Human Computer Interaction

MCA-307 (Elective 5.2.2)

MCA –V Sem.

Unit 2

HCI

Human Computer Interface (HCI) was previously known as the man-machine studies or man-machine interaction. It deals with the design, execution and assessment of computer systems and related phenomenon that are for human use.

The goals of HCI are to produce usable and safe systems, as well as functional systems. In order o produce computer systems with good usability, developers must attempt to:

- understand the factors that determine how people use technology
- develop tools and techniques to enable building suitable systems
- achieve efficient, effective, and safe interaction
- put people first

The goals of interaction design

- The goal of user interface design is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals (user-centered design). Good user interface design facilitates finishing the task at hand without drawing unnecessary attention to itself. Graphic design and typography are utilized to support its usability, influencing how the user performs certain interactions and improving the aesthetic appeal of the design; design aesthetics may enhance or detract from the ability of users to use the functions of the interface. The design process must balance technical functionality and visual elements to create a system that is not only operational but also usable and adaptable to changing user needs.

Design goals

User interface design requires a good understanding of user needs. It mainly focuses on the requirements of the platform and its user expectations.

Some of the design goals are discussed below :

- Clarity: the information content is conveyed quickly and accurately.
- Discriminability: the displayed information can be distinguished accurately.
- Conciseness: users are not overloaded with extraneous information.
- Consistency: a unique design, conformity with user's expectation.
- Detectability: the user's attention is directed towards information required.
- Legibility: information is easy to read.
- Comprehensibility: the meaning is clearly understandable, unambiguous, interpretable, and recognizable.

Interface Design Guidelines

Interface design is involved in a wide range of projects from computer systems, to cars, to commercial planes; all of these projects involve much of the same basic human interactions yet also require some unique skills and knowledge. As a result, designers tend to specialize in certain types of projects and have skills centered on their expertise, whether it is a software design, user research, web design, or industrial design.

Some more important HCI design guidelines are presented below, they are divided in three categories:

- General interaction
- information display
- data entry

General Interaction

Guidelines for general interaction are comprehensive advices that focus on general instructions such as −

- Be consistent.
- Offer significant feedback.
- Ask for authentication of any non-trivial critical action.
- Authorize easy reversal of most actions.
- Lessen the amount of information that must be remembered in between actions.

General Interaction

- Seek competence in dialogue, motion and thought.
- Excuse mistakes.
- Classify activities by function and establish screen geography accordingly.
- Deliver help services that are context sensitive.
- Use simple action verbs or short verb phrases to name commands.

Information Display

Information provided by the HCI should not be incomplete or unclear or else the application will not meet the requirements of the user.

To provide better display, the following guidelines are prepared −

- Exhibit only that information that is applicable to the present context.
- Don't burden the user with data, use a presentation layout that allows rapid integration of information.
- Use standard labels, standard abbreviations and probable colors.
- Permit the user to maintain visual context.

Information Display

- Generate meaningful error messages.
- Use upper and lower case, indentation and text grouping to aid in understanding.
- Use windows (if available) to classify different types of information.
- Use analog displays to characterize information that is more easily integrated with this form of representation.
- Consider the available geography of the display screen and use it efficiently.

Data Entry

The following guidelines focus on data entry that is another important aspect of HCI −

- Reduce the number of input actions required of the user.
- Uphold steadiness between information display and data input.
- Let the user customize the input.
- Interaction should be flexible but also tuned to the user's favored mode of input.
- Disable commands that are unsuitable in the context of current actions.
- Allow the user to control the interactive flow.
- Offer help to assist with all input actions.
- Remove "mickey mouse" input.

Steps in designing HCI Applications

HCI design is considered as a problem solving process that has components like planned usage, target area, resources, cost, and viability. It decides on the requirement of product similarities to balance trade-offs.

The following points are the four basic steps of designing HCI applications −

- Identifying requirements
- Building alternative designs
- Developing interactive versions of the designs
- Evaluating designs

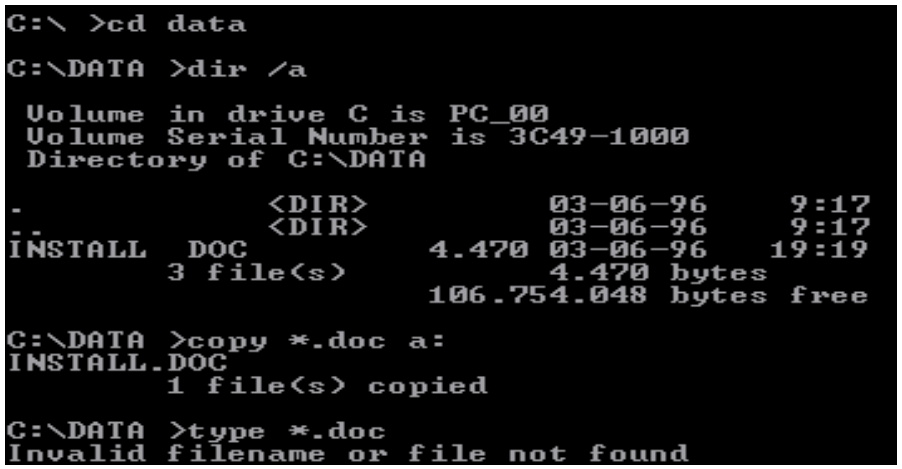
Categories of Screen Based User Interface

- Screen design describes the design of graphical user interfaces. Screen design includes a wide variety of applications where screens or displays can be used as part of human-machine interaction. Screen design should be distinguished from the functions of a graphical user interface. Technical implementation is not part of screen design.

There are five main types of user interface:

- command line (cli)
- graphical user interface (GUI)
- menu driven (mdi)
- form based (fbi)
- natural language (nli)

Command Line



- **First interactive dialog style to be used**
- **A mean of expressing instruction to the computer directly using function keys, single characters, abbreviations or whole word command**
- **user responds to a prompt on the screen by entering an appropriate command**

Command Line

- **Benefits of command line:**
  - It offers direct access to system functionality
  - Quick to use.
    - The command can be applied to many objects at once
  - Easily extensible
  - Suitable for experience user

Command Line

- **Disadvantages of command line:**
  - Difficult to use
  - Difficult to learn
  - Difficult for error correction
  - Difficult for novice user
  - Text only data representation

Hint: using consistent and meaningful commands and abbreviations

Command Line

Design guidelines:

- **Offer maximum flexibility**
  - Conduct task analysis to determine the necessary commands
- **Facilitate command remembering**
  - Use meaningful, descriptive names
  - Use consistent format of the command line
  - Provide on-line help

Command Line

Design guidelines:

- **Facilitate error correction**
  - Give feedback on both successful and unsuccessful commands

Menus

A menu driven interface is commonly used on cash machines (also known as automated teller machines (ATM's), ticket machines and information kiosks . They provide a simple and easy to use interface comprised of a series of menus and sub-menus which the user accesses by pressing buttons, often on a touch-screen device.

Some key points about Menus:

- It has a set of options displayed on screen
- Relies on recognition rather than recall

Menus

- **Benefits of Menus:**
  - Easy to use, reduces memorisation
  - Structure the user’s decisions
  - Easy to program

Menus

- **Disadvantages of Menus:**
  - Limited choices per menu
  - Slow to use in large systems
  - Multi-user systems
    - slow response times
  - Can take up a lot of space

Menus

- **Design guidelines:**
  - Group logically related options
  - Various categories of grouping:
    - Alphabetical
    - Categorical
    - Conventional
    - Frequency
  - Limit options to 7 per menu approximately, or break into sections
  - Avoid excessively deep hierarchies
  - Options that are not available at a given time should be faded (grayed).

Form – Based

- Designed for clerical workers
  - Requires little experience with computers
  - To enable them to carry out repetitive clerical data collection tasks.
  - Mimicked paper forms in order to retain the characteristics of the manual task
  - Designed for a specific type or task.

Form – Based

- Advantages
  - Forms offer a neat, structured way of gathering information.
- Disadvantages
  - A form has to be designed specifically for each task.
  - Users will require a certain level of typing skill

Interaction Style: Form – Fills

- **Can you suggest some improvements of the form - fills interface, based on the above advantages and disadvantages?**

Form – Based

- **Design guidelines:**
  - **Interdependencies** can be incorporated in the program.
    - For example, if one element asks if user is pregnant, then 'female' is automatically entered in the 'sex' field.

WIMP

- **Windows, icons, menus and pointers**
- **The user carries out some physical action (e.g. clicking, dragging) rather than typing commands with complex syntax**
- **The results of the action are seen immediately and, usually, actions are reversible**

WIMP

- Advantages
  - Novices can learn the basic functions quickly, usually through demonstration and practice rather than from formal instruction or a manual.
  - Intermittent users can retain the main operational concepts of the interface because it involves visual recognition.
  - Error messages are rarely needed because most actions are reversible.

WIMP

- Advantages
  - There is immediate feedback as to whether or not the user's goals have been achieved.
  - Users are less anxious, again because they know actions can be reversed.

Natural language interface

- A natural language interface is a spoken interface where the user interacts with the computer by talking to it. Sometimes referred to as a 'conversational interface', this interface simulates having a conversation with a computer. Made famous by science fiction (such as in Star Trek), natural language systems are not yet advanced enough to be in wide-spread use.
- Commonly used by telephone systems as an alternative to the user pressing numbered buttons the user can speak their responses instead. An Example of this type of interface is Voice Recognition
- This is the kind of interface used by the popular iPhone application called Siri and Cortana in Windows.

Graphical User Interface

- User interface is the front-end application view to which user interacts in order to use the software. User can manipulate and control the software as well as hardware by means of user interface.
- Graphical User Interface provides the user graphical means to interact with the system. GUI can be combination of both hardware and software. Using GUI, user interprets the software.
- Typically, GUI is more resource consuming than that of CLI. With advancing technology, the programmers and designers create complex GUI designs that work with more efficiency, accuracy and speed.

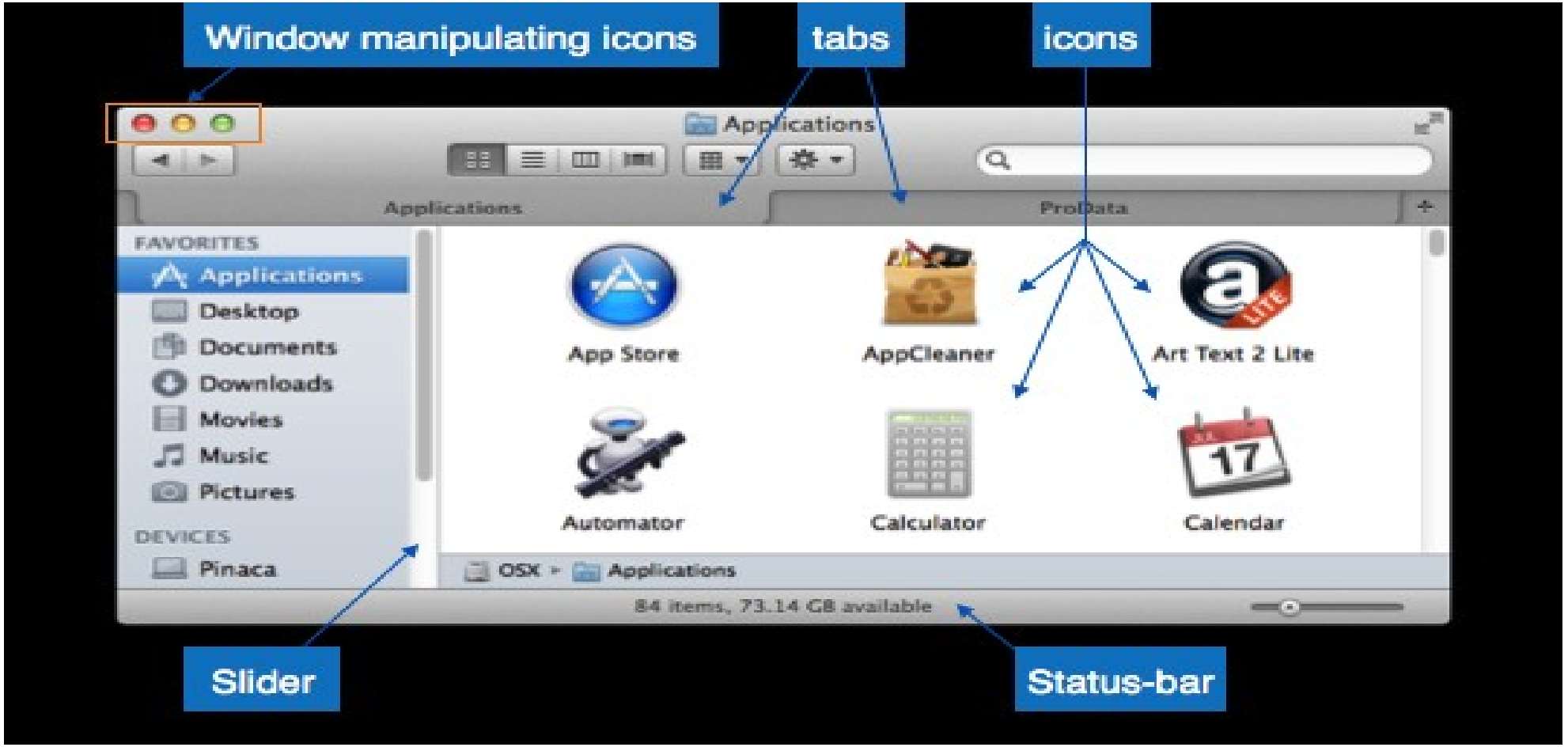
GUI Elements

GUI provides a set of components to interact with software or hardware. Every graphical component provides a way to work with the system.

A GUI system has following elements such as:

- **Window** - An area where contents of application are displayed. Contents in a window can be displayed in the form of icons or lists, if the window represents file structure. It is easier for a user to navigate in the file system in an exploring window. Windows can be minimized, resized or maximized to the size of screen. They can be moved anywhere on the screen. A window may contain another window of the same application, called child window.

- **Tabs** - If an application allows executing multiple instances of itself, they appear on the screen as separate windows. Tabbed Document Interface has come up to open multiple documents in the same window. This interface also helps in viewing preference panel in application. All modern web-browsers use this feature.
- **Menu** - Menu is an array of standard commands, grouped together and placed at a visible place (usually top) inside the application window. The menu can be programmed to appear or hide on mouse clicks.


Window manipulating icons
tabs
icons
Applications
Applications
ProData
FAVORITES
Applications
Desktop
Documents
Downloads
Movies
Music
Pictures
DEVICES
Pinaca
App Store
AppCleaner
Art Text 2 Lite
Automator
Calculator
Calendar
OSX ▸ Applications
84 items, 73.14 GB available
Slider
Status-bar

- **Icon** - An icon is small picture representing an associated application. When these icons are clicked or double clicked, the application window is opened. Icon displays application and programs installed on a system in the form of small pictures.
- **Cursor** - Interacting devices such as mouse, touch pad, digital pen are represented in GUI as cursors. On screen cursor follows the instructions from hardware in almost real-time. Cursors are also named pointers in GUI systems. They are used to select menus, windows and other application features.

Usability

"Usability: the extent to which a product can be used by specified users to achieve specified goals with *effectiveness, efficiency and satisfaction* in a specified context of use."

Usability

- **Why is usability important?**
  - It makes the difference between performing a task accurately and completely or not, and enjoying the process or being frustrated.
  - Determine the success or failure of a system
- **Poor usability…**
  - Reduce productivity
  - Increase cost time and effort

Usability

- Usability usually refers to software but is relevant to any product. Some ways to improve usability include:
  - shortening the time to accomplish tasks,
  - reducing the number of mistakes made,
  - reducing learning time,
  - and improving people's satisfaction with a system.

Usability

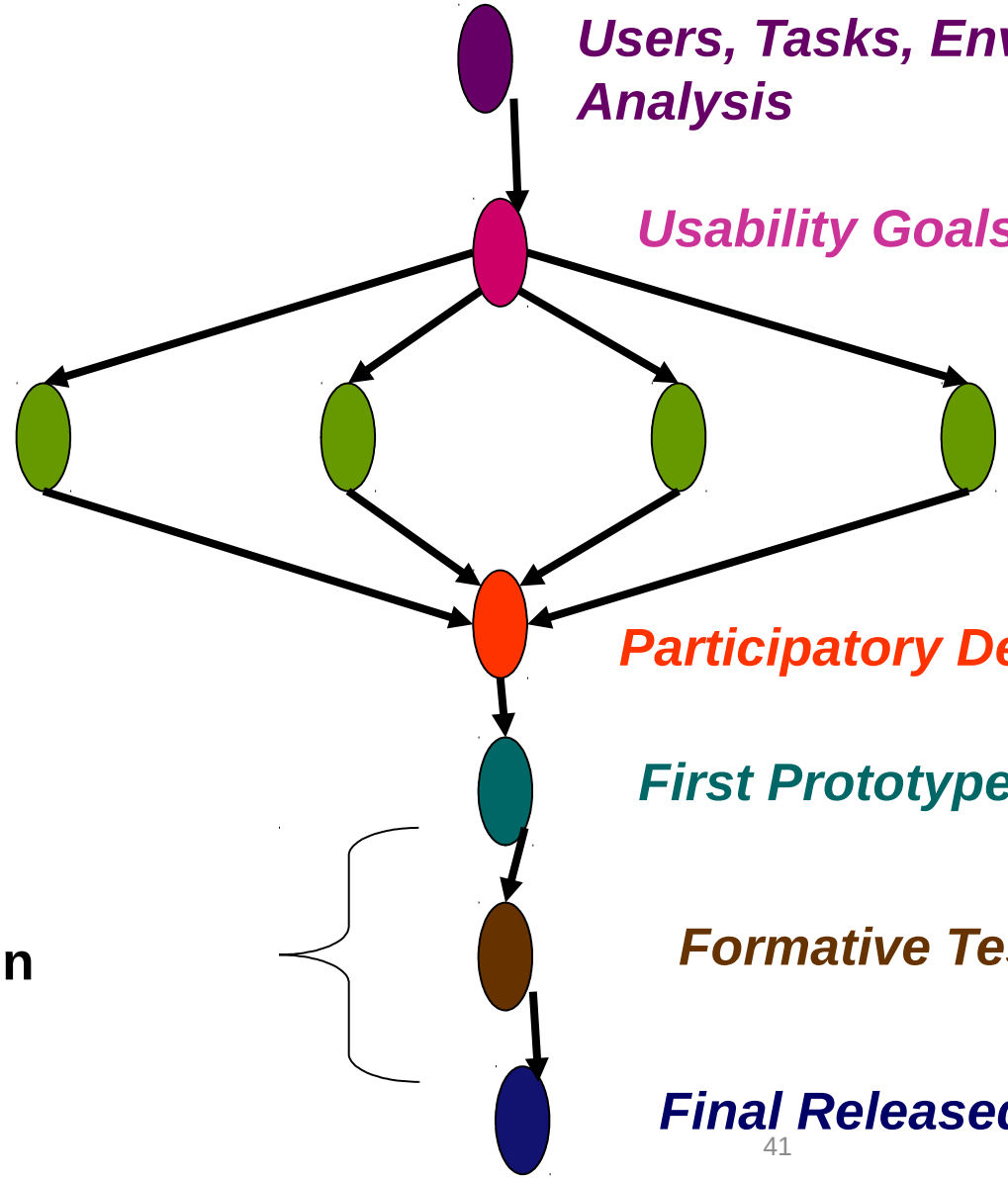
Usability is defined by five quality components :

- **Learnability** : ease of learning for novice users.
- **Efficiency** : steady-state performance of expert users.
- **Memorability** : ease of using system intermittently for casual users.
- **Errors** : error rate for minor and catastrophic errors.
- **Subjective Satisfaction** : how pleasant the system is to use.

Usability Engineering

- The term **usability engineering** describes a process of user interface development, sometimes referred to as **user centred design**.
- It is a lifecycle process that puts an early emphasis on **user and task analysis** and actual user involvement in the design and **testing of a product**.
- A product developed with such a user centred process is likely to be a more usable product than one that is developed independent of user considerations and involvement.

Usability Engineering Lifecycle



Users, Tasks, Environment Analysis

Usability Goals , Competitive Analysis

Parallel Design Sketches

Participatory Design

First Prototype

Iterative Design

Formative Testing

Final Released Product

Usability Engineering Lifecycle

1. Identify user requirements and problems
   - Profile Users
   - Task Analysis
2. Identify usability goals based on user requirements
3. Checkout similar products
4. Design and prototype a solution (involve users)
5. Evaluate prototype
   - Usability testing (*real users and real tasks*)
6. Reiterate steps 4-5 …until users are satisfied

Usability Engineering Lifecycle

- **Identify user requirements and problems:**
  - Define your user population.
  - Determine the distribution of **skills, knowledge and experience** within your user population.
  - Assess the user's skill level with respect to both the **task and computer domain**.

Usability Engineering Lifecycle

- **Identify user requirements and problems:**
  - Task analysis allows a designer to identify the goals and purposes of the intended user group.
  - This used to involve further analysis of user requirements or investigation/observation of customers
  - Used to guide user interface design

Usability Engineering Lifecycle

- **Identify usability goals based**
  - Learnability, Efficiency, Memorability, Error, Subjective Satisfaction
  - Decide in advance on usability metrics and desired level of measured usability
  - E.g.

Errors Per Hour			
Optimal	Target	Current	Unacceptable
0	1 - 3	4.5	> 5

Usability Engineering Lifecycle

- **Check out similar products (Competitive Analysis)**
  - Competitive analysis of software components
  - Competitive analysis of competing systems

Usability Engineering Lifecycle

- **Parallel Design (Explore design alternatives)**
  - designers should work independently, then compare draft designs

Usability Engineering Lifecycle

- **Participatory Design**
  - Have access to pool of representative users.
  - Guided discussion of prototypes, paper mock-ups, screen designs with representative users.
  - E.g. Card Sorting

Usability Engineering Lifecycle

- **Applying Guidelines**
  - Guidelines . . . general principles and advice about usability characteristics of interfaces
  - Can be *intimidating* – often *hundreds* or *thousands* of specific recommendations.

Usability Engineering Lifecycle

Prototyping & Testing

- Perform usability evaluation as early as possible in the design cycle by building and evaluating prototypes

- A usable interface has three main outcomes:
- It should be **easy for the user to become familiar with and competent in** using the user interface during the *first* contact with the website. For example, if a travel agent's website is a well-designed one, the user should be able to move through the sequence of actions to book a ticket *quickly*.

- It should be **easy for users to achieve their objective** through using the website. If a user has the goal of booking a flight, a good design will guide him/her through the *easiest* process to purchase that ticket.

- It should be **easy to recall the user interface and how to use it on subsequent visits**. So, a good design on the travel agent’s site means the user should *learn* from the first time and book a second ticket *just as easily*.

Usability attributes

Usability has multiple components and is traditionally associated with these five usability attributes:

- **Learnability**: The system should be easy to learn so that the user can rapidly start getting some work done with the system.

- **Efficiency**: The system should be efficient to use, so that once the user has learned the system, a high level of productivity is possible.

- **Memorability**: The system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.

- **Errors**: The system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them. Further, catastrophic errors must not occur.

- **Satisfaction**: The system should be pleasant to use, so that users are subjectively satisfied when using it; they like it.

References

- https://nptel.ac.in/courses/124/107/124107008/
- K. Meena, R. Sivakumar, *“Human-Computer Interaction”*, PHI Learning
- Wilbert O Galitz, “*The essential guide to user interface design* “,Wiley
- Dix A., Finlay J., Abowd G. D. and Beale R. “*Human Computer Interaction*“, Pearson Education