

**Introduction to Human Computer Interface**

**Sub code: SWE2002**

**TPC:3-0-3**

**Day & Time: Tuesday :12-12:50PM**

**Thursday: 8:00-8:50AM**

**Friday: 9:00-9:50AM**

**Venue: G-15, CB**

**Instructor Name:Dr.Sachi Nandan Mohanty(PhD, Post Doc)**

**CB, 215**

Academic Calendar FALL 2023-24 Semester	
Description	Period
Commencement of FALL 2023-24 Semester	25 <sup>th</sup> July 2023 (Tuesday)
Muharram	29 <sup>th</sup> July, 2023 (Saturday)
Independence Day	15 <sup>th</sup> August 2023 (Tuesday)
CAT-1	9 <sup>th</sup> - 16 <sup>th</sup> September 2023
Vinayaka Chaturthi	18 <sup>th</sup> September 2023 (Monday)
Milad-un-Nabi	28 <sup>th</sup> September 2023 (Thursday)
Mahatma Gandhi Jayanti	02 <sup>nd</sup> October 2023 (Monday)
CAT-2	14 <sup>th</sup> - 21 <sup>th</sup> October 2023
Vijaya Dasami/ Dussehra	24 <sup>th</sup> October 2023 (Tuesday)
Deepavali	12 <sup>th</sup> November 2023 (Sunday)
FAT	30 <sup>th</sup> November- 07 <sup>th</sup> December 2023
Engineering Clinics Expo*	8 <sup>th</sup> , 9 <sup>th</sup> and 11 <sup>th</sup> December 2023
End of FALL 2023-24 Semester	11 <sup>th</sup> December 2023 (Monday)
Tentative Commencement of WIN 2023-24 Semester	12 <sup>th</sup> December 2023 (Tuesday)
Winter vacation for students (Tentative)	24 <sup>th</sup> December 2023 to 2 <sup>nd</sup> January, 2024

\* Evaluation and demonstration of health discipline learning projects

## Course objective

Course Objectives		
Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Explain the capabilities of both humans and computers from the viewpoint of human information processing. Understand the basics and usability of interactive system	PO2
CO2	Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.	PO5
CO3	Apply an interactive design process and universal design principles to designing HCI systems.	PO1, PO3
CO4	Describe and use HCI design principles, standards and guidelines.	PO1, PO3
CO5	Analyse and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.	PO5, PO6, PO7
CO6	Discuss tasks and dialogs of relevant HCI systems based on task analysis and dialog design.	PO3

# Syllabus

<b>Module No. 1</b>	<b>Introduction</b>	<b>8 Hours</b>
Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession Managing Design Processes: Introduction, Design process, Models and Theories, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Empirical study to validate usability of interactive system, Usability Testing and Laboratories		
<b>Module No. 2</b>	<b>Menu Selection, Form Fill-In and Dialog Boxes</b>	<b>7 Hours</b>
<b>Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus:</b> Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays		
<b>Module No. 3</b>	<b>Command and Natural Languages and Interactive Devices</b>	<b>8 Hours</b>
<b>Command and Natural Languages:</b> Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing <b>Interaction Devices:</b> Introduction, Keyboards and Keypads, Pointing Devices, Displays- Small and large <b>Advanced Interactive Systems and Techniques:</b> Interaction through gesture posture, Mid-Air Interaction, Speech and Auditory Interfaces, BCI, AR VR & MR <b>HCI &amp; AI:</b> Overview of AI enabled interactive computing systems		
<b>Module No. 4</b>	<b>Quality of Service, Balancing Function and Fashion</b>	<b>7 Hours</b>
<b>Quality of Service:</b> Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences. <b>Balancing Function and Fashion:</b> Introduction, Error Messages, Nonanthropomorphic Design, Display Design, Web Page Design, Window Design, Color.		
<b>Module No. 5</b>	<b>User Documentation and Information taxonomy</b>	<b>7 Hours</b>
Introduction, Online Vs Paper Documentation, <u>Reading</u> from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, Ethics in creation of video tutorials. Filters and validation of search. Data Taxonomy		
<b>Module No. 6</b>	<b>User interface of Mobile App Development</b>	<b>8 Hours</b>
Challenges of mobile website- Design of mobile user interface for applications. Tools for Integrated application development for several platforms. Usage of open source API for applications.		

# Text Book

## Text Books

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, "Designing the User Interface, Strategies for Effective Human Computer Interaction", Pearson ,2017

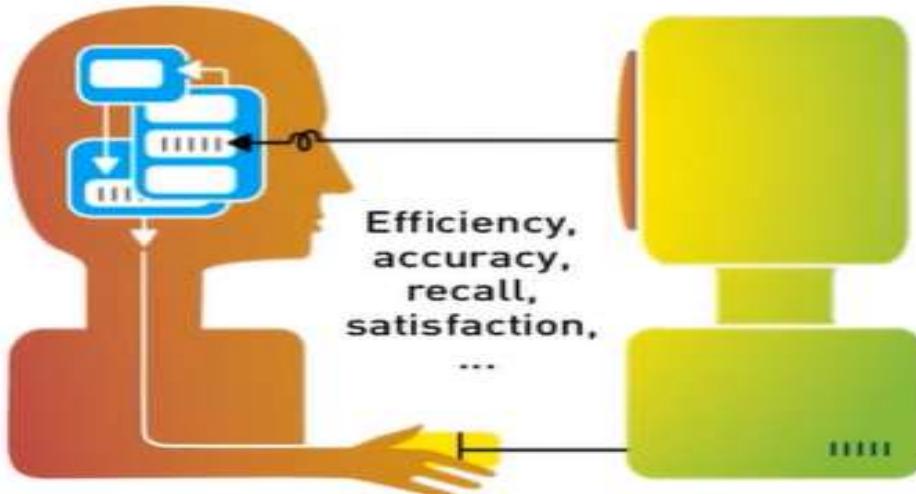
## References

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human-Computer Interaction", 3rd Edition, Pearson, 2004.
2. Wilbert O Galitz, "The Essential guide to user interface design" 2<sup>nd</sup> Edition, Wiley DreamaTech 2016.

## Mode of Evaluation

Mode of Evaluation	Continuous Assessment Test-1	20%
	Continuous Assessment Test-2	20%
	Continuous Assessment Test-3	20%
	Practical Assignment	40%

# Introduction



1. What is HCI?
2. Why HCI?
3. HCI interdisciplinary field
4. Questionnaires about HCI
5. HCI Scope
6. HCI Scope Contents
7. Introduction of Component's of HCI

- Human Computer interaction (HCI) is characterized as a dialogue or interchange between the human and the computer
- Because the output of one serves as the input for the other in an exchange of actions and intentions.
- HCI is the study of interaction between people (users) and computers.
- Human Computer Interaction is concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

# Applications of HCI



# Why HCI

- In the past, computers were expensive & used by technical people only.
- Now, computers are cheap and used by non-technical people (different backgrounds, needs, knowledge, skills)
- Computer and software manufacturers have noticed the importance of making computers “user-friendly”: easy to use, save people time, etc.

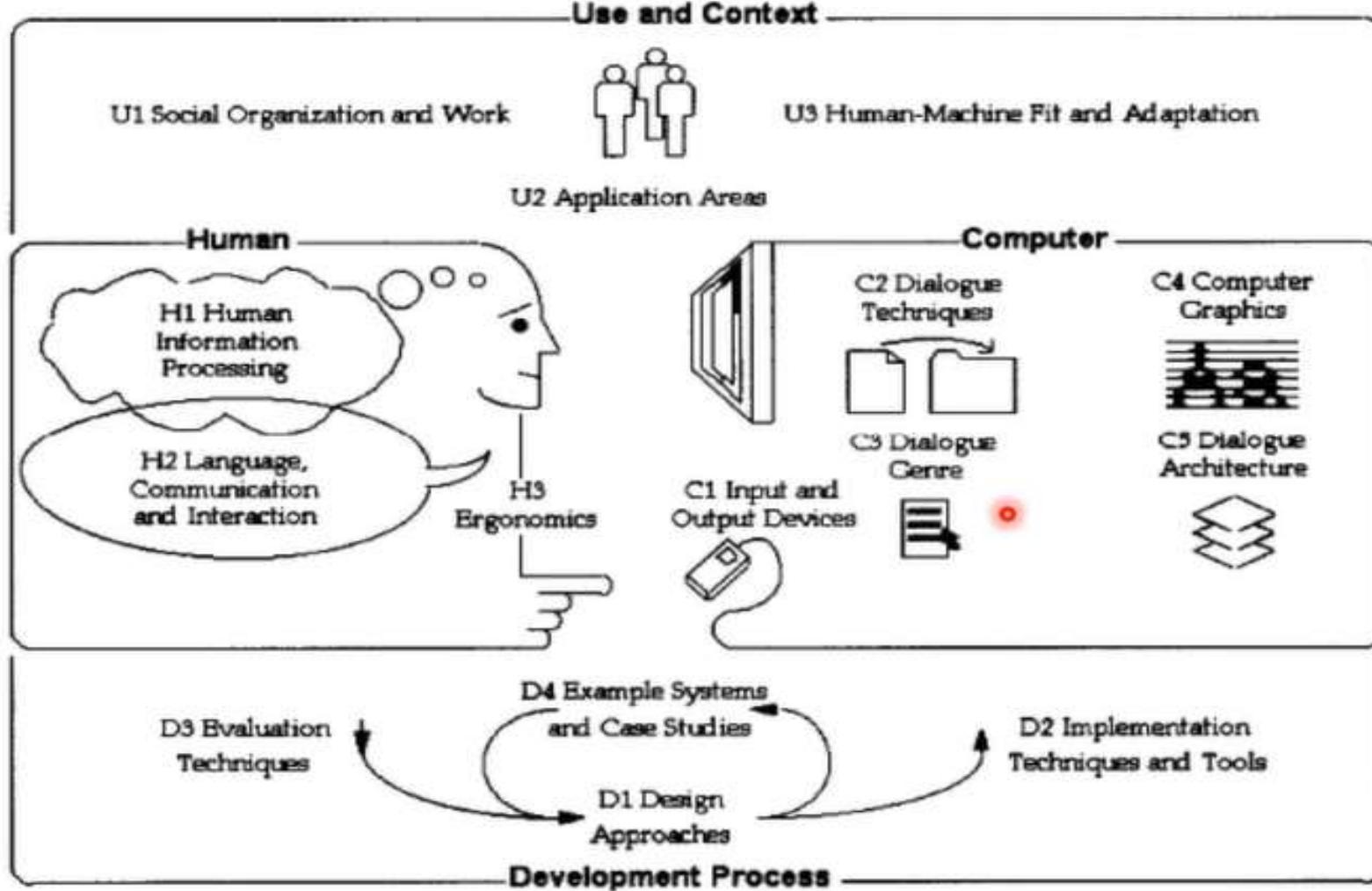
# Questionnaire's about HCI

HCI tackles questions concerning how people interact with computers

- ✓ Are computers intuitive or complicated?
- ✓ Are computers rewarding or frustrating?
- ✓ How can computers be made accessible to everybody?  
(e.g. Different physical abilities, different languages etc.)
- ✓ To what level can computer interaction be standardized?
- ✓ Are computers “user-friendly”?

# HCI Development process

## HCI Scope



## Components of HCI

The goal of HCI is to improve the interaction between users and computers by making computers more user-friendly and receptive to the user's need

## HCI Scope contents

- Human
- Computer
- Interaction

<b>Use &amp; Context:</b>	Find application areas for computers
<b>Human:</b>	Study psychological & physiological aspects e.g., study how a user learns to use a new product, study human typing speed
<b>Computer:</b>	Hardware & software offered e.g., input & output devices, speed, interaction styles, computer graphics
<b>Development:</b>	Design, implementation & evaluation

## Component's of HCI

**Human:** Individual user, a group of users working together, a sequence of users in an organization

**Computer :** Desktop computer, Large-scale computer system, Pocket PC, Embedded System(e,g Photocopier, microwave oven),Software(e.g search engine, word Processor)

**User Interface:** Parts of the computer that the user contacts with system

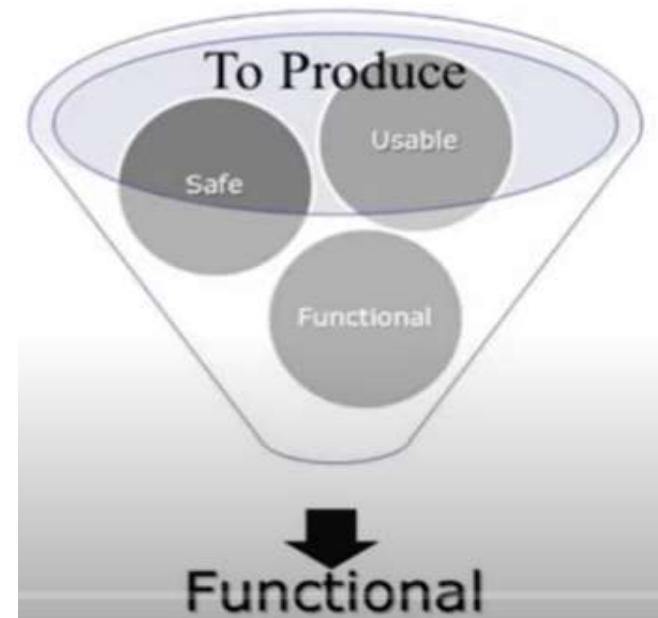
**Interaction:** Usually involve a dialog with feedback & control throughout performing a task(e.g.user invokes “print” command and then interface replies with a dialog box)

Goals  
of  
Human Computer Interaction

# Topic to be covered

- List of HCI Goals
- Description of HCI goals
- Example

- Develop or improve
- Safety
- Utility
- Effectiveness
- Efficiency
- Usability
- Appeal



- **Safety**: protecting the user from dangerous conditions and undesirable situations
  - **Users**
    - Nuclear energy plant or bomb-disposal - operators should interact with computer-based systems remotely
    - Medical equipment in intensive care unit (ICU)
  - **Data**
    - Prevent user from making **serious** errors by reducing risk of wrong keys/buttons being mistakenly activated
    - Provide user with means of recovering errors

Ensure privacy (Protect personal Information such as habits and address )

Seurity ( Protect sensitive information such as passwords, VISA card numbers)

- **Utility:** extent of providing the right kind of functionality so that users can do what they need or want to do
  - **High utility**
    - Scientific calculator provides many mathematical operations, built-in formulae, and is programmable
  - **Low utility**
    - Software drawing tool does not allow free-hand drawing but supports polygon shape drawing
- **Effectiveness:** concern a user's ability to accomplish a desired goal or to carry out work
  - Find a master thesis in our library Web

Example: play the song , select the song

- **Efficiency**: a measure of how quickly users can accomplish their goals or finish their work using the system
  - Find a book “human computer interaction” in our library Web
  - How about a master thesis whose author’s last name is “Cheng”?
  - How about the newest book in the subject of “human computer interaction”?

- **Usability**: ease of learning and ease of use
  - Can I use the basic functions of a new digital camera without reading the manual?
  - Does the software facilitate us to learn new functions easily?
- **Appeal**: how well the user likes the system
  - First impression
  - Long-term satisfaction

Bank, Airline reservation , hotel , School , etc

- Use Microsoft WORD as an example:

Goals	Achieved?	Example
Safety	Yes	Warning for "Exit before Save"
Utility	Yes	A lot of word processing functions is provided
Effectiveness	Yes	A science student can edit equations
Efficiency	Yes	Default template avoids initial document setting
Usability	Yes	Icons help ease of learning
Appeal	Yes	Interface is attractive

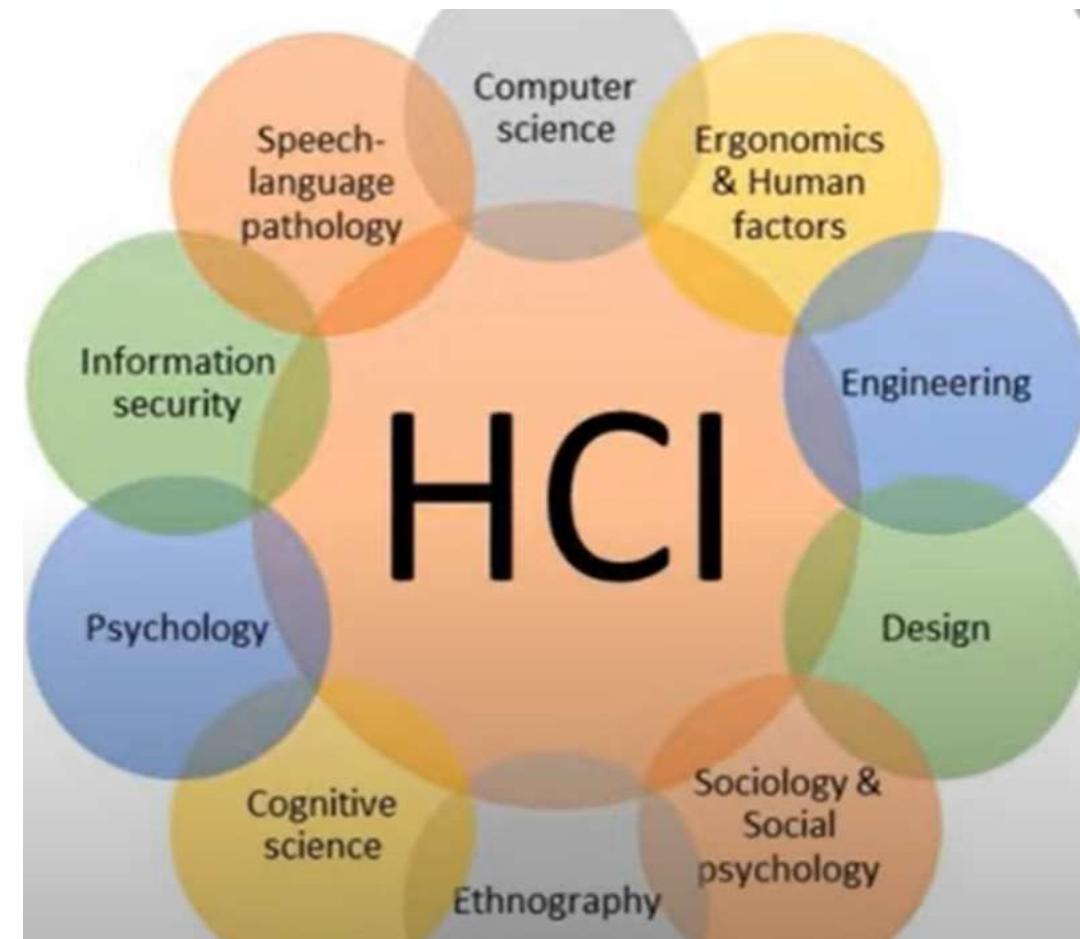
**Benefits & Functionality  
of  
Human Computer Interaction**

# Topics to be covered

1. HCI Benefits
2. HCI Benefits in detail
3. Good & Poor Design Examples
4. Functionality of HCI

# HCI Benefits

1. Gaining Market Share
2. Improving Productivity
3. Lowering Support Cost
4. Reducing Development Cost



- Gaining market share
  - People intend to buy/use products with higher usability
  - e.g., Google's search engine has the largest market share because it is easy to use with higher efficiency
- Improving productivity
  - Employees in a company perform their jobs in a faster manner
  - e.g., Workers in a mainland company needed to press a lengthy sequence of buttons in performing a task. An IAS student helped to increase their productivity via writing a batch program for the button pressing operation

- Lowering support costs

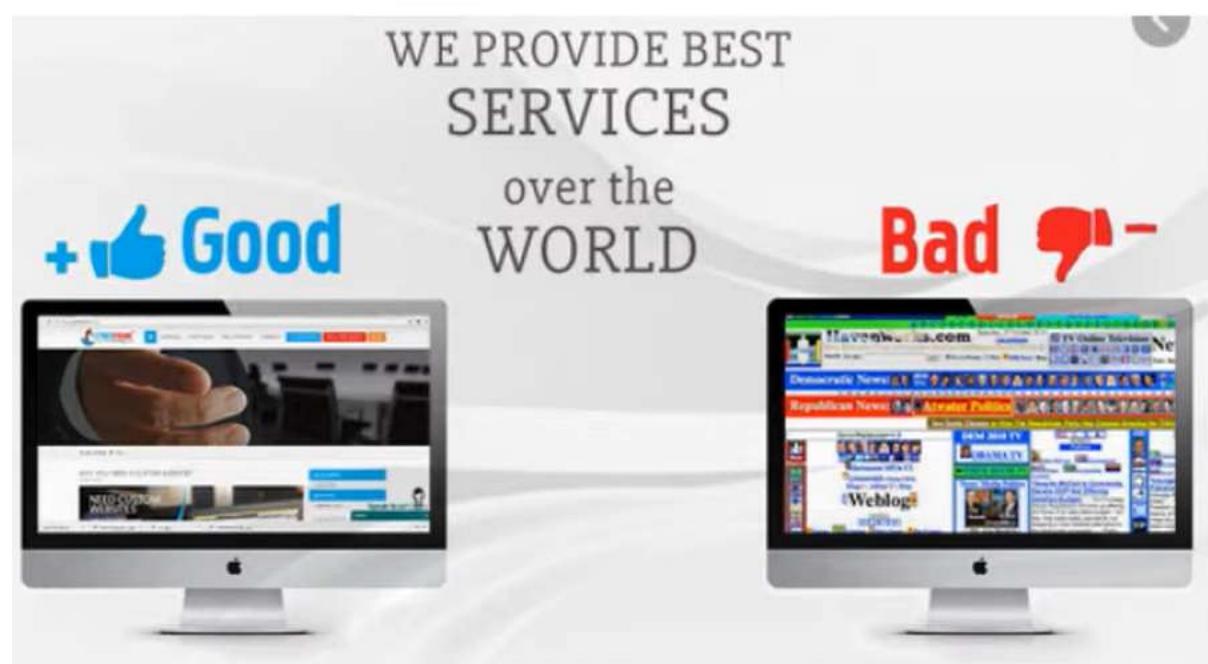
- If the product is not usable, calls to customer support can be enormous
- e.g., If a washing machine is difficult to use even after reading the instruction manual, many users will call the customer service and the cost per call can be over \$100

- Reducing development cost

- Avoid implementing features users don't want and creating features that are annoying or inefficient
- e.g., If there are too many unnecessary confirmation dialog boxes in using a word processor, it is likely this product needs to be redeveloped

# Good & Poor Design Examples

## 1. Website



## 2. Elevator Control



3. Glass



4. Dialog Box



## 5. Directions



## 6. Parking Schedule



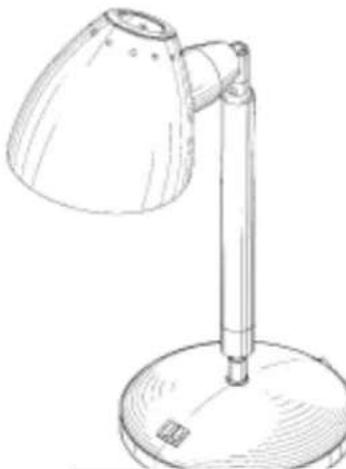
PARKING SCHEDULE			
M-F	SAT	SUN	
7am	(P) FREE	(P) FREE	(P) FREE
8am	(R)	(P) 1 HR	(R)
8:30am	(R)	(P) 1 HR	(R)
4pm	(P) 1 HR		(P) 1 HR
7pm	(P)	(P)	(P)

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# Functionality of HCI

## Lamp

- Function/objective: to illuminate the environment
- Interface: power switch button
- Functional part: light bulb
- Interaction: press “On”, light on; press “Off”, light off
- User tasks: turn on the lamp, turn off the lamp



## Stapler

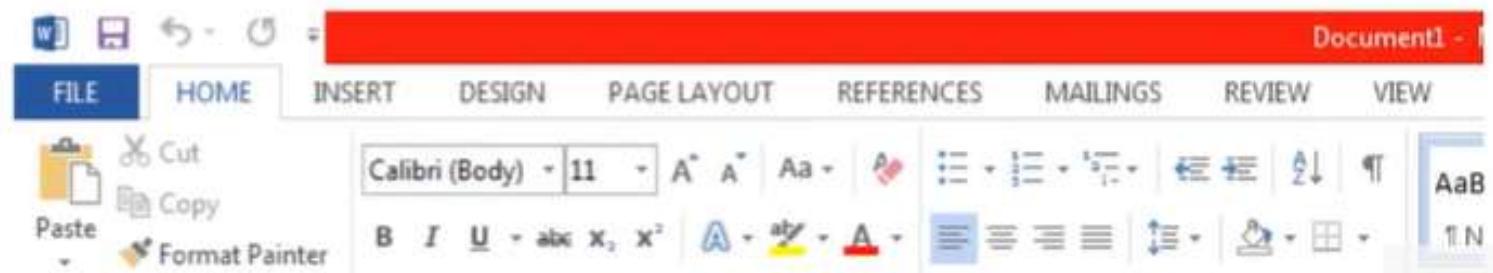
- Objective: to bind paper together
- Interface: top surface where you press
- Functional part: stapler ejection gap
- Interaction: put an edge of the stack of paper in the stapler’s mouth, press down firmly and quickly, hear “click” sound, see paper bound
- User tasks: bind paper together, refill the staples



# Functionality of HCI

## Word processor

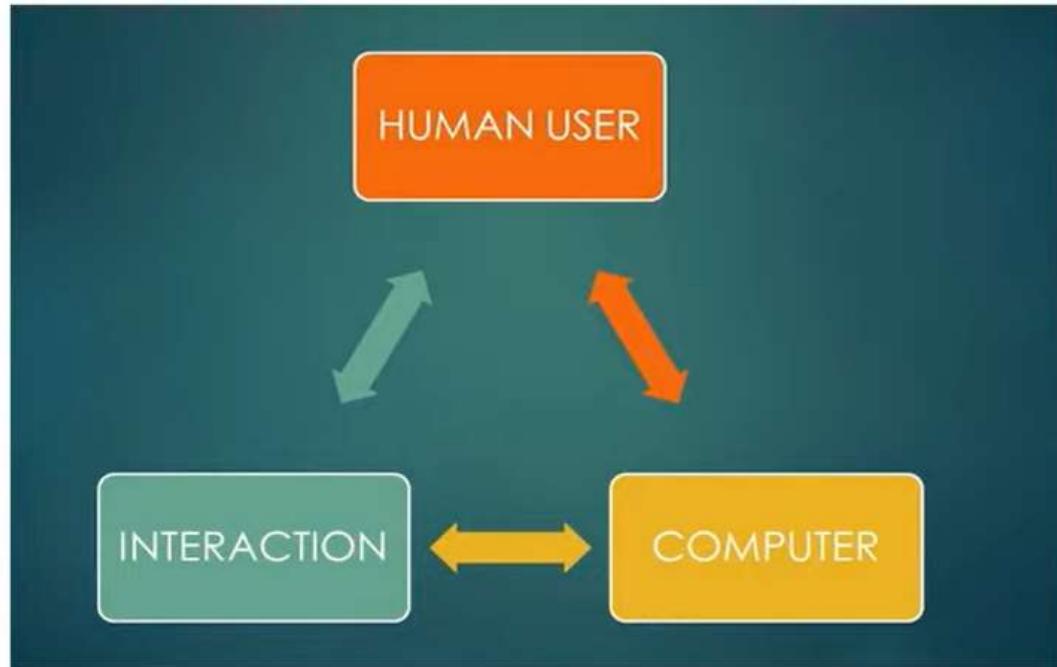
- Objective: to edit a document
- Interface: windows, icons, menus, pointers (WIMP), etc.
- Functional part: sub-routines for command execution, file handling, etc.
- Interaction: use mouse to click the "WORD" icon, observe WORD is invoked, use mouse to click "FILE" icon, ...
- User tasks: edit file, save file, etc.



**Component's  
of  
Human Computer Interaction**

# Topics Covered?

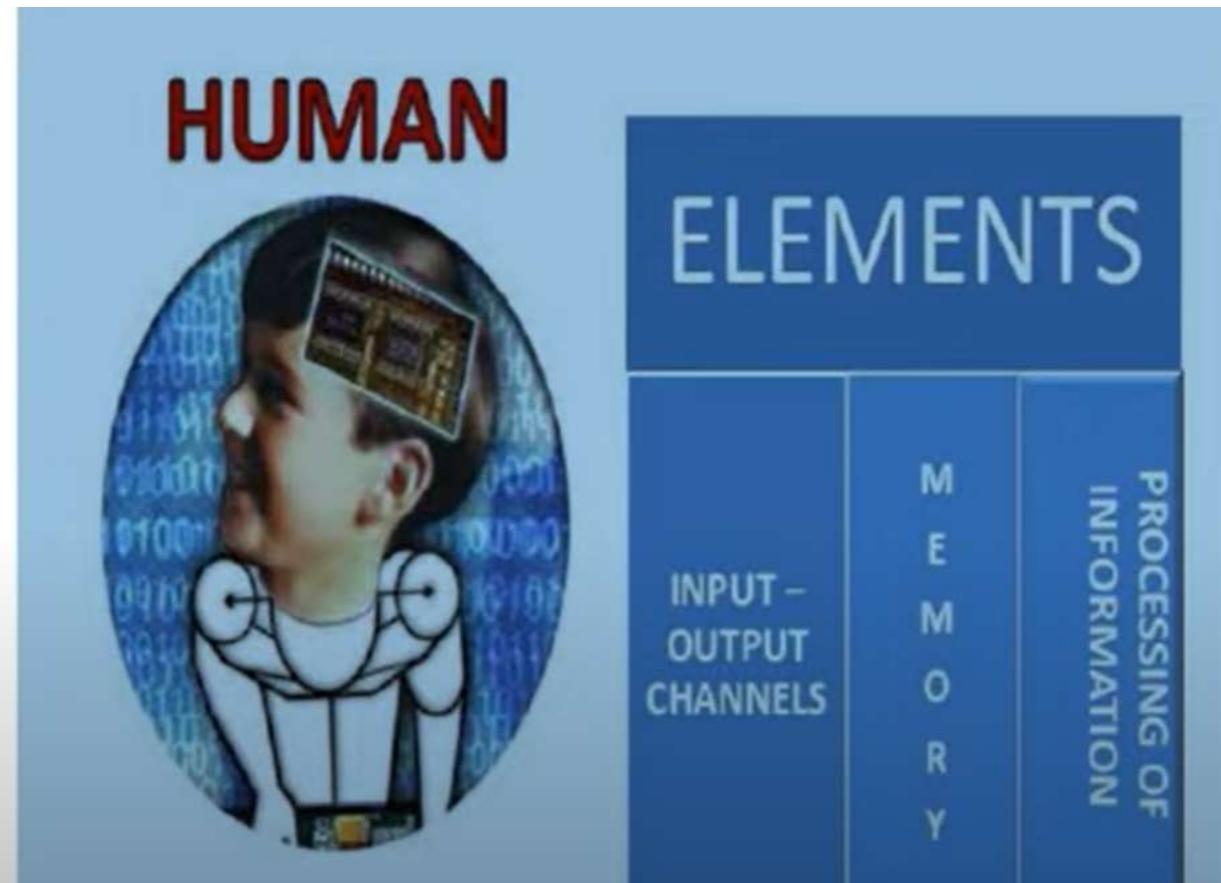
1. Component's of HCI
2. Model Human Processor
3. To Understand Human
4. Computer
5. What is Interaction?
6. What is Interface?
7. What is Human Computer User Interface Interaction?



The goal of HCI is to improve the interaction between users and computer by making computers more user-friendly and receptive to the user need/ demand

## Model Human Processor

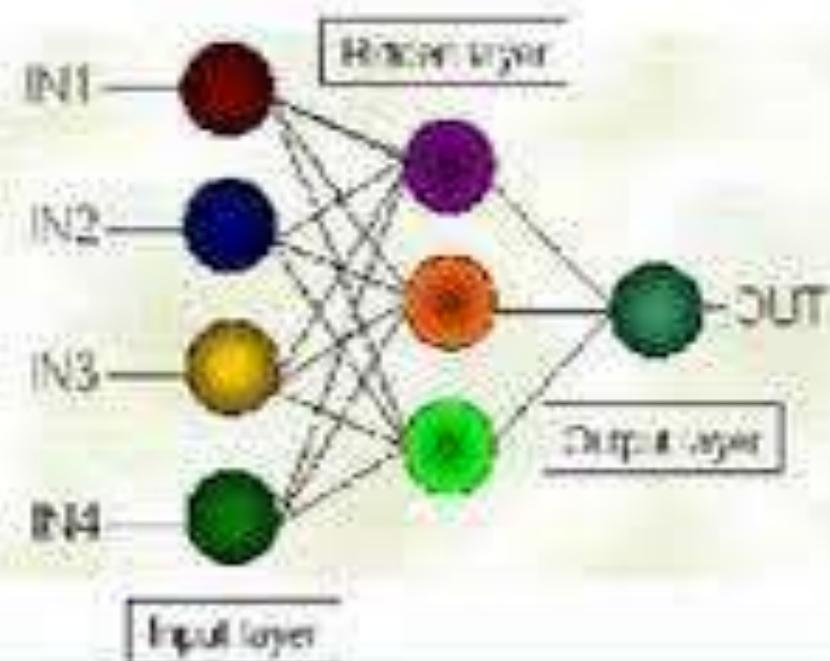
- Card, Moran and Newell (1983), described the Model Human Processor (MHP).
- A simplified view of the human processing involved in interacting with computer system.

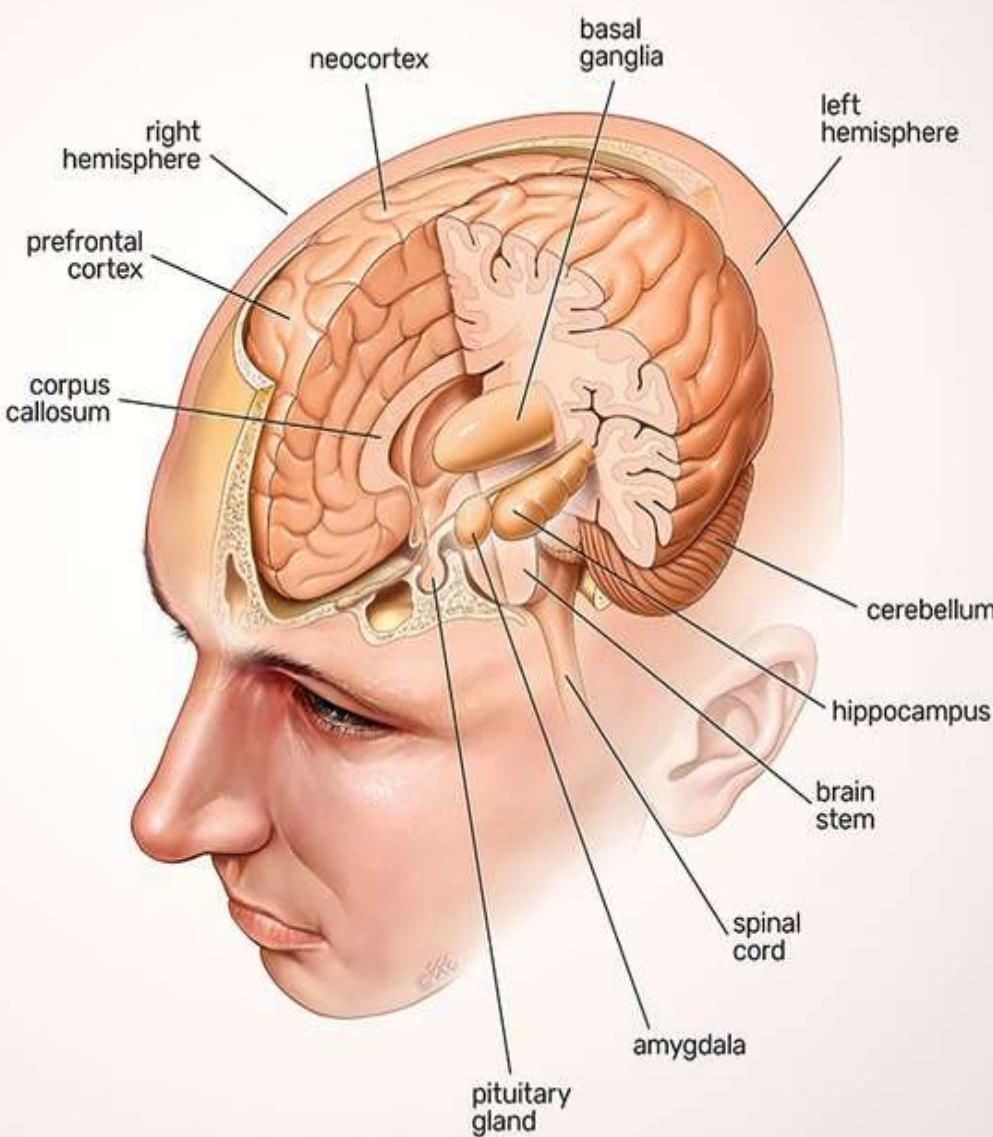


(a) Human Brain



(b) Artificial Neural Network (ANN)





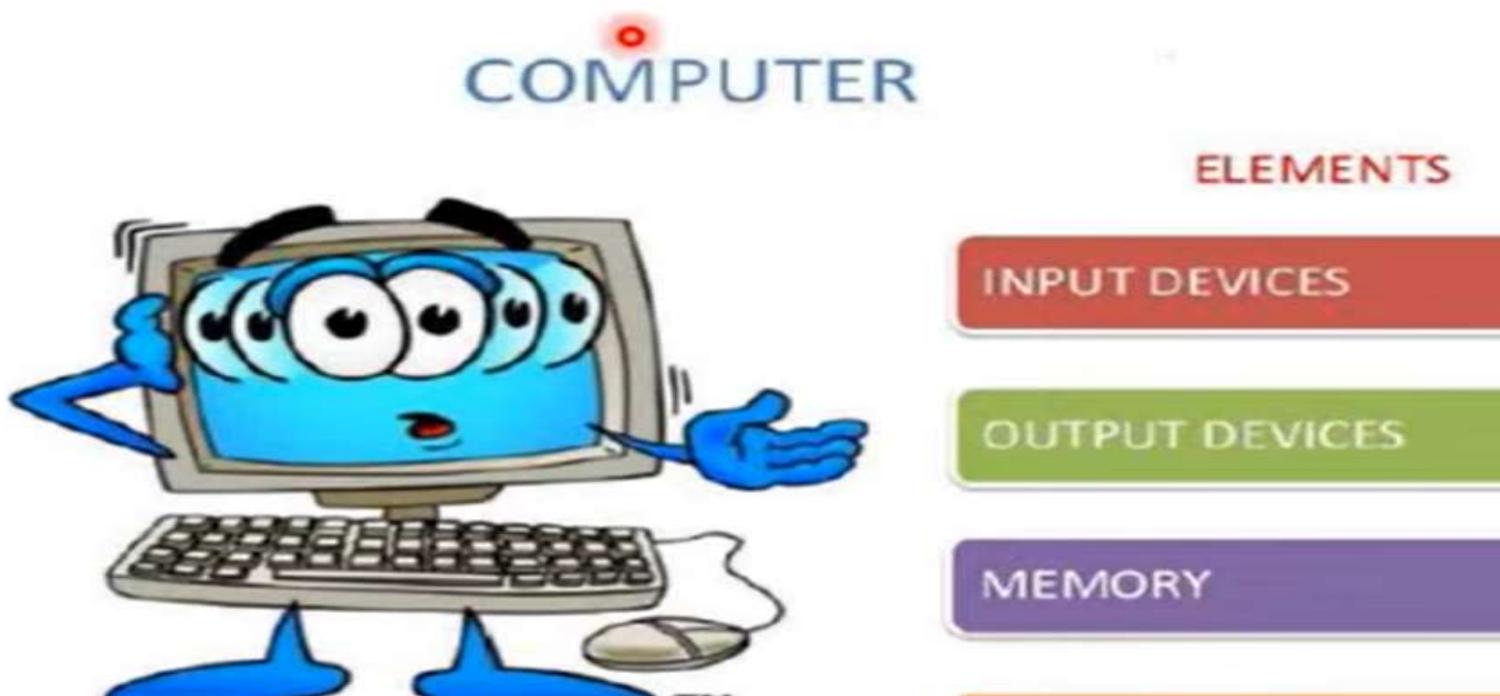
HUMAN BRAIN	VS	CPU
High IQ level		Have no IQ
Sometimes Slow		Basically Fast
Can develop CPU		Reduces human efforts
Based on emotion, feelings and Natural intelligence		Based on algorithms, pseudocode, commands and Artificial Intelligence

# Need to Understand the Humans

- Interacting with technology is cognitive.
- Human information processing referred to as cognition.
- Human cognition process is involved when interacting with system, like attention, perception and recognition, memory, learning, reasoning, problem solving and decision making.
- Need to take into account cognitive processes involved and cognitive limitations of users.
- Provides knowledge about what users can and cannot be expected to do.
- Identifies and explains the nature and causes of problems users encounter.
- Supply theories, modelling tools, guidance and methods that can lead to the design of better interactive products.
- Must consider what are users good and bad at?

# Computer

In fact, the most sophisticated machines are worthless unless they can be used properly by men.



A computer without human

# What is Interaction?

communication



- ▶ Interaction refers to a dialogue generated by the command and data, input to the computer and the display, output of the computer and the sensory/perceptual input to the human and motor response output of the human.
- ▶ There are number of ways in which the user can communicate with the system, batch input, direct manipulation etc.

# What is Interface?

- ▶ Interface is made up of a set of hardware devices and software tools from the computer side and a system of sensory, motor ~~and~~ cognitive processes from the human side.

Interaction takes place at the *Interface*,

# Human Computer (User Interaction) Interaction

## Human:

Individual user, a group of users working together, a sequence of users in an organization

## Computer:

Desktop computer, large-scale computer system, Pocket PC, embedded system (e.g., photocopier, microwave oven), software (e.g., search engine, word processor)

## User interface:

Parts of the computer that the user contacts with

## Interaction:

Usually involve a dialog with feedback & control throughout performing a task (e.g., user invokes "print" command and then interface replies with a dialog box)

What are the interface of the human

What are the interface of the Computer

What is the difference between interaction and interface

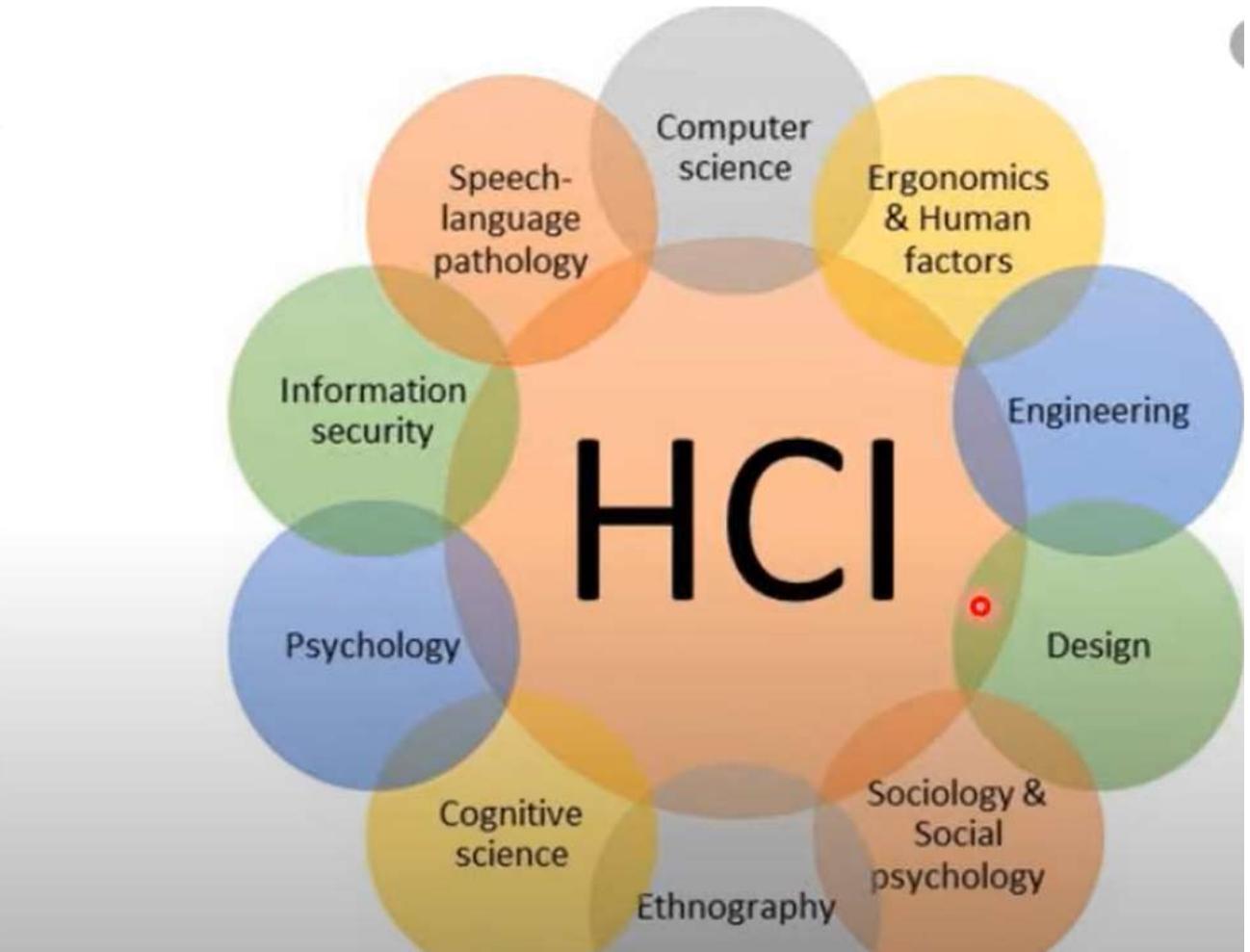
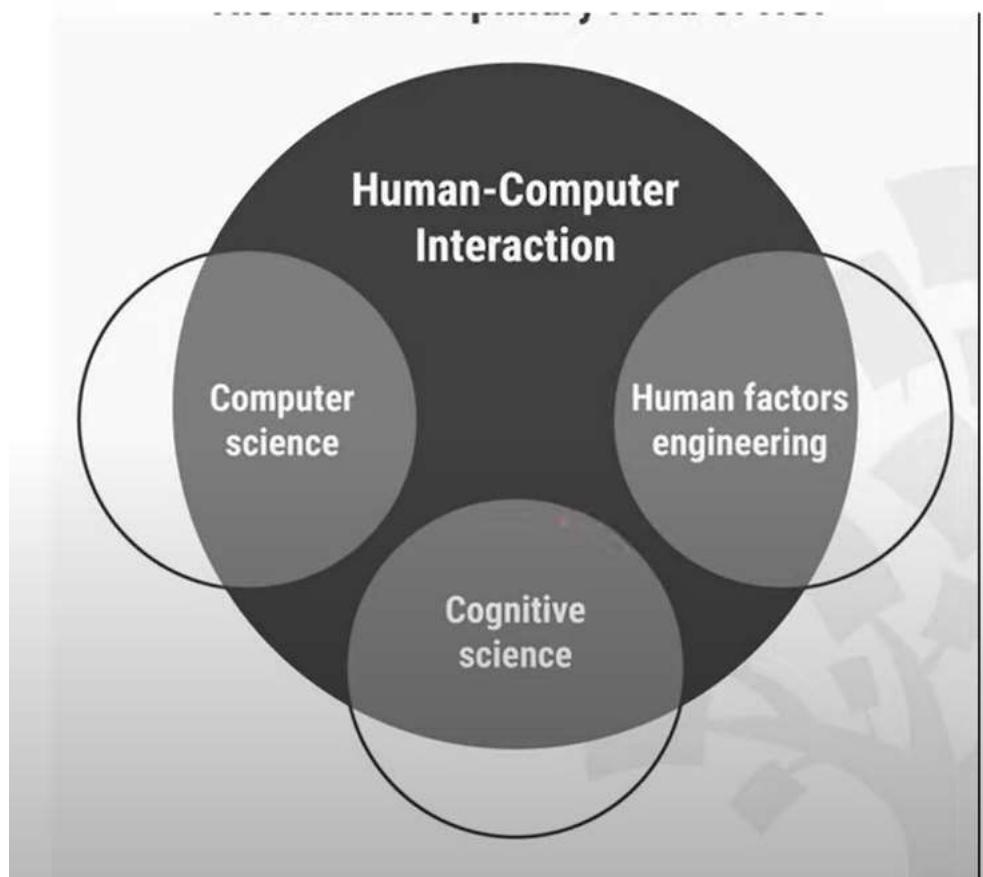
# Multidisciplinary Fields in Human Computer Interaction

## Topics Covered

1. Multidisciplinary Fields of HCI
2. Detail about Disciplines Contribute to HCI
3. People in HCI Business



# Multidisciplinary Fields of HCI



## **Academic Disciplines**

**Computer Science:** Develop programming language, system architectures etc of the computing systems

**Engineering:** Provide faster and cheaper equipment

Linguistics, Artificial Intelligence: Speech synthesis and recognition, natural language processing's, etc.

**Psychology:** Provide information about human mental capabilities (e.g Memory, Decision making)

**Ergonomics (Human factors):** Provide Information about human Physical capabilities

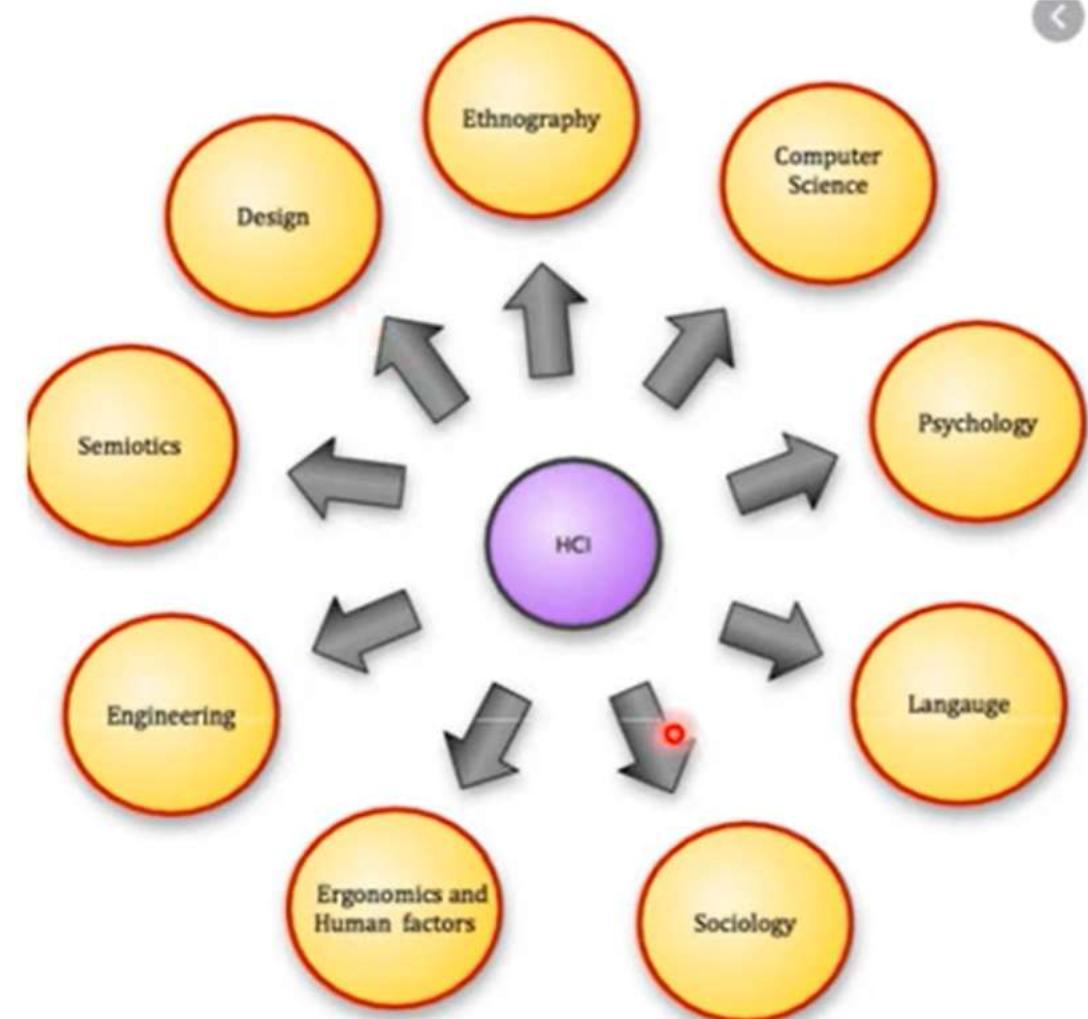
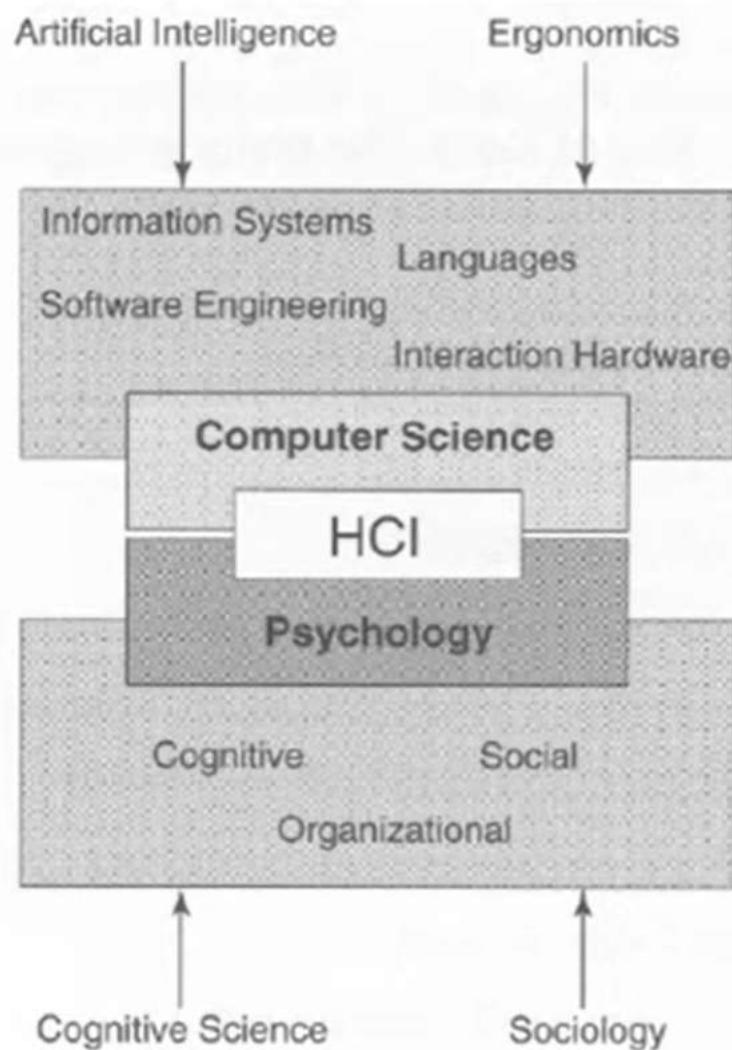
**“The study of people's efficiency in their working environment”**

- Sociology
  - How people interact in groups

### Design Practices:

- Graphic Design
  - Art of combining text and graphics and communicating an effective message in design of posters, brochures, signs, logos & other type of visual communications
- Product Design
  - Process of planning the product's specification
- Industrial Design
  - Applied art whereby aesthetics and usability of products may be improved. Aspects include overall shape of the object, colors, textures, sounds & product ergonomics

# Disciplines Contribute to HCI



# People in HCI Business

- **Interactive / Interaction Designers:** People involved in the design of all the interactive aspects of a product
- **Usability Engineers:** People who focus on evaluating products using usability methods and principles
- **UI Designers:** People experienced in user-centered design methodologies
- **UI Design Engineers:** People who develop and model the end user experience
- **Web Designers:** People who develop and create the visual design of websites, such as layouts & animations
- **Information Architects:** People who come up with ideas of how to plan and structure interactive products
- **User Experience Designers:** people who do all the above

# People in HCI Business

User experience is

- An important concept in interaction design
- About how people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, opening it, closing it, etc.
- Examples: how smoothly a switch rotates, the sound of a click, the touch of a button when pressing it

## What is API

- API stands for Application Programming Interface.
- In the context of APIs, the word Application refers to any software with a distinct function.
- Interface can be thought of as a contract of service between two applications.



# **User Centered Design in Human Computer Interaction**

# **Topics Covered**

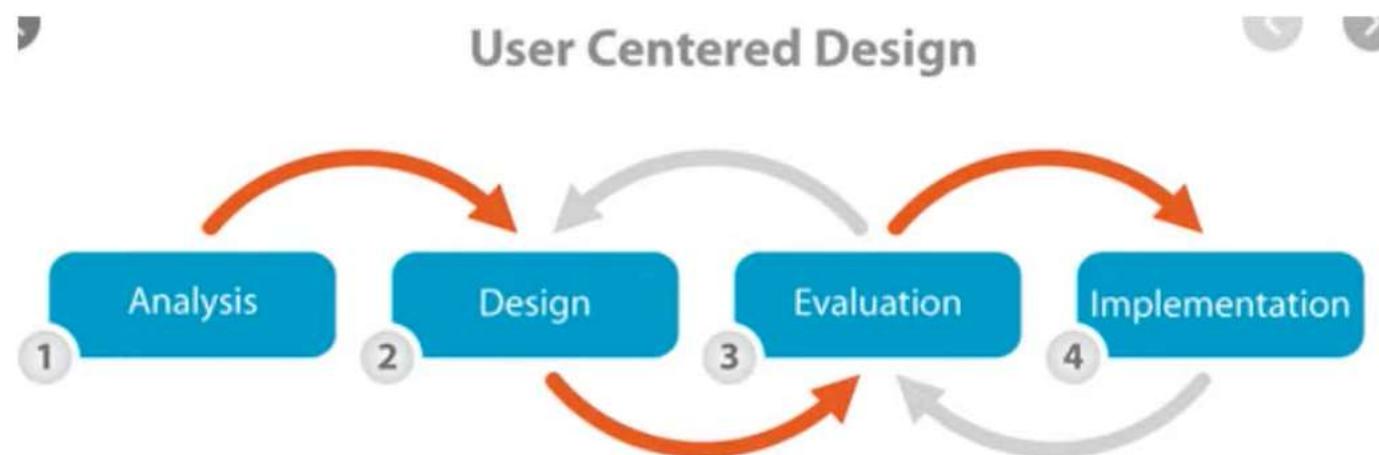
1. What is User Centered Design?
2. Why User Centered Design?
3. User Centered Design Process
4. Example of User Centered Design.
5. Advantages & Disadvantages of UCD



**Multidisciplinary Design Teams  
for User-Centered Design**

# What is User Centered Design?

- User-centered design (UCD) is an iterative design process in which designers focus on the users and their needs in each phase of the design process.
- In UCD, design teams involve users throughout the design process via a variety of research and design techniques, to create highly usable and accessible products for them.



# Why User Centered Design?

The goal of UCD is to create products that users find **useful** and **usable**.

UCD seeks answers to:

- What is important to users
- The tasks users do, how frequently, and in what order
- The users' work environment
- The users' problems and constraints
- Users' expectations in terms of functionality
- Output required & in what form
- How can the design of this 'product' facilitate users' cognitive processes?

UCD seeks to answer questions about users and their tasks and goals, then use the findings to drive development and design.

- Easy-to-use products
- Satisfy customers
- Decrease expenditures on technical support and training
- Advertise ease-of-use successes
- Ultimately increase market share

UCD cuts costs and increases **user satisfaction** and **productivity**.

UCD can improve the usability (ease-of-use) and usefulness (relevance) of everything from "everyday things" to software to information systems to processes... anything with which people interact.

# User Centered Design Process 1

## 1. Specify context of use:

1. Identify who the primary users of the product?
2. Why they will use the product?
3. What are their requirements?
4. Under what environment they will use it?
5. Collect information about their users' needs.

# User Centered Design Process-2

## 2. Specify Requirements

Once the context is specified,

1. It is time to identify the granular requirements of the product
2. This is an important process, which can further facilitate the designers to create storyboards and set important goals to make the product successful
3. The designers and the stockholders provide detailed specifications for new product.

# User Centered Design Process 3

## **3. Create Design solutions and development:**

1. Based on product Goals, Requirements & Design.
2. Start an iterative process of product design and development.
3. Create unique design solutions — building a solution, from rough concept to finished design.
4. Evaluate designs — Through usability testing with actual users.
5. Implementation — the process of developing and delivering the product.

For Example: Class diagram, Use case diagram, Activity diagram, State Use case diagram, Sequence Diagram

# User Centered Design Process 4

## 4. Evaluate Product by Testing & Deployment:

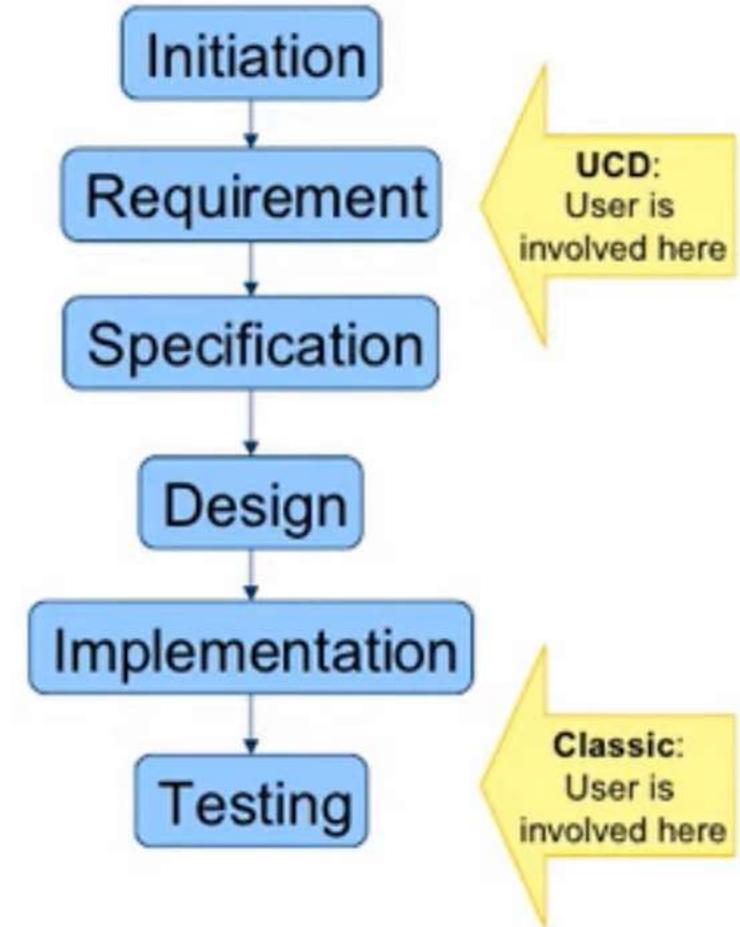
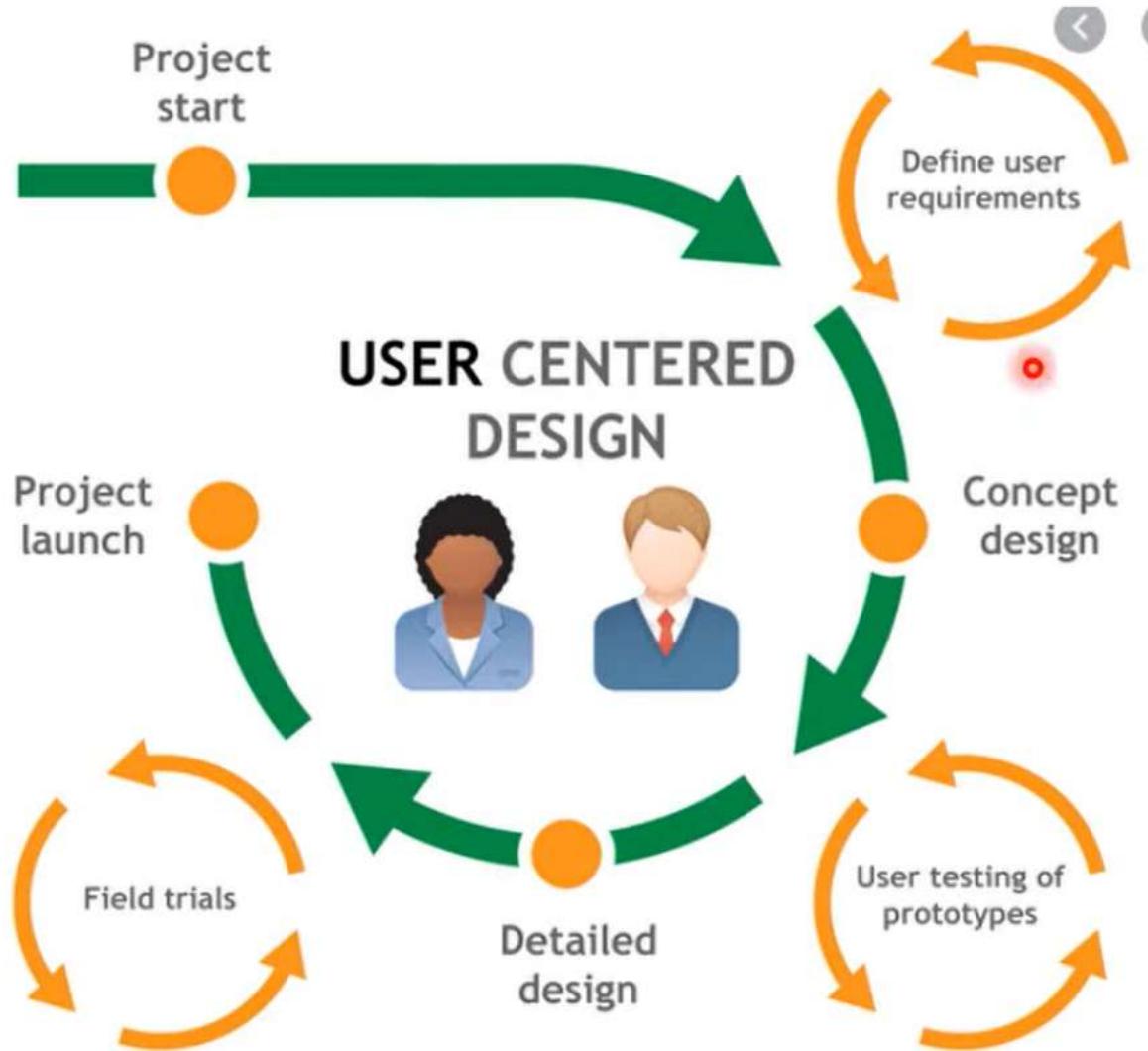
1. Product designers do usability testing to get users' feedback of the product.
2. Testers can do testing of finalized product.
3. Product evaluation is a crucial step in product development which gives critical feedback of the product.
4. Deployment — the final product is frequently evaluated, as consumer needs evolve and change.

Unit Testing=Each module of the product will be tested

Integration Testing=Overall product will be tested

Usability testing=User feedback will be tested

# Example of User Centered Design



# Advantages & Disadvantages of UCD

User-Centered Design is a method for designing **ease of use** into the total user experience with products.

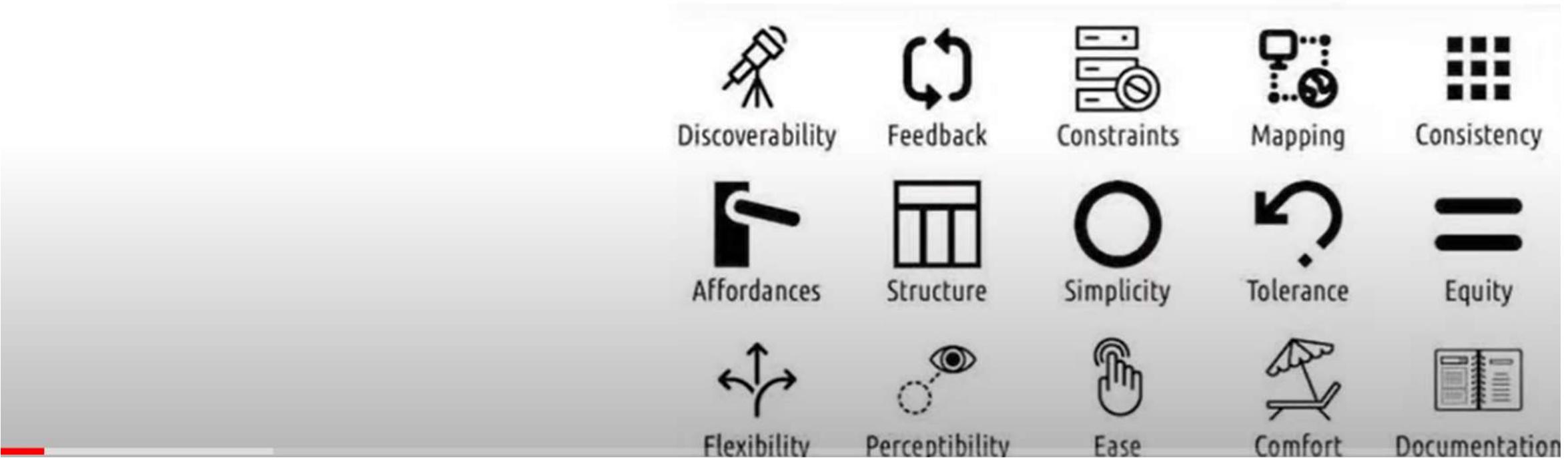
Advantages	Disadvantages
Products are more efficient, effective, and safe	It is more costly.
Assists in managing users' expectations and levels of satisfaction with the product.	It takes more time.
Users develop a sense of ownership for the product	May require the involvement of additional design team members (i. e. ethnographers, usability experts) and wide range of stakeholders
Products require less redesign and integrate into the environment more quickly	May be difficult to translate some types of data into design
The collaborative process generated more creative design solutions to problems.	The product may be too specific for more general use, thus not readily transferable to other clients; thus more costly



# Principles of Human Computer Interaction

# Topics to be covered

1. Principles of HCI Design
2. General Principles of HCI Design



# Principles of HCI Design

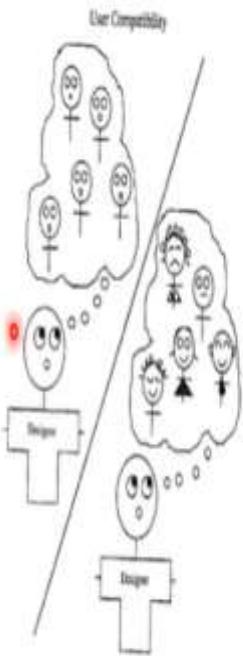
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- Making systems **easy to use & learn**
- **Usability** applies to all aspects of a system
- Some principles to support usability are:
  - **Compatibility**
  - **Ease of Learning**
  - **Memorability**
  - **Predictability**
  - **Simplicity**
  - **Flexibility**
  - **Responsiveness**
  - **Protection**
  - **Invisible Technology**
  - **Control**

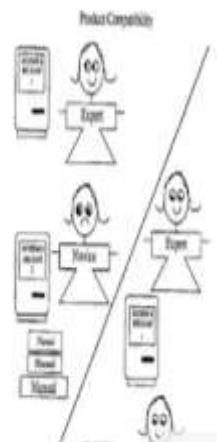


## 1. Compatibility

- User - know the user



- Product - can reduce both learning time & errors  
**Any disadvantage?**



## 2. Ease of Learning

- Ease of learning - the system should be easy to learn so that the user can rapidly start getting some work done with the system



### 3. Memorability

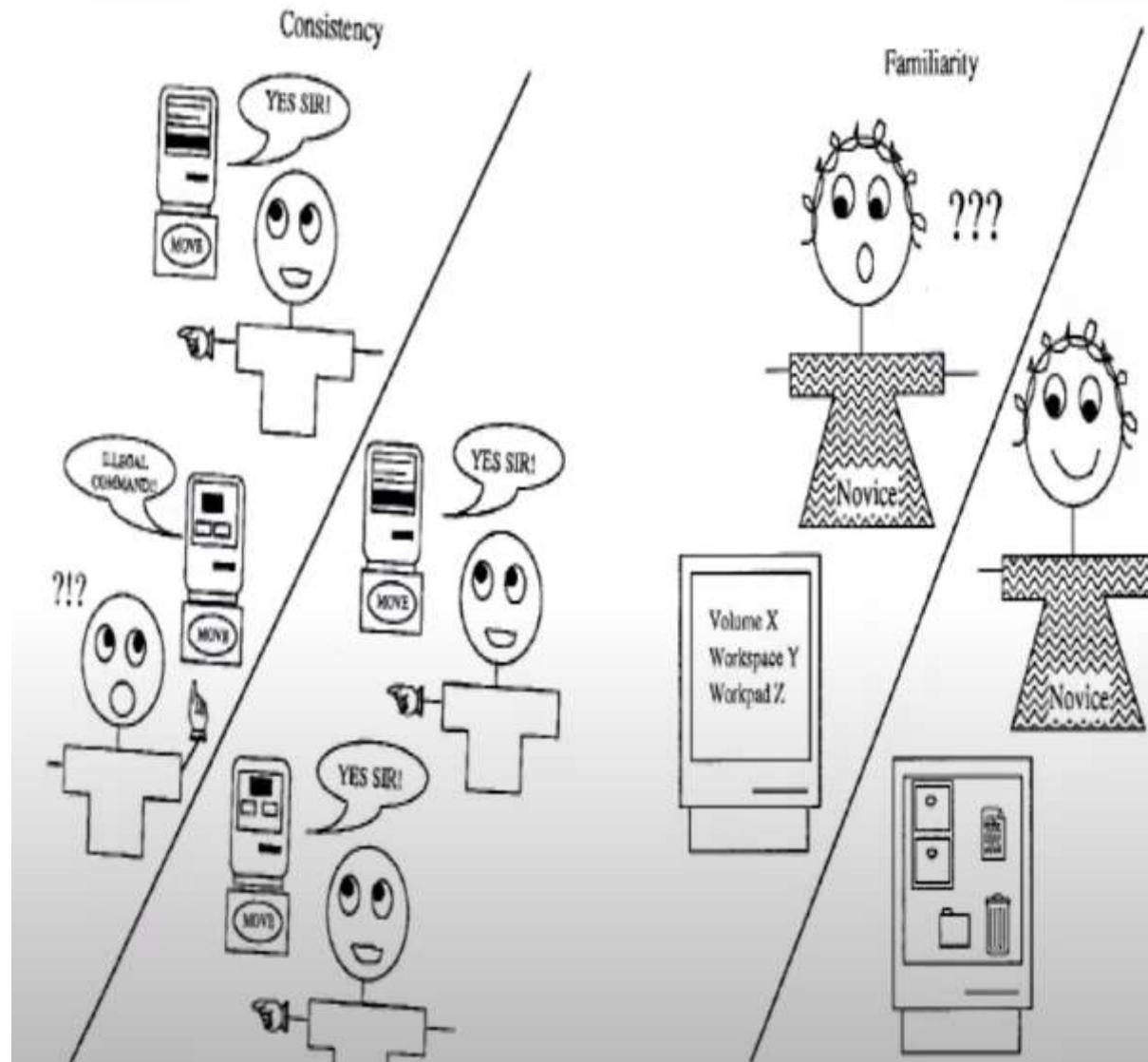
Interfaces that have high memorability will be easier to learn and use. Factors which affect memorability include

- Location: It will be easier to remember if a particular object is placed in a consistent location, e.g., always putting the search box in the upper right-hand corner of a Web page
- Logical grouping: It will be easier to remember if things are grouped logically, e.g., putting related options together in a menu
- Conventions: Conventional objects and symbols will be easier to remember, e.g., shopping cart symbol 

## 4. Predictability

Predictability involves a person's expectations and his/her ability to determine the results of actions ahead of time. It includes:

- **Consistency** - reinforce our associations and therefore increase our ability to remember and predict outcomes and processes
- **Generalizability** - Help us use the knowledge we gathered from previous experience and apply it to similar situations
- **Familiarity** - e.g., familiar menu names and options help users locate objects and functions more easily



## 5. Simplicity

If things are simple they will be easy to understand and thus easy to learn and remember



## Simplicity

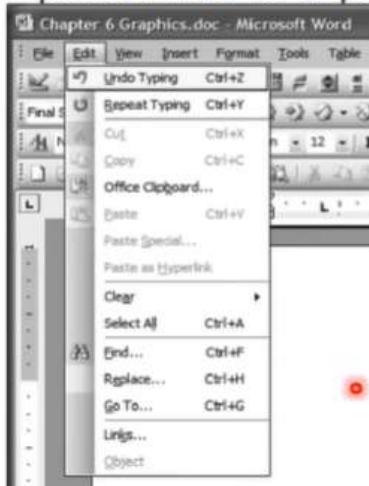
It includes:

- **Progressive disclosure** - Show the user only what is necessary



## Simplicity

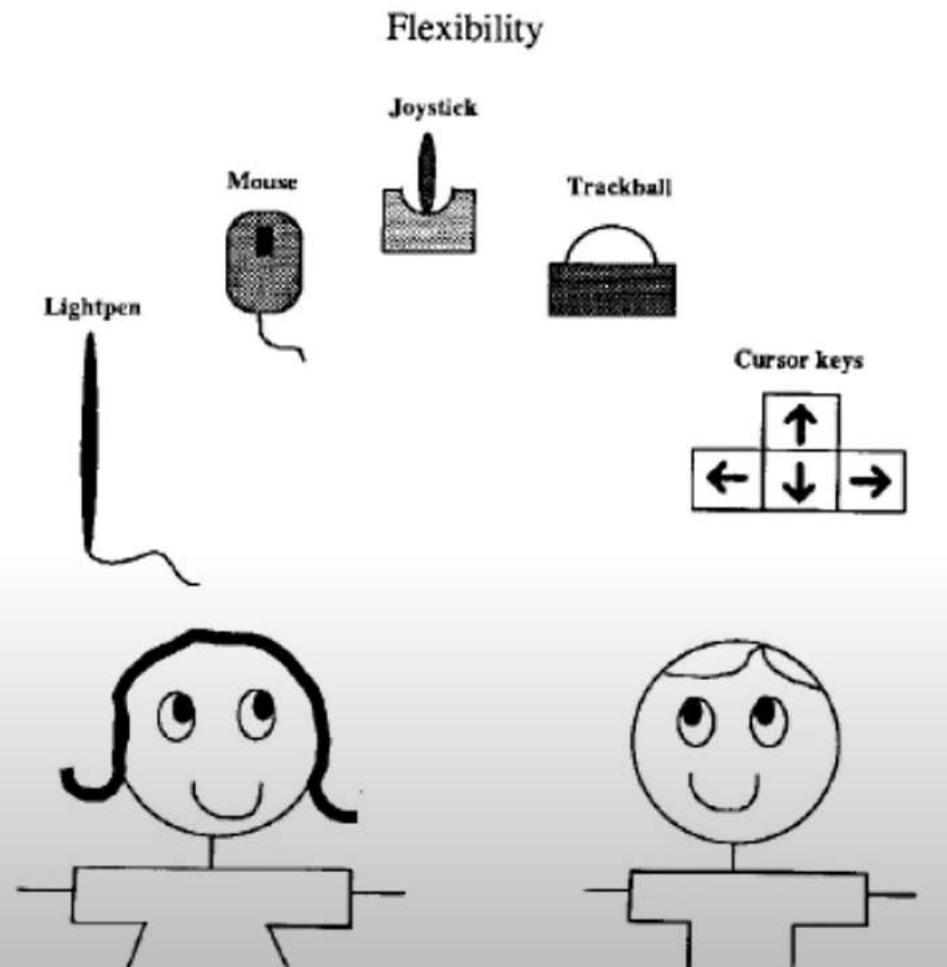
- **Constraints** - Involve limiting the actions that can be performed in a particular design



# 6. Flexibility

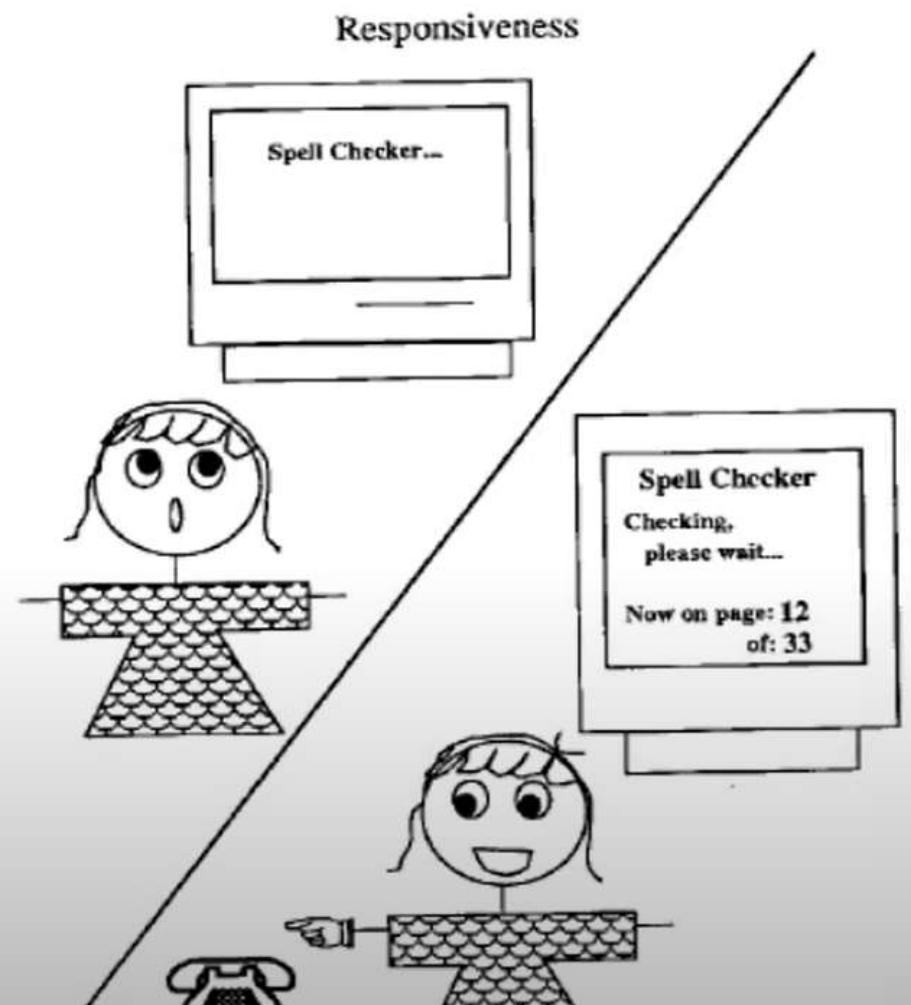
- Allow more user control & accommodates variations in user skill and preferences, i.e., give users **choices**

- Hardware
- Styles of interaction
- Data format



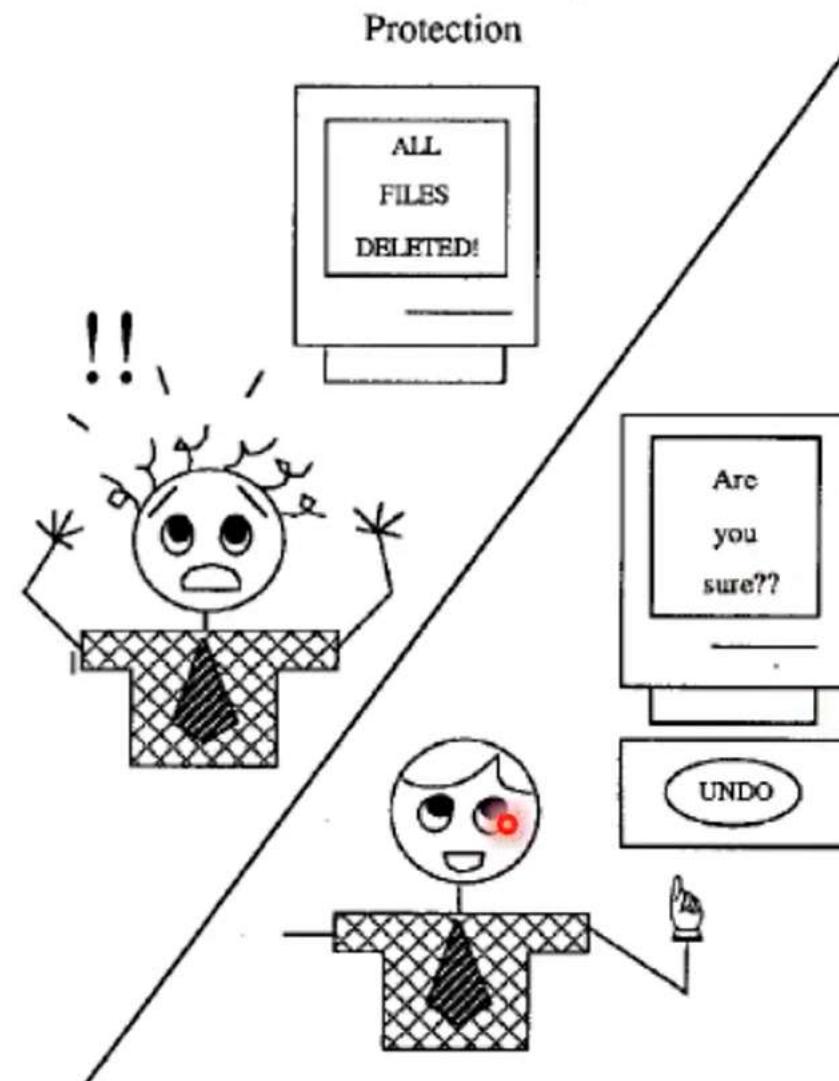
# 7. Responsiveness

- Computer should respond immediately to a user's input or inform the user when long delays are unavoidable



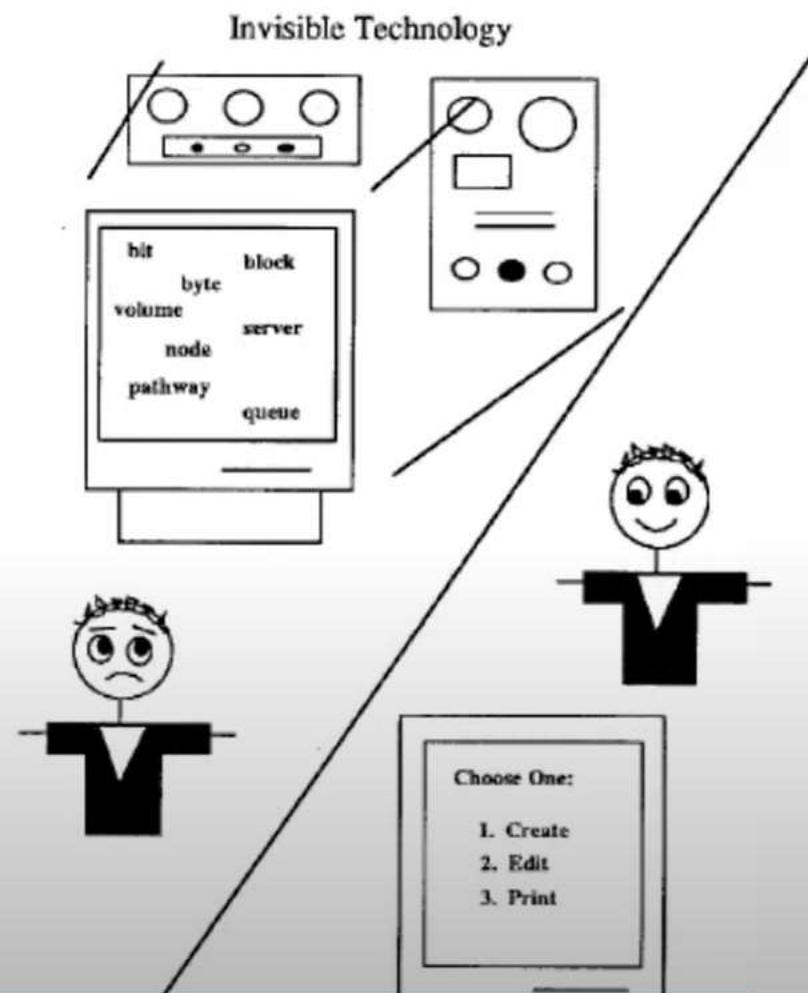
# 8. Protection

- Protect users against disastrous results of common human error



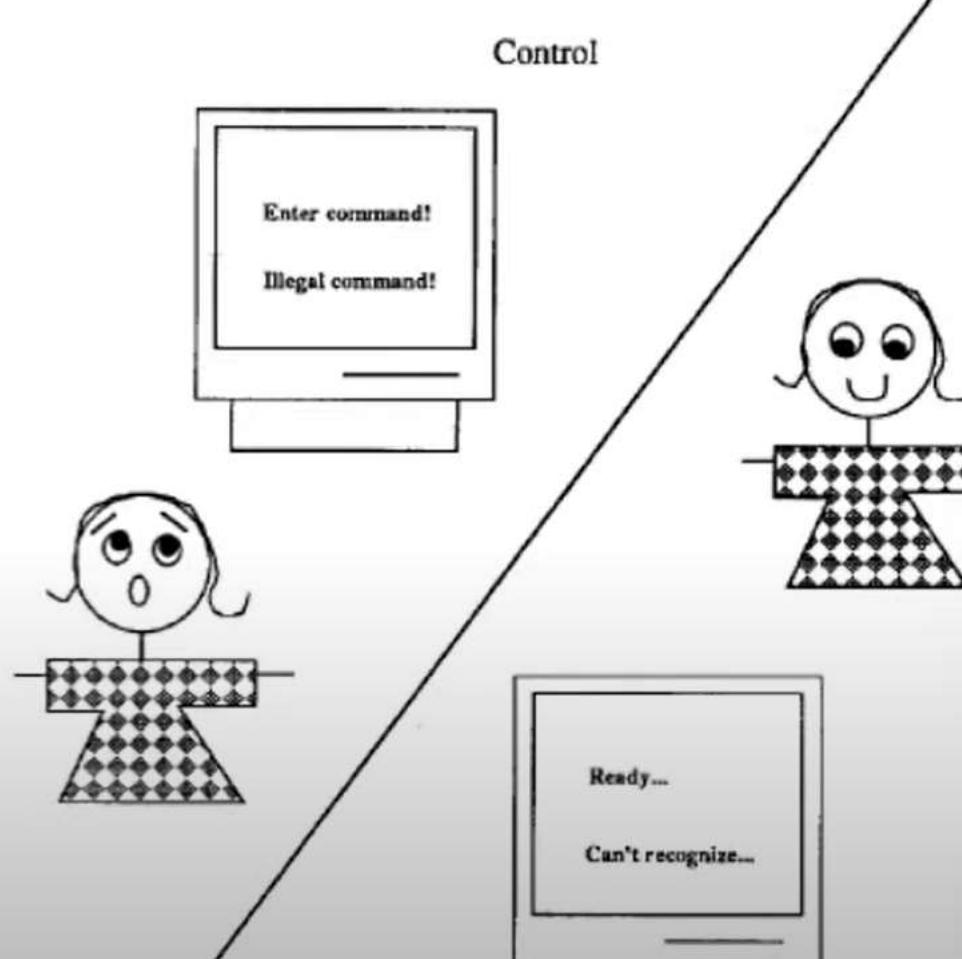
# 9. Invisible Technology

- No need to know the technical details



# 10. Control

- Users should feel more in control if the interface is passive



# General Principles of HCI Design

- Principles which do / do not support user experience
  - Satisfying
  - Fun
  - Enjoyable
  - Entertaining
  - Helpful
  - Surprising
  - Aesthetically pleasing
  - Rewarding
  - Supportive of creativity
  - Emotionally fulfilling
  - Boring
  - Frustrating
  - Annoying

# General Principles of HCI Design

- Principles are often in direct conflicts with one another. In order to make the trade-offs intelligently, a thorough understanding of the intended users is required
- These principles are very general and designers may not know how to apply them directly

