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Course Notes 8

Information Visualization

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Lecturers

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Course Notes Abstract

Visual representation of information requires merging of data visualization methods, computer graphics, design, and imagination. In contrast with scientific spatial data, information spaces are abstract and different from physical data spaces and thus require different visualization approaches.

This course describes the emerging field of information visualization including visualizing retrieved information from large document collections (e.g., digital libraries), the World Wide Web, and databases. The course highlights the process of producing effective visualizations, making sense of information, taking users' needs into account, and illustrating good practical visualization procedures in specific case studies.

More specifically, the course will cover the following topics:

- What is visualization including examples driving research and development
- Visualization and interaction techniques
- Perceptual basis of information visualization
- Case studies including the WWW
- Conclusions and discussion

Speaker Biographies

Stuart Card
Stuart Card is a Xerox Research Fellow and the manager of the User Interface Research group at the Xerox Palo Alto Research Center. His research interests center around the theory and design of interactive computing systems. With George Robertson and Jock Mackinlay he has been involved in the Information Visualizer, an animated, 3D interactive information workspace program. Card has been an adjunct associate professor at Stanford University, a co-author of the ACM SIGCHI Curriculum Report, and an instructor for two tutorials at the CHI Conferences ("Designing Curricula in Human-Computer Interaction" and the "Psychology of Human-Computer Interaction").

Stephen G. Eick
Stephen G. Eick is the Technical Manager of the Data Visualization Research Group at Bell Laboratories, a division of Lucent Technologies . His research focuses on extracting the information latent in large databases using novel interactive visualizations. This involves inventing the techniques, developing the software tools, and building an infrastructure to mine knowledge from corporate databases so that it can be put to competitive and commercial advantage. His research group has developed a suite of visualizations including tools for visualizing abstract networks, software source code, text corpora, log files, program slices, and relational databases. He is particularly interested in visualizing databases associated with large software projects, networks, and building high-interaction user interfaces. Eick received a B.A from Kalamazoo College (1980), M.A. from the University of Wisconsin at Madison (1981), and Ph.D. in Statistics from the University of Minnesota (1985).

Eick co-organized the first Information Visualization Symposium (October 1995) and presented tutorials on perception at SIGGRAPH '94 & '95 and a software visualization tutorial at Visualization '93 Conference.

Nahum Gershon

Nahum Gershon is a Principal Scientist at The MITRE Corp. His work is concerned with information and data visualization, network browsers, image processing, data organization, and analysis of medical, environmental, and other multidimensional data. He pursues research in the use of understanding of the perceptual system in improving the visualization process. He received his Ph.D. from the Weizmann Institute of Science and has held positions at the Massachusetts Institute of Technology, Johns Hopkins University, and the National Institutes of Health.

Gershon has extensively published in the area of visualization and has organized and chaired 7 SIGGRAPH Panels in the last 5 years. He served as a Co-Chair of Visualization '94 and '95 Conferences and co-organized the first Information Visualization Symposium (October 1995). He is a member of the Advisory Panel of the Earth Observing System Data and Information System (EOSDIS) and the US National CODATA Committee.

Course Schedule and Table of Contents

Chapter 1: Introduction to Information Visualization

Nahum Gershon

Introduction

This chapter describes what is information visualization (info vis), and how it is similar and different from scientific data visualization. Examples of information visualization driving research and development in this field are given including visualization in the World Wide Web environment. Finally, different user's tasks where info vis could help and functional levels of visualization of retrieved information are discussed.

What is Visualization
Visualization is *more* than a method of computing. It is a process of transforming information into a visual form enabling the user to *observe* the information. On the computer science side, it uses techniques of computer graphics and imaging. Besides relying on visual computing and display it involves human beings. Thus, we need to take into account human perceptual and cognitive capabilities, human variations, and task characteristics.

Visualization is *more* than pretty pictures. Successful visualizations can reduce the time it takes to get the information, make sense out of it, and enhance creative thinking.

In contrast with most data used in scientific visualization, information is usually non-spatial data or abstract. To create visualization, one needs to map the information into a physical space that will represent relationships contained in the information faithfully and efficiently. This could enable the observer to use his/her innate abilities to understand spatial relationships. Finding a good spatial representation of the information at hand is one of the most difficult tasks in visualization of abstract information.

The World Wide Web (WWW) & the Internet
Browsing and searching the WWW could be often frustrating to users. Users could feel lost, disoriented, and overwhelmed by huge lists resulting from a simple search. Visualization could make the WWW and the Internet environments more effective and easier to use. This topic is further discussed in Chapter 4.

Examples driving R&D in information visualization
Examples driving the research and development in information visualization include the visualization of
- Hierarchical information
- Relationships and networks
- Citiscapes
- Text structure
- Text contents
- Tabular information
- Long lists

Different user tasks
Information visualization is effective in assisting the user in different tasks that include
- Browsing and "navigation" (driving and steering through information space is not the same as navigation through physical space)
- Searching (the user poses a query and the system responds by listing all documents or entities satisfying the query)

- Comparing (e.g., the user would like to compare two pieces of text)
- Grouping (the user groups similar objects, e.g., aggregating all documents dealing with a particular subject in one neighborhood in a list or table)
- Analysis (the user analyzes the retrieved information and tries to formulate a conclusion)
- Creating new information (e.g., after reading a number of documents, the user creates new information based on the existing facts and on his/her understanding and intuition)

Functional levels of visualization of retrieved information
In discussing the visualization of retrieved information, it helps to consider the four functional levels listed in the slide (Stuart Card). The same technique could be applied across the functional levels.

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