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SPECIAL ISSUE:  
*HYPERMEDIA AND ARTIFICIAL INTELLIGENCE*  
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*Guest Editor's Introduction:*

## **Hypermedia, Cognition, and Artificial Intelligence**

Alice was beginning to get very tired of sitting by her sister on the bank and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversation in it. "and what is the use of a book," thought Alice, "without pictures or conversation?"

Alice's Adventures in Wonderland. Lewis Carroll

Hari Seldon and his band of psychologists planted a colony—the Foundation—to incubate art, science, and technology, and form the nucleus of the Second Empire.

The Foundation Trilogy. Isaac Asimov

I am very grateful to the contributors to this Special Edition and their positive response to the idea of collecting together a few articles dealing with current developments in the exciting area of hypermedia with a particular focus on cognitive aspects.

The computer-based technologies are converging with the audiovisual, telecommunications, and publishing technologies. As multimedia, distance learning and telematics systems are emerging, methods of formalization of information storage and the communication of information are being developed, and these I believe are within the realms of Artificial Intelligence (AI). Psychology can play a key role in computer-based cognitive sciences and it can be considered a melting pot of the sciences and the humanities. Simple tools will have to be provided for the manipulation of information and very sophisticated human-machine interactivity will need to evolve. These processes should involve the potential users as early as possible so that the appropriate human dimensions can be engineered. These include the appropriate social and cultural aspects of human representation and communication.

By way of an introduction to these articles, I would like to deal briefly with some of the terms of reference.

"Multimedia" is a term which is used in two contexts: with reference to all the different forms of information such as text, number, pictures, and sound and, with reference to all the different means of information delivery, such as the book, television, the computer, optical discs, etc. In *"The Media Lab: Inventing the Future at MIT,"* Stewart Brand suggests that "media" means broadcast news media to most people—radio, television, newspapers, and sometimes magazines. In *"Understanding Media: the Extension of Man,"* Marshall McLuhan suggests the broadcast interpretation for media to include everything from zips to credit cards. "Media" in the Media Laboratory at the Massachusetts Institute of Technology is held to mean simply the electronic communication technologies. According to the Oxford English Dictionary,

"Hyper" (Greek) means, "over, beyond, over much, above measure"; Webster's Dictionary adds, "super (as in hyperphysical), excessively (as in hypersensitive)" and, "that is or exists in a space of more than three dimensions (as in hypercube and hyperspace)." Computer-based multimedia technologies offer the possibility for the encapsulation and storage of very large amounts of information of all forms and the provision of the tools for access which can be essentially dynamic and interactive. These technologies are the vehicle for hypermedia. Hypermedia is something which occupies the realm of ideas and imagination that has something to do with computers but is a concept rather than a completely formulated reality. Hypermedia promises a means of representation and communication about the world—instant access to a global data base.

There are a number of key areas of interest in the development of hypermedia. These include the study of a variety of human cognitive processes, social, and cultural aspects of communication, the design of the human computer interface and the identification of different means of dealing effectively with very large amounts of information. If computer-based hypermedia is to contribute to means of improving human communication it must involve the creation of meaningful links between language, numbers, images, and sound. The organization of space and time must be represented and this must be achieved at the speed of normal thought and dialogue.

Hypermedia is currently much in vogue and comes in a number and variety of guises. As it is being gathered up in the media hype, it has a tendency to appear rather informal and is in danger of antagonizing its potential audience by promising too much too soon and delivering immature results, not to mention the fact that it is also quite expensive!

Artificial Intelligence, on the other hand, is a much more serious endeavor. One of the founding fathers of AI, Marvin Minsky, has suggested that "intelligence" is a collection of mysteries whereas "artificial" just means to make machines do things like people. Alan Turing in his 1950 paper "*Computing Machinery and Intelligence*" noted that people's intelligence is judged by their conversation. He suggested that a machine may be deemed intelligent when it can pass for a human being in a blind test. AI is concerned with problems of representation, meaning, and cognition, rather than just signal processing. It has been suggested that a benchmark for AI would be the ability of the machine to tell when something is funny. While many pursue the development of machine analogs of the human sensorimotor system in robotics, and, as Minsky would put it, "the twenty most important ways that the mind works" (Brand, 1986), others in their development of computer-based multimedia technologies, are embedding aspects of human intelligence as subsystems in hypermedia information systems.

In "*Prototyping 'Intelligent' Applications for Interactive Multimedia System*," the author, Phil Lloyd, describes the application of AI techniques to the creation of a knowledge-based interactive multimedia prototype system incorporating a cookery adviser which is delivered on one of the newer technologies, CD-I (compact disc interactive). The complexity of the authoring process for interactive multimedia is

discussed as is the structuring of material from various points of view—entertainment, stimulation, and education.

The study and development of hypermedia requires multi- and cross-disciplinary approaches and skills. Its domain includes computing, telecommunications, television, film, and music. It is concerned with the communication of information in all its forms and this includes notions of education, entertainment, and collaborative working. If "idea processing" is to become the next phase in the revolution of personal computing and the development of telematics environments (in which wide area networks of workstations will provide rapid and comprehensive data exchange between people), new interfaces to these systems will have to be constructed which are aesthetically pleasing, stimulating, and which provide the appropriate tools and utilities for general information modeling and distribution. Such systems will be best developed by a combination of basic research and the development of prototypes or products which are verified by thorough evaluation as suited for real applications in the marketplace.

In the past, personal computer technology has been developed by technologists with insufficient regard for real users who are for the most part non-technologists. Most commercially available systems reflect this in their complexity and lack of a simple interface or tools and seem to have been designed without real users in mind.

Designers need to understand the user community better. What is required is a dynamic collaboration between technology and the humanities, cognitive scientists and the authors of multimedia software who understand the communications design issues and the information taxonomies of the domain. The designers of system interfaces must work closely with target users and understand their requirements and modes of working. This is true whether the interface is regarded as separate from the information and the machine or whether as, in object-oriented architectures, the interface is a more integral part of the system. Important issues include the design of information into logical taxonomies (databases and archives for access/retrieval) and knowledge structures (in the representation of meaning and the facilitation of learning). Another important issue is the organization of information into formatted surfaces (cf. design of pages in a book and the visual display surface of the computer). In "*Evaluation of Visual Display Surfaces by Real Users Early in the Design Stage*," Rodger Harris and colleagues describe experimental work using realistic mock-ups of large image terminals. They argue for the importance of eliciting needs and attitudes of real end-users from the very early design stages of—in this case—a large interactive terminal.

In hypermedia systems there is the possibility of representing and modeling a world(s) of "virtual reality." They can be configured to provide great educational experience and opportunities for the analysis of individual perceptual models and their appropriateness to the real world. Information systems in education and training applications will have to include subsystems for support of the user in the search for knowledge and in the confirmation of understanding. In "*Learning with a Computer-based Advisor*," the development of an advisory subsystem is described. The authors Farath Arshad and Gerry Kelleher include a discussion of learning and study goals and adaptation to different categories of students by the provision of alternative search

strategies for the location of learnable items. In "The Electronic Teaching Theater: Interactive Hypermedia and Mental Models of the Classroom," Kent Norman discusses the use of models of instructional interaction among students, the instructors, the course material, and the product. He suggests that hypermedia and collaborative work environments may add new possibilities for exploration and collaboration in the classroom.

Logically, hypermedia systems must confront the problems of scale and complexity—with vast amounts of information of all kinds requiring a taxonomy which will facilitate access, navigation and browsing, and retrieval—not only to items of information but to structures of information representing knowledge and meaning. There is a documented phobia, being "lost in hyperspace." In "Navigation, Browsing and Understanding in an Anatomical 'Hypermedia' Environment," Angie Hulley considers some of the background to the problem and some of the approaches to generic and domain-determined information modelling that may become included in the design of interfaces and multimedia databases. In "The Andrew System: the Role of Human Interface Guidelines in the Design of Multimedia Applications," Maria Wadlow describes the development of a system incorporating standards and guidelines for developers and the components such systems will require in order to provide access and utilities for the handling of multimedia information.

If computers are to support us in the solution of real world problems they will have to be provided with representations of the real world to process. AI in computers implies that by processing real world (multimedia) input they may adaptively negotiate with the real world and be able to conduct appropriate dialogue with human users. Theoretically, all modes of communication will have to be accommodated, including acts of gesture and even the analysis of chemicals as odor which contain information. AI machines will have to be capable of learning and recognizing the context in which transactions must occur.

The papers in the Special Edition represent something of a blend of hypermedia and artificial intelligence topics and I hope that they will stimulate new ideas in the development of interactive multimedia systems of the future.

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