ENCYCLOPEDIA ARTICLE



# Human-computer interaction

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An interdisciplinary field focused on the interactions between human users and computer systems, including the user interface and the underlying processes which produce the interactions. The contributing disciplines include computer science, cognitive science, human factors, software engineering, management science, psychology, sociology, and anthropology. Early research and development in human-computer interaction focused on issues directly related to the user interface. Some typical issues were the properties of various input and output devices, interface learnability for new users versus efficiency and extensibility for experienced users, and the appropriate combination of interaction components such as command languages, menus, and graphical user interfaces (GUI). Since the late 1990s, the field of human-computer interaction has broadened and become more attentive to the processes and context in which the users' experience with human-computer interactions takes place. The focus of research and development is now on understanding the relationships among users' goals and objectives, their personal capabilities, the social environment, and the designed artifacts with which they interact. As an applied field, human-computer interaction is also concerned with the development process used to create the interactive system and its value for the human user.

**For further study:**

Q Q&A

**Q:** *What is the difference between computer science and computer engineering?*

**Read the Answer**

D DICTIONARY

- **human-computer interaction**

## Example of interaction

The interfaces and processes that make up human-computer interaction are understood and advanced through a variety of methods reflecting the field's interdisciplinary nature. Consider, for example, a recent university graduate using a personal computer to search for a job on the Internet. At one level, this interaction can be characterized by the capabilities and processes of the human and the computer to accept input, process that input, and generate output. The computer capabilities include the hardware (input and output devices) such as the monitor, mouse, keyboard, and Internet connection. These devices reflect contributions from computer science and engineering, whereas the human capabilities, both mental and physical, are understood through cognitive science and ergonomics. See also: Computer peripheral devices

At another level, the interaction between the computer and the human consists of user interface software which governs the meanings of the inputs and outputs for the computer, as well as the corresponding rules and expectations that the user applies to generate meaningful actions. The software in this example includes an Internet browser with a graphical user interface that reflects recent advances in software engineering and multimedia design. The user's internal model of the interaction is supported by visual cues in the interface and designed in accordance with principles of human factors. See also: Human-factors engineering

At a higher level, this interaction includes the context of goals, motivations, and other people and resources that determine what the person is doing, as in this example, searching the Internet for job openings. Understanding the process at this level requires insights from social and organizational sciences.

## Advances

Recent advances in knowledge about human-computer interactions across all these levels, from technology to social context, have contributed to the ongoing evolution of the field and to the resulting products and processes available.

### Technology

Advances in computer science have significantly increased the processing power of computers while decreasing their size. These advances have provided the underlying technology for creating a wider variety of human-computer interactions. For example, streaming audio and video over the Internet, now common, would not be possible without the increased processing power and network connectivity of computers. These technological developments were influenced by the discovery of useful applications in human-computer interaction. Increasingly sophisticated software has become available to address input through natural speech and immersive environments, providing a virtual reality experience. See also: Virtual reality

### Human capability

There is a growing body of knowledge that is providing a good understanding of how humans learn and work with computers. Many factors need to be considered, including models of cognition, motivation, individual differences, and human diversity. Studies on memory, perception, motor skills, attention, learning and skill acquisition, and vigilance are important. Also, there are ergonomic issues that must be considered, such as sensory limits, fatigue, health, temperature, and environmental noise.

### User interface

The user interface includes the input and output devices—such as the monitor, keyboard, and mouse—and the methods by which the users interact with them to carry out tasks. For example, the graphical user interface on most personal computers currently uses a windowing screen designed so that the user can have more than one software application active at any given time. The interface design must provide ways to share both technological and human resources, such as by allocating space on the monitor screen between the active applications and those not in use. These user interface issues are often addressed by interdisciplinary teams. For example, the concept of a windowed environment for multiple applications was investigated by an interdisciplinary team lead by Alan Kay at the Xerox Palo Alto Research Center and popularized in the Macintosh and Windows operating systems. Such empirical studies collect data on how people make use of these facilities, and guide the design of the next generation of the interface to better fit human capabilities and expectations, which are constantly evolving as computer use becomes more ubiquitous. Of particular importance in recent years have been advances in applications fostering human-human collaborations, in visualizing and manipulating multidimensional problem spaces, and in supporting navigation and information retrieval in complex interactive spaces.

### Contextual design

Methods from fields such as management sciences, sociology, and anthropology have provided insights into the overall context in which interaction is taking place. For example, people often work in teams to reach goals, so that the interactions taking place between an individual team member and a computer must be considered within the larger framework of human-human communications. The issues involved would be significantly different from the situation of a user who is physically alone but who is participating in a game with fellow players on the Internet, even though the underlying technologies and the software processes might be similar.

## Development process

Developing human-computer interactions involves design on both sides of the interaction. On the technology side, the designer must have a thorough understanding of the available hardware and software components and tools. On the human side, the designer must have a good understanding of how humans learn and work with computers, including envisioning new modes of working. The designer's task is to create effective, efficient, and satisfying interactions by balancing factors such as cost, benefits, standards, and the environmental constraints in which the interaction will take place.

Modern prototyping tools allow for the use of an iterative development model where a representative portion of the interface is designed and implemented with each iteration. Feedback from testers is used to enhance the design with each iteration. The final design consists of many elements: the resulting artifacts for use by the target population, as well as supporting elements such as an analysis of needs and tasks, descriptions of the dialog rules and users' conceptual models, expected scenarios of use, and the designer's rationale and reflections from the development process.

## Evolution

With the rapid technological advances in interactive computer systems, it is inevitable that new technologies will raise new human-computer interaction issues. For example, the explosive use of multimedia over the Internet has raised issues at various levels. Computer scientists are concerned with providing the highest-quality video possible, given the current computer processing capabilities. User-interface designers are addressing new issues, such as how to index digital video. The types and varieties of human-computer interactions and human-human conversations mediated by the Internet have increased significantly as it has gained wide acceptance at work, school, and home. Understanding the context of these interactions has become more complex as computer use has become more widespread. Perhaps the major challenge facing human-computer interactions is the speed of technological change. The field of human-computer interactions must build the foundations for users to experience incremental change, even though it may not know where those changes will lead.

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## How to cite this article

Tom Carey, Kevin Harrigan, "Human-computer interaction", in AccessScience@McGraw-Hill, http://www.accessscience.com, DOI 10.1036/1097-8542.757304