelligence, expert systems, gateways, user-friendly interfaces, etc., to overcome barriers to information sources. Outlines the STINET concept.

***EVERYTHING IS DEEPLY INTERTWINGLED.
Especially in the well-designed interactive system.***

Ted Nelson, DREAM MACHINES (p.70), the flip side of COMPUTER LIB, Tempus Books, 1974,1987.

ADDENDA

DISTRIBUTED ARTIFICIAL INTELLIGENCE

"I think I left that part of my mind in my other suit--"

Distributed Artificial Intelligence (DAI) is concerned with the cooperative solution of problems by a decentralized group of intelligent agents. In the Hypermedia Laboratory we are interested in the aspect of cooperative problem solving which mutually shares the necessary information to allow a group of agents acting as a whole to produce a solution. The agents are decentralized in that both control and data are logically and often geographically distributed.

DAI technologies can be viewed as the next step in intelligent systems development strategy. It can be used to interconnect expert systems that have different, but possibly overlapping expertise, and therefore enable the whole system to solve problems larger than those solvable by the individual expert systems (remember 'synergy?'). Thus one can build small expert systems which will later be joined to solve complex problems.

The Hypermedia Laboratory's interest in DAI is the result of several practical considerations:

1. Modularity:

The complexity of a large expert system is a major problem in expert system development and maintenance. This problem grows with the size of its knowledge base. DAI technology is the natural approach to decompose the system into manageable subsystems for ease of developing, testing, and maintaining.

2. Speed:

Each subsystem can operate in parallel.

3. Reliability:

The larger system can still be functional even if one of its subsystems fails.

4. Knowledge Acquisition:

It is much easier to build small expert systems based on the expertise of narrow-domained experts. Through several well-developed DAI techniques, conflict and cooperation of subsystems can be managed to produce useful solutions.

With the above advantages DAI is highly promising as a framework to solve several problems in the field of information retrieval. The Hypermedia Laboratory staff are studying several applications in this domain, for example:

- The User/Librarian Interaction:

We view this problem as the interaction between two expert systems. One is a small expert system which emphasizes the aspect of user-modeling. Through elaborate knowledge acquisition and training processes this expert system is embodied with knowledge about the user's goals and preference.

The other expert system is the librarian assistant. This expert system retains the expertise of the human expert librarian, in the working of library information processes and functions.

The cooperative interaction of these two expert systems, with the inclusion of human user intervention when appropriate, is optimal for yielding essential results for the user.

- Distributed Document Processing System:

This system consists of a number of document databases located in networked computer systems. Each subsystem is a knowledge-based system located in a computer or workstation. The subsystems share both knowledge and tasks to cooperate in retrieving documents for users. They also learn to customize information retrieval for each user based on document distribution, as well as user's preferences and interests.

DAI coupled with the network-transparent window system of X-WINDOWS* can be the building blocks for truly cooperative intelligent systems. * See Hypermedia Lab. Technical Note 9, Dec 88.

The prime goal of the Hypermedia Laboratory is to create programs that make the human-machine interface more human in the machine's responses.

DEFENSE TECHNICAL INFORMATION CENTER SPECIAL PROJECTS OFFICE, ALEXANDRIA, VIRGINIA

CASE-BASED REASONING

"... put d over f but not before placing a on b then attach to c ..."

Case-based reasoning (CBR) is the form of reasoning that draws from experiences in the past and applies them toward a current situation or problem.

Case-based reasoning is popular in law and business school teaching. Both of these disciplines use heavily historical cases to their study. The law depends upon judges reasoning from prior cases, and lawyers try to find prior cases that will serve as precedents in favor of their clients. The reason for this is that the law cannot account for every single possibility that might ever occur in the future of mankind. In order to practice law effectively, case-based reasoning means knowing the cases or at least where to find cases when one needs them. For law, knowledge means knowledge of cases.

The same is true in business. In business school students are taught the successes and failures of cases in business history. The student is led to reason from the business case to understand what principles it exhibits and what lessons can be drawn from it for application in a different industry, or with a different product, or in a different location.

When used as an artificial intelligence technique, CBR requires that the system must be designed to understand how cases are stored in memory and how cases are found and adapted when used. CBR relies on its memory of past episodes, rather than other causal models.

Its use of memories consists of three aspects:

- 1) Memories of past successes are accessed and modified to create new solutions.
- 2) Memories of past failures are used to anticipate and avoid future failures.
- 3) Memories of past repairs of prior cases are called upon to determine how to deal with an applied solution that fails.

In the Hypermedia Laboratory we plan to use case-based reasoning as one of the methods for constructing queries in the Query Builder project. Given a set of goals (the information the user seeks) that the system must satisfy, the system searches for existing cases that satisfy as many as possible. It then applies transformations (e.g., search term substitution, expanding field codes, etc.) to bring the query closer to what is required. It then performs the query on a database, discovers problems, and applies transformations to get rid of them. Finally it indexes the newly acquired case for further reference.

In other words, THE SYSTEM LEARNS.

The prime goal of the Hypermedia Laboratory is to create programs that make the human-machine interface more human in the machine's responses.

**DEFENSE TECHNICAL INFORMATION CENTER SPECIAL PROJECTS OFFICE
ALEXANDRIA, VIRGINIA**

DEFENSE APPLIED INFORMATION TECHNOLOGY CENTER

HYPERMEDIA

DAITC

LABORATORY

VISION

RESPOND TO THE SURGE IN HYPERMEDIA TECHNOLOGY

IDENTIFY TECHNOLOGIES THAT INTEGRATE INTO THE HYPERMEDIA CONCEPT

MAINTAIN AN EMERGING TECHNOLOGIES WATCH

IDENTIFY THE HYPERMEDIA TECHNOLOGIES THAT RELATE TO DAITC ACTIVITIES

INTEGRATE THE COMPONENT DAITC TECHNOLOGIES

IN THE NEWS

"Hold the presses ... !!!"

DOD Lab Studies Hypermedia As Boost for Existing Products

BY JOAN M. HOSINSKI
GCN Staff

ANAHEIM, Calif. — A Defense Department laboratory has been studying how hypermedia can improve the performance of existing hardware and software.

The Defense Applied Information Technology Center in Alexandria, Va., has laboratories exploring such areas as gateway technology, text searches, CD-ROM and optical-storage media, interoperability and hypermedia, said Gladys Cotter, director of the center's Special Projects Office.

Cotter spoke at a session at the Federal Computer Conference and Defense and Government Computer Graphics Conference West.

A hypermedia system is one that links a combination of data, text, graphics, video images or voice so users can move easily and quickly between the elements.

The hypermedia laboratory was set up about a year ago to study integration technology that goes beyond hooking up hardware and software, Cotter said.

"We feel that getting to information, regardless of the form it is in, is critical," said Allan Kuhn, project director of the hypermedia laboratory in the center's Special Projects Office.

The key areas critical to hypermedia, Kuhn said, are artificial intelligence, which was the vehicle for the Defense Department to get involved with hypermedia, bit-map systems, networking and storage media.

The hypermedia laboratory only works with existing off-the-shelf technology to try

to get that technology to perform as well as possible, Cotter said.

The vision of the future is to be able to respond to the surge in hypermedia technology, identify technology that can be integrated into a hypermedia context and that relates to the center's activities, and maintain a watch on emerging technology, Kuhn said. For example, X Window is viewed as a way to "create hypermedia gateway systems by networking graphics programs, but we are not yet sure if this is really possible," he said.

Intelligent Hypermedia

Artificial intelligence eventually will serve as an interface into a hypermedia system and become merged into that system, Kuhn said.

The bit-map system will be able to take advantage of windows.

Theodore Nelson, who coined the terms "hypermedia" and "hypertext" in 1965, has spent more than 20 years working on the Xanadu project, a storage program that provides a unified address space for documents, links and other materials.

Autodesk Inc. of San Rafael, Calif., has acquired the project and will release in the first quarter of 1990 a Xanadu document-server program for single-server and local area networks, said Nelson, an Autodesk distinguished fellow.

Existing applications will not be able to be used with the Xanadu program, Nelson said. But Autodesk already works with independent developers, so front-end applications should not be a problem, he said.

GOVERNMENT
COMPUTER NEWS

JUNE 12, 1989
VOLUME 8 NUMBER 12

\$3.95

THE NATIONAL NEWSPAPER OF GOVERNMENT COMPUTING

60 • June 12, 1989 • Government Computer News

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DEFENSE TECHNICAL INFORMATION CENTER SPECIAL PROJECTS OFFICE
ALEXANDRIA, VIRGINIA

This report constitutes the last report of the Hypermedia Laboratory, DAITC/DTICSP0. The Laboratory was closed down with the closing of the DAITC/DTICSP0 effective 31 August 1989.

Publications of the Laboratory for 1989

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Hypermedia: Our Entry into the Intertwining Zone.
August 1989, Hypermedia Lab Report Number 5.

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Session: "Expert System Applications."

NATO Thesaurus Steering Group Meeting
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Defense & Government Computer Graphics Conference
Anaheim, California, 25-28 April 1989.
Session: "Hypermedia."
Chaired by DAITC; Guest Speaker: Ted Nelson, author of Computer Lib: Dream Machines.

Special Libraries Association 80th Annual Conference
New York City, 10-15 June 1989.
Session: "Hypermedia - What's All The Hype About?"

**THANKS IS GIVEN TO ALL WHO HELPED THE DAITC HYPERMEDIA
LABORATORY FLOURISH AND ASSISTED IN ITS EXPLORATIONS,
ASSESSMENTS, DEVELOPMENTS, AND APPLICATIONS.**

ADK RLB DTT
