

# CS4051/CS7006 Human Computer Interaction

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# Interactive Systems

- Most computer systems interact with a user or users in some way.
- This can be directly, for example sitting in front of a PC, giving input by typing, mouse operations, and viewing output from the system on a monitor.
- Interaction can also be more indirect, as in an intelligent building, which switches on the heating when you enter a room.

# HCI and Human Factors

- Human Computer Interaction (HCI) is concerned with the design, evaluation and implementation of interactive computing systems for human use, and the study of phenomena surrounding them.

# Why did this change happen?



# IBM Simon Phone



IBM, 1993  
See Buxton collection  
(MSR) for details

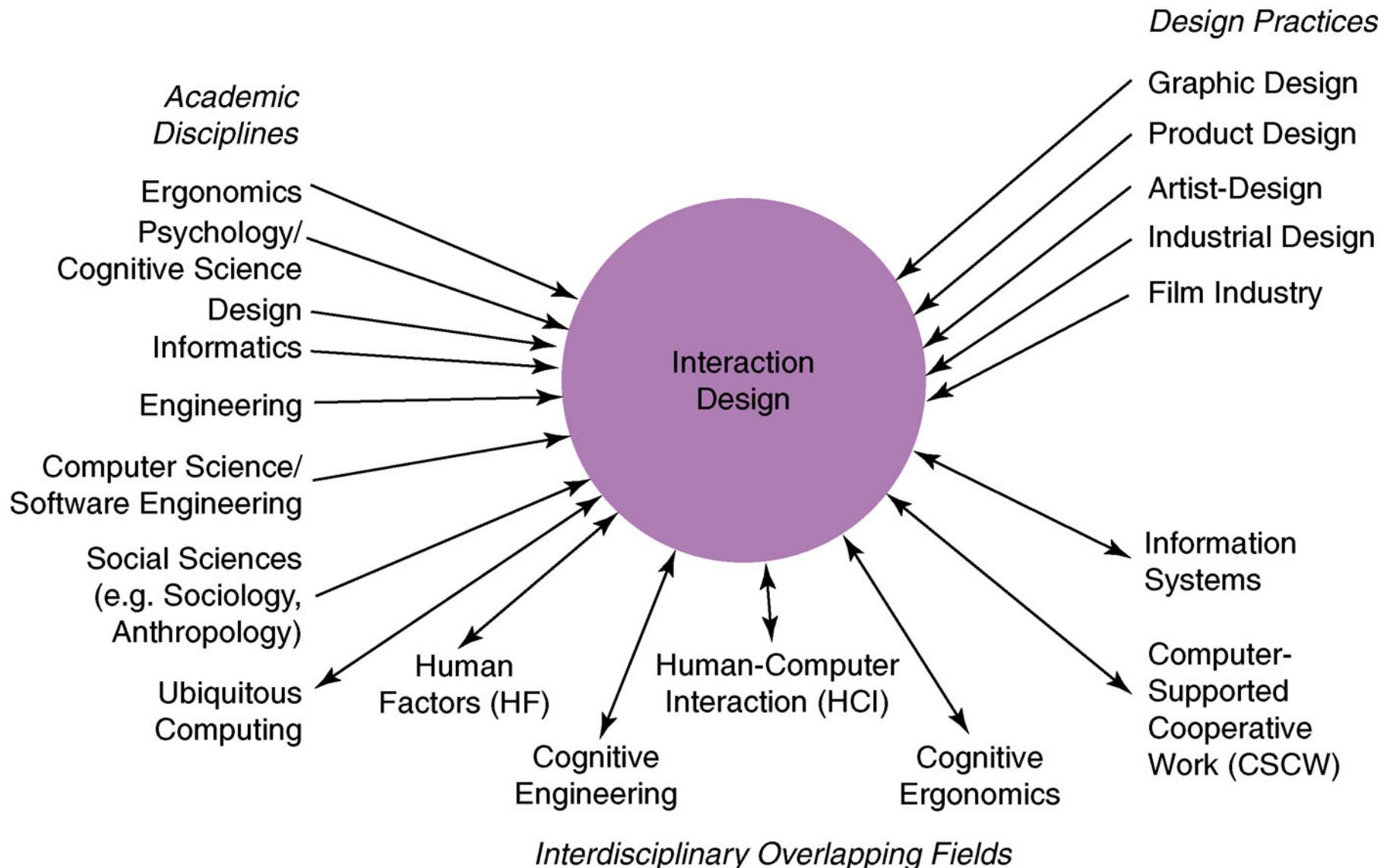
# Why study Human Computer Interaction?

- Help produce systems which are:
  - ***Useful***; accomplish what is required; play music, fly aircraft, format a document.
  - ***Usable***; do it easily and naturally, without danger of error, etc.
  - ***Used***; make people want to use it, be attractive, engaging etc.
- How do we do this?

## Interdisciplinary nature of HCI

- HCI born out of interest in man-machine interaction following second world war (desire to produce more effective weapons systems), ergonomics.
- Addition of cognitive dimension, applied to any type of system.
- Human Computer Interaction incorporates work on information science and technology.
- Draws on many areas, in computer science and systems design it is a central concern.

# Disciplines involved



# Usability

- If the user can't use it, it doesn't work. It's broken.
- Many systems are broken by design. They make "human error" highly likely, sometimes inevitable.
- If you're an engineer and you're producing systems which are poorly matched with the end users, their tasks, and their environment, you're not doing your job properly.
- To the average user the interface *is* the system.
- Interfaces must be designed with the capabilities and limitations of the user in mind.

# Interaction Design

- Need to take into account:
  - Who the users are
  - What activities are being carried out
  - Where the interaction is taking place
- Need to optimize the interactions users have with a product:
  - So that they match the users' activities and needs
- “Designing interactive products to support the way people communicate and interact in their everyday and working lives.”
  - Preece, Sharp and Rogers (2015)

# Usability goals

- Effective to use
- Efficient to use
- Safe to use
- Have good utility
- Easy to learn
- Easy to remember how to use

# User experience goals

## Desirable aspects

satisfying  
enjoyable  
engaging  
pleasurable  
exciting  
entertaining

helpful  
motivating  
challenging  
enhancing sociability  
supporting creativity  
cognitively stimulating

fun  
provocative  
surprising  
rewarding  
emotionally fulfilling

## Undesirable aspects

boring  
frustrating  
making one feel guilty  
annoying  
childish

unpleasant  
patronizing  
making one feel stupid  
cutesy  
gimmicky

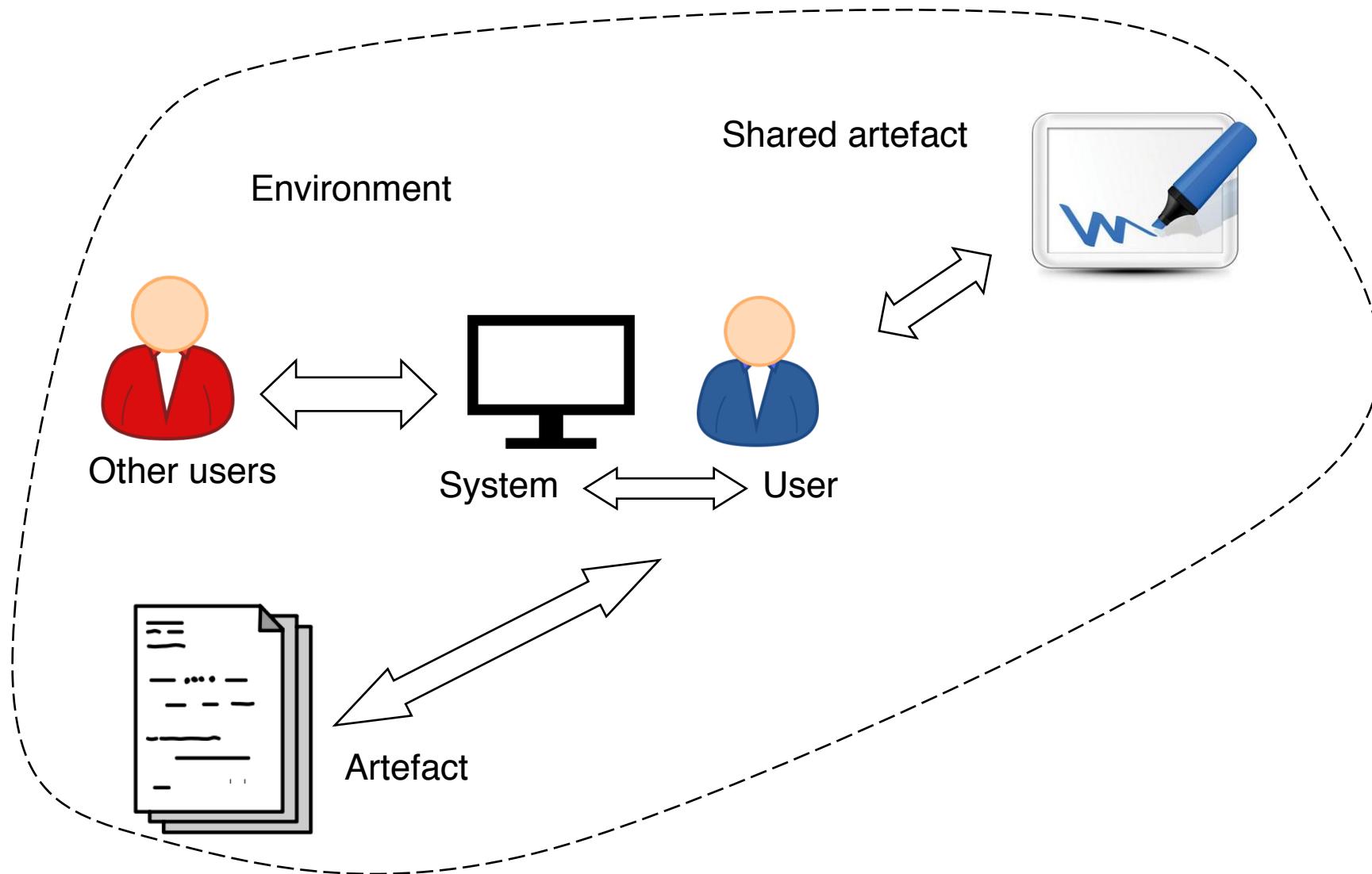
# Bad user experiences

- It's simply not possible to do what you want to do.
- You can't work out how to do what you want to do.
- Working out how to do things takes a long time.
- Doing simple things takes longer than it should do.
- You regularly make the same error.
- You make an error which causes you to lose a lot of work/melts down the reactor.
- You find it frustrating to use.
- The system does something automatically which makes you irritated/angry.
- You think the system looks ugly.

# Factors affecting design

- Human factors: “Know thy user”
  - Physical capabilities (motor skills, sight, hearing)
  - Cognitive capabilities (memory, attention span, decision making).
  - Social, cultural influences.
- Environmental factors
  - Lighting, ambient noise, operational conditions (eg. time pressure).

# Interactive Systems



# Users

- In the early days of computing, building interfaces for the devices was relatively easy:
  - Users very similar
  - Well-educated programmers
  - Similar tasks (ballistics, particle simulations).



# Users

- In the modern era:
  - Different jobs (operator, manager)
  - Different tasks (design, administration, entertainment)
  - Varying education (secondary, third level)
  - Different usages (casual, frequent).
  - Different age range
  - Different contexts



## Understanding the user's needs

- Need to take into account what people are good and bad at.
- Consider what might help people in the way they currently do things.
- Listen to what people want and get them involved.
- Use tried and tested user-based methods.

## Fitts' List

**Humans appear to surpass present-day machines with respect to the following:**

1. Ability to detect small amounts of visual or acoustic energy.
2. Ability to perceive patterns of light or sound.
3. Ability to improvise and use flexible procedures.
4. Ability to store very large amounts of information for long periods and to recall relevant facts at the appropriate time.
5. Ability to reason inductively.
6. Ability to exercise judgement.

## Fitts' List (2)

**Present-day machines appear to surpass humans with respect to the following:**

1. Ability to respond quickly to control signals, and to apply great force smoothly and precisely.
2. Ability to perform repetitive, routine tasks.
3. Ability to store information briefly and then to erase it completely.
4. Ability to reason deductively, including computational ability.
5. Ability to handle highly complex operations, i.e. to do many different things at once.

## So that was 1951...

- Simplistic and uses qualitative terms only. The capabilities of man and machine are not directly comparable; they are complementary.
- Ignores other aspects of the allocation trade-off
- Treats the operator's tasks as independent modules, which can be allocated without interaction.
- Broader organizational and cultural issues as well as psychological and financial issues are not taken into account.
- This set of decisions is referred to as “function allocation”

# Sheridan's levels of automation

Level	Description
1	The computer offers no assistance: human must take all decision and actions.
2	The computer offers a complete set of decision/action alternatives, or
3	narrowing the selection down to a few, or
4	suggests one alternative, and
5	executes that suggestion if the human approves, or
6	allows the human a restricted time to veto before automatic execution, or
7	executes automatically, then necessarily informs humans, and
8	informs the human only if asked, or
9	informs the human only if it, the computer, decides to.
10	The computer decides everything and acts autonomously, ignoring the human.

## Problems with automation

- Advantages of automation are easy to see
  - disadvantages may be less obvious.
- Increased probability of system error.
- Operators become less skilled at low-level tasks.
- Operators become bored or complacent.  
They may lose situation awareness.
- Automation can increase operator workload - must understand automation as well as system.

# Dialogue

- In the design of many systems, interaction between the user and system takes the form of a dialogue (this is referred to as the dialogue metaphor).
- Messages are passed between user and system, these messages can be:
  - control
  - data
- On the system side:
  - prompt
  - data
  - status
  - error
  - help

# Tasks and Goals

- Users are goal directed:
  - have specific problems to solve;
  - have tasks to accomplish;
  - feedback from interface must address this.
- Tasks are complex:
  - few relate solely to the computer;
  - decomposed into sub-tasks.
- For example:
  - task is to produce a letter;
  - sub-task to format address.

# Measures of Success

- What are the measurable factors:
  - Ease of learning, how much time and training is required for a new user to perform competently with the system.
  - Productivity measures, should support performance of tasks quickly and efficiently.
  - Error rates, error detection and error recovery, good feedback and awareness of situations by the user greatly aids.
  - User satisfaction - interviews and questionnaires.

# Measures of Success

- Fiscal measures
  - Increased market share.
  - Reduced number of modifications.
  - Reduced need for customer support.

## What do you think?

- Think of a system or device that you really like using. What's good about it?
- Think of a system that you really dislike using or which you find frustrating to use. What's wrong with it?
- The goal of the module is to help you build systems which deliver the first type of experience, and avoid the second.

# Reading

- (Recommended) Interaction Design, 3<sup>rd</sup>/4<sup>th</sup> edition. Y. Rogers, H. Sharp, J. Preece, 2011/2015.
- Human-Computer Interaction, 3e, A. Dix, J. Finlay, G. Abowd, R. Beale, Prentice Hall, 2004, hcibook.com/e3
- Designing Interactive Systems 3<sup>nd</sup> ed, D. Benyon, 2013, Addison-Wesley.
- Bill Buxton, Sketching User Experiences, Morgan Kaufmann 2007.