Module 1

The User Interface—an Introduction and Overview

1. Define user interface design and list the importance of good design.

User interface design is a subset of a field of study called human-computer interaction (HCI). Human-computer interaction is the study, planning, and design of how people and computers work together so that a person's needs are satisfied in the most effective way.

HCI designers must consider a variety of factors: what people want and expect, what physical limitations and abilities people possess, how their perceptual and information processing systems work, and what people find enjoyable and attractive.

The user interface is the part of a computer and its software that people can see, hear, touch, talk to, or otherwise understand or direct. The user interface has essentially two components: input and output. Input is how a person communicates his or her needs or desires to the computer. Some common input components are the keyboard, mouse, trackball, one's finger, and one's voice Output is how the computer conveys the results of its computations and requirements to the user.

Importance of good design

A well-designed interface and screen is terribly important to our users. It is their window to view the capabilities of the system. To many, it is the system, being one of the few visible components of the product we developers create. It is also the vehicle through which many critical tasks are presented. These tasks often have a direct impact on an organization's relations with its customers, and its profitability.

A screen's layout and appearance affect a person in a variety of ways .If they are con- fusing and inefficient, people will have greater difficulty in doing their jobs and will make more mistakes. Poor design may even chase some people away from a system permanently. It can also lead to aggravation, frustration, and increased stress.

2. Explain the benefits of good design

Productivity benefits we could gain through proper design. Based on an actual system requiring processing of 4.8 million screens per year and illustrated in Table Impact of Inefficient Screen Design on Processing Time an analysis established that if poor clarity forced screen users to spend one extra second per screen, almost one additional person-year would be required to process all screens. Twenty extra seconds in screen usage time adds an additional 14 person-years.

Table : Impact of Inefficient Screen Design on Processing Time

Additional Seconds Required Per Screen in Seconds	Additional Person Years Required To Process 4.8 Million Screens Per Year
1	0.7
5	3.6
10	7.1
20	14.2

The benefits of a well-designed screen have also been under experimental scrutiny for many years. One researcher, attempted to improve screen clarity and readability by making screens less crowded. Separate items, which had been combined on the same display line to conserve space, were placed on separate lines instead. The result: screen users were about 20 percent more productive with the less-crowded version.

Another researcher has reported that reformatting inquiry screens following good design principles reduced decision-making time by about 40 percent, resulting in a savings of 79 person-years in the affected system. In a second study comparing 500 screens, it was found that the time to extract information from displays of airline or lodging information was 128 percent faster for the best format than for the worst.

Proper formatting of information on screens does have a significant positive effect on performance. Cope and Uliano (1995) found that one graphical window redesigned to be more effective would save a company about $20,000 during its first year of use.

Productivity benefits of well-designed Web pages have also been scrutinized. Baca and Cassidy (1999) redesigned an organization's home page because users were complaining they were unable to find information they needed. These designers established a usability objective specifying that after redesign users should be able to locate the desired information 80 percent of the time. After one redesign, 73 percent of the searches were completed with an average completion time of 113 seconds.

3 . Define graphical user interface and its history.

In the 1970s, another dialog alternative surfaced. Research at Xerox's Palo Alto Research Center provided an alternative to the typewriter, an interface using a form of human gesturing, the most basic of all human communication methods. The Xerox systems, Altus and STAR, introduced the mouse and pointing and selecting as the primary human-computer communication method. The user simply pointed at the screen, using the mouse as an intermediary. These systems also introduced the graphical user interface as we know it today. Ivan Sutherland at the Massachusetts Institute of Technology (MIT) is given credit for first introducing graphics with his Sketchpad program in 1963. Lines, circles, and points could be drawn on a screen using a light pen. Xerox worked on developing handheld pointing devices in the 1960s and patented a mouse with wheels in 1970. In 1974, Xerox patented today's ball mouse, after a researcher was suddenly inspired to turn a track ball upside down. A chronological history of GUIs is found in Table below.

Table Chronological History of Graphical User Interfaces

1973	Pioneered at the Xerox Palo Alto Research Center.
1981	First to pull together all the elements of the modern GUI. First commercial marketing as the Xerox STAR
1983	Apple introduces the Lisa. -Features pull-down menus and menu bars.
1984	Apple introduces the Macintosh. Macintosh is the first successful mass-marketed system.
1985	Microsoft Windows 1.0 released. Commodore introduces the Amiga 1000.
1987	X Window System becomes widely available. IBM's System Application Architecture released. -Including Common User Access (CUA). IBM's Presentation Manager released. -Intended as graphics operating system replacement for DOS. Apple introduces the Macintosh II. -The first color Macintosh.
1988	NeXT's Next Step released. -First to simulate three-dimensional screen.
1989	UNIX-based GUIs released. -Open Look by AT&T and Sun Microsystems. -Innovative appearance to avoid legal challenges. -Motif, for the Open Software Foundation by DEC and Hewlett-Packard.
1992	OS/2 Workplace Shell released. Microsoft Windows 3.1 released.
1993	Microsoft Windows NT released.
1995	Microsoft Windows 95 released.
1996	IBM releases OS/2 Warp 4. Microsoft introduces NT 4.0.
1997	Apple releases the Mac OS 8.
1998	Microsoft introduces Windows 98.

1999	Apple releases Mac OS X Server. — A UNIX-based OS.
2000	Microsoft Windows 2000 released. Microsoft Windows ME released
2001	Microsoft Windows XP released

4. Brief the history of screen design.

While developers have been designing screens since a cathode ray tube display was first attached to a computer, more widespread interest in the application of good de- sign principles to screens did not begin to emerge until the early 1970s, A 1970s screen often resembled the one pictured in Figure 1.1. It usually consisted of many fields (more than are illustrated here) with very cryptic and often unintelligible captions. It was visually cluttered, and often possessed a command field that challenged the user to remember what had to be keyed into it. Ambiguous messages often required referral to a manual to interpret. Effectively using this kind of screen required a great deal of practice and patience. Most early screens were mono- chromatic, typically presenting green text on black backgrounds.

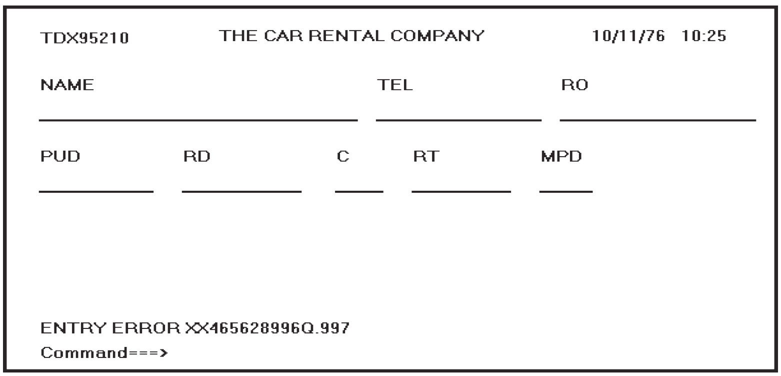
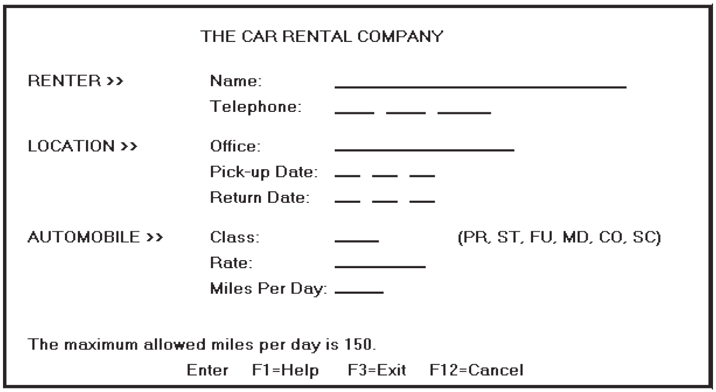


Figure 1.1 A 1970s screen

Screens began to take on a much less cluttered look through concepts such as grouping and alignment of elements, as illustrated in Figure 1.2. User memory was



supported by providing clear and meaningful field captions and by listing commands on the screen, and enabling them to be applied through function keys. Messages also became clearer. These screens were not entirely clutter-free, however. Instructions and reminders to the user had to be inscribed on the screen in the form of prompts or completion aids such as the codes PR and SC. Not all 1980s screens looked like this, however. In the 1980s, 1970s-type screens were still being designed, and many still reside in systems today.

Figure 1.2 A 1980s screen.

The advent of graphics yielded another milestone in the evolution of screen design, as illustrated in Figure 1.3. While some basic design principles did not change, groupings and alignment, for example, borders were made available to visually enhance groupings and buttons and menus for implementing commands replaced function keys. Multiple properties of elements were also provided, including many different font sizes and styles, line thicknesses, and colors. The entry field was supplemented by a multitude of other kinds of controls, including list boxes, drop-down combination boxes, spin boxes, and so forth.

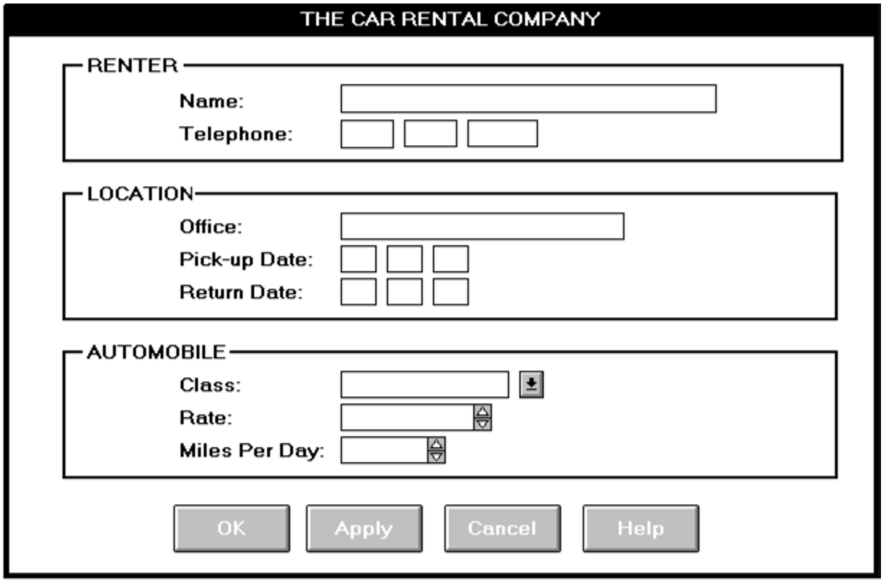


Figure 1.3. A 1990's and beyond screen.

5. Explain the concept of direct manipulation system.

The term used to describe this style of interaction for graphical systems was first used by Shneiderman. He called them "direct manipulation" systems, they possess the following characteristics:

- **The system is portrayed as an extension of the real world:**

It is assumed that a person is already familiar with the objects and actions in his or her environment of interest. The system simply replicates them and portrays them on a different medium, the screen. A person has the power to access and modify these objects, among which are windows. A person is allowed to work in a familiar environment and in a familiar way, focusing on the data, not the application and tools. The physical organization of the system, which most often is unfamiliar, is hidden from view and is not a distraction.

- **Continuous visibility of objects and actions:**

Objects are continuously visible. Reminders of actions to be performed are also obvious, labelled buttons replacing complex syntax and command names. Cursor action and motion occurs in physically obvious and intuitively natural ways.

- **Actions are rapid and incremental with visible display of results:**

Since tactile feedback is not yet possible, the results of actions are immediately displayed visually on the screen in their new and current form. Auditory feedback may also be provided. The impact of a previous action is quickly seen, and the evolution of tasks is continuous and effortless.

- **Incremental actions are easily reversible:**

Finally, actions, if discovered to be incorrect or not desired, can be easily undone.

6. Explain the concept of indirect manipulation system.

Direct manipulation of all screen objects and actions may not be feasible because of the following:

- The operation may be difficult to conceptualize in the graphical system.
- The graphics capability of the system may be limited.
- The amount of space available for placing manipulation controls in the window border may be limited.
- It may be difficult for people to learn and remember all the necessary operations and actions.

Indirect manipulation substitutes words and text, such as pull-down or pop-up menus, for symbols, and substitutes typing for pointing. Most window systems are a combination of both direct and indirect manipulation. A menu may be accessed by pointing at a menu icon and then selecting it .The menu itself is a textual list of operations. When an operation is selected from the list, by pointing or typing, the system executes it as a command.

7. What are Graphical Systems? Brief the advantages of Graphical Systems.

Simplified interface they presented was thought to reduce the memory requirements imposed on the user, make more effective use of one's information-processing capabilities, and dramatically reduce system learning requirements.

advantages of these systems.

- **Symbols recognized faster than text.** Research has found that symbols can be recognized faster and more accurately than text, graphical attributes of icons, such as shape and color, are very useful for quickly classifying objects, elements, or text by some common property.
- **Faster learning.** Research has also found that a graphical, pictorial representation aids learning, and symbols can also be easily learned.
- **Faster use and problem solving**. Visual or spatial representation of information has been found to be easier to retain and manipulate and leads to faster and more successful problem solving. Symbols have also been found to be effective in conveying simple instructions.
- **Easier remembering.** Because of greater simplicity, it is easier for casual users to retain operational concepts.
- **More natural.** Graphic representations of objects are thought to be more natural and closer to innate human capabilities. In human beings, actions and visual skills emerged before languages. It has also been suggested that symbolic displays are more natural and advantageous because the human mind has a powerful image memory.
- **Exploits visual/spatial cues.** Spatial relationships are usually found to be under- stood more quickly than verbal representations.
- **Fosters more concrete thinking.** Displayed objects are directly in the high-

level task domain, or directly usable in their presented form. There is no need mentally to decompose tasks into multiple commands with complex syntactic form.

- **Increased feeling of control.** The user initiates actions and feels in control. This increases user confidence and hastens system mastery.
- **Immediate feedback.** The results of actions furthering user goals can be seen immediately. Learning is quickened. If the response is not in the desired direction, the direction can be changed quickly.
- **Predictable system responses.** Predictable system responses also speed learning.
- **Easily reversible actions.** The user has more control. This ability to reverse un- wanted actions also increases user confidence and hastens system mastery.
- **Less anxiety concerning use.** Hesitant or new users feel less anxiety when using the system because it is so easily comprehended, is easy to control, and has predictable responses and reversible actions.
- **More attractive.** Direct-manipulation systems are more entertaining, cleverer, and more appealing. This is especially important for the cautious or skeptical user.
- **May consume less space.** Icons may take up less space than the equivalent in words. More information can often be packed in a given area of the screen. This, how- ever, is not always the case.
- **Replaces national languages.** Language-based systems are seldom universally applicable. Language translations frequently cause problems in a text-based sys- tem. Icons possess much more universality than text and are much more easily comprehended worldwide.

- **Easily augmented with text displays.** Where graphical design limitations exist, direct-manipulation systems can easily be augmented with text displays. The re- verse is not true.
- **Low typing requirements.** Pointing and selection controls, such as the mouse or trackball, eliminate the need for typing skill.
- **Smooth transition from command language system**. Moving from a command language to a direct-manipulation system has been found to be easy. The reverse is not true.

8. List out the disadvantages of Graphical Systems.

Disadvantages of Graphical Systems are these:

- **Greater design complexity.** The elements and techniques available to the graphical screen designer far outnumber those that were at the disposal of the text-based screen designer. Controls this design potential may not necessarily result in better design, unless the choices are thoughtfully selected and consistently and simply applied.
- **Learning still necessary.** The first time one encounters many graphical systems, what to do is not immediately obvious. The meanings of many words and icons may not be known. It is not often possible to guess their meanings, especially the more arbitrary symbols. How to use a pointing device may also have to be learned. A severe learning and remembering requirement is imposed on many users, and it takes a while to get up to speed. A text-based system could easily be structured to incorporate a set of clear instructions: (1) Do this, (2) now do this, and so on.
- **Lack of experimentally-derived design guidelines.** The graphical interface is still burdened today by a lack of widely available experimentally derived design guidelines. Because of a number of factors. First, builders of platforms

and packages will not publish their study results because they want to maintain a competitive advantage.

- **Inconsistencies in technique and terminology.** Inconsistencies occur because of copyright and legal implications, product differentiation considerations, and our expanding knowledge about the interface. The result is that learning, and relearning, for both designers and users are much more difficult than it should be.
- **Working domain is the present.** While direct-manipulation systems provide con- text, they also require the user to work in the "present.
- **Not always familiar.** Symbolic representations may not be as familiar as words or numbers. We have been exposed to words and numbers for a long time. Research has found that numeric symbols elicit faster responses than graphic symbols in a visual search task.
- **Human comprehension limitations.** Human limitations may also exist in terms of one's ability to deal with the increased complexity of the graphical interface. The variety of visual displays can still challenge all but the most sophisticated users. The number of different icons that can be introduced is also restricted because of limitations in human comprehension.
- **Window manipulation requirements**. Window handling and manipulation times are still excessive and repetitive. This wastes time and interrupts the decision- making needed to perform tasks and jobs.
- **Production limitations.** The number of symbols that can be clearly produced using today's technology is still limited. A body of recognizable symbols must be produced that are equally legible and equally recognizable using differing technologies. This is extremely difficult today.
- **Inefficient for touch typists.** For an experienced touch typist, the keyboard is a

very fast and powerful device. Moving a mouse or some other pointing mechanism may be slower.

- **Inefficient for expert users**. Inefficiencies develop when there are more objects and actions than can fit on the screen. Concatenation for a command language is impossible.
- **Not always the preferred style of interaction.** Not all users prefer a pure iconic interface. A study comparing commands illustrated by icons, icons with text, or text-only, found that users preferred alternatives with textual captions.
- **Not always fastest style of interaction.** Another study has found that graphic instructions on an automated bank teller machine were inferior to textual instructions.
- **May consume more screen space.** Not all applications will consume less screen space. A listing of names and telephone numbers in a textual format will be more efficient to scan than a card file.
- **Hardware limitations.** Good design also requires hardware of adequate power, processing speed, screen resolution, and graphic capability. Insufficiencies in these areas can prevent a graphic system's full potential from being realized.

9. What are the characteristics of Graphical User Interface? Explain briefly.

Sophisticated Visual Presentation Visual presentation is the visual aspect of the interface. It is what people see on the screen. The sophistication of a graphical system permits displaying lines, including drawings and icons. It also permits the displaying of a variety of character fonts, including different sizes and styles. The display of 16 million or more colors is possible on some screens. Graphics also permit animation and the presentation of photographs and motion video.

Pick-and-Click Interaction Elements of a graphical screen upon which some action is to be performed must first be identified. The motor activity required of a person to identify this element for a pro- posed action is commonly referred to as pick, the signal to perform an action as click. The primary mechanism for performing this pick-and-click is most often the mouse and its buttons. The user moves the mouse pointer to the relevant element (pick) and the action is signalled (click). Pointing allows rapid selection and feedback.

Restricted Set of Interface Options The array of alternatives available to the user is what is presented on the screen or what may be retrieved through what is presented on the screen, nothing less, and nothing more.

Visualization is a cognitive process that allows people to understand information that is difficult to perceive. The best visualization method for an activity depends on what people are trying to learn from the data. The goal is not necessarily to reproduce a realistic graphical image, but to produce one that conveys the most relevant information..

Object Orientation A graphical system consists of objects and actions. Objects are what people see on the screen. They are manipulated as a single unit. A well-designed system keeps users focused on objects, not on how to carry out actions. Objects can be composed of sub objects.

Use of Recognition Memory Continuous visibility of objects and actions encourages use of a person's more powerful recognition memory. The "out of sight, out of mind" problem is eliminated.

Concurrent Performance of Functions Graphic systems may do two or more things at one time. Multiple programs may run simultaneously. When a system is not busy on a primary task, it may process back- ground tasks. When applications are running as truly separate tasks, the system may divide the processing power into time slices and allocate portions to each application. Data may also be transferred between programs. It may be temporarily stored on a "clipboard" for later transfer or be automatically swapped between programs.

10. Explain the concept of object orientation in graphical user interface design.

A graphical system consists of objects and actions. *Objects* are what people see on the screen. They are manipulated as a single unit. A well-designed system keeps users focused on objects, not on how to carry out actions. Objects can be composed of *subobjects.*

Breaks objects into three meaningful classes: data, container, and device. *Data objects* present information. This information, either text or graphics, normally appears in the body of the screen.

Container objects are objects to hold other objects. They are used to group two or more related objects for easy access and retrieval. There are three kinds of container objects: the workplace, folders, and work areas.

The *workplace* is the desktop, the storage area for all objects. *Folders* are general-purpose containers for long-term storage of objects. *Work areas* are temporary.

Device objects represent physical objects in the real world, such as printers or trash baskets. These objects may contain others for acting upon.

A *collection* is the simplest relationship the objects sharing a common aspect. A collection might be the result of a query or a multiple selection of objects.

A *constraint* is a stronger object relationship. Changing an object in a set affects some other object in the set. A document being organized into pages is an example of a constraint.

A *composite* exists when the relationship between objects becomes so significant that the aggregation itself can be identified as an object.

A *container* is an object in which other objects exist. Examples include text in a document or documents in a folder. A container often influences the behavior of its con- tent. These relationships help define an object's *type*. Similar traits and behaviors exist in objects of the same object type. Another important object characteristic is *persistence*. Persistence is the maintenance of a state once it is established.

11. Differentiate between Graphical user interfaces with Web Page Design.

Devices. In GUI design, the characteristics of interface devices such as monitors and modems are well defined, and design variations tend to be restricted. Monitor display capabilities, such as installed fonts and screen size, are established and easily considered in the design process. In Web design, no assumptions about the user's interface devices can be made. User devices may range from handheld mechanisms to high-end workstations.

User focus. GUI systems are about well-defined applications and data, about transactions and processes. Thorough attention must usually be addressed to tasks in need of completion. The Web is about information and navigation, an environment where people move back and forth in an unstructured way among many pages of information. Web use is most often characterized browsing and visual scanning of information to find what information is needed.

Data/information. GUI data is typically created and used by known and trusted sources, people in the user's organization or reputable and reliable companies and organizations. The properties of the system's data are generally known, and the information is typically organized in an understandable and meaningful fashion. A notion of shared data exists, as does a notion of data privacy. The Web is full of unknown content typically placed there by others unknown to the user. Typical users don't put information on the Web.

User tasks. GUI system users install, configure, personalize, start, use, and upgrade programs. They open, use, and close data files. Fairly long times are spent within an individual application, and people become familiar with many of its features and its design. Web users do things like linking to sites, browsing or reading pages, filling out forms, registering for services, participating in transactions, and downloading and saving things.

User's conceptual space. In a GUI environment the user's conceptual space is controlled by the program and application. A user's access to data is constrained, and space is made available where their data can be stored and managed. A Web user's space is infinite and generally unorganized. Little opportunity for meaningful organization of personal information exists.

Presentation elements. The main presentation elements for GUIs are various kinds of windows, menus, controls, toolbars, messages, and data. Many elements are transient, dynamically appearing and disappearing based upon the current context of the interaction. They are also generally standardized as a result of the toolkits and style guides used. Elements are presented on screens exactly as specified by the designer. Web systems possess two components: the browser and page. Many browsers are substantially GUI applications with traditional GUI presentation elements. Within a page itself, however, any combination of text, images, audio, video, and animation may exist.

Navigation. GUI users navigate through structured menus, lists, trees, dialogs, and wizards. Paths are constrained by design and the navigation mechanisms standardized by toolkits and style guides. Navigation is a weakly established concept, a supplement to more important task func- tions and actions. Web users control their own navigation through links, bookmarks, and typed URLs. Navigation is a significant and highly visible concept with few constraints.

Context. GUI systems enable the user to maintain a better sense of context. Paths are restricted, and multiple overlapping windows may be presented and be visible, enabling users to remember how what they are doing fits into the overall task picture. Web pages are single entities with almost unlimited navigation paths. They do not bring up separate dialog boxes to ask questions, provide or request supplemental information, or present messages. Contextual clues become limited or are hard to find.

Interaction. GUI interactions consist of such activities as clicking menu choices, pressing buttons, selecting choices from list, keying data, and cutting, copying, or pasting within context established by an open window and an active program. The basic Web interaction is a single click. This click can cause extreme changes in context such as moving to another site or changing the displayed information within a site. The user may not notice subtle changes when they occur.

Response time. Compared to the Web, response times with a GUI system are fairly stable, if not nearly instantaneous. Web response times can be quite variable, and often aggravatingly slow. Line transmission speeds, system loads, and page content can have a dramatic impact. Long response times can upset and frustrate users.

Visual style. In GUI systems, the visual style is typically prescribed and constrained by toolkit. (Exceptions are entertainment and multimedia applications.) Visual creativity in screen design is allowed but it is difficult to do. While some user options and style choices do exist, little opportunity exists for screen personalization. In Web page design, a more artistic, individual, and unrestricted presentation style is allowed and encouraged.

System capability. GUI system capabilities are only limited in proportion to the capability of the hardware in terms of speed, memory, and configuration, and the sophistication of the software. The Web is more constrained, being limited by constraints imposed by the hardware, browser, and software.

Task efficiency. GUI systems are targeted to a specific audience performing specific tasks. Generally, the efficiency of performing a task is only limited by the amount of programming undertaken to support it. Browser and network capabilities limit Web task efficiency.

Consistency. Consistency in GUI system design is a major objective in most development efforts. While they are far from perfect, an attempt is made to be consistent both within applications and across applications. Many organizations possess interface and screen design standards and toolkits to aid in the standardization process. Toolkits and guidelines also allow a certain degree of universal consistency in GUI products. In Web page design, the heavy emphasis on graphics, a lack of design standards, and the desire of Web sites to establish their own identities results in very little consistency across sites.

User assistance. User assistance is an integral part of most GUI systems applications. This assistance is accessed through standard mechanisms such as the F1 key and Help menus. Message and status areas are also provided on the screen. Documentation, both online and offline, is normally provided, as is a support desk to answer user questions and provide guidance and assistance. Web pages do not yet provide similar help systems. What little help that is available is built into the page. Customer service support, if provided, is generally oriented to the product or service offered.

Integration. A primary goal of most GUI applications is the seamless integration of all pieces. Common functions are supported across applications and import/ex- port capabilities exist. Again, toolkits and their components are key elements in accomplishing this objective. In Web design, some integration is apparent within a site for basic functions such as navigation and printing.

Security. In a GUI environment, security and data access can be tightly controlled, in proportion to the degree of willingness of an organization to invest resources and effort. For home applications, security is not an issue for most PC users. The Web is renowned for security exposures. This is a major inhibitor of Web use for both businesses and consumers. Browser-provided security options have typically not been well understood by average Web users.

Reliability. Like security, reliability in GUI systems is established and controlled in proportion to the degree of willingness of an organization to invest resources and effort. The computer being used influences reliability as does, if applicable, the local area network.

12. Highlight the general principles of UI design.

Fundamental principle to design and implementation of all effective interfaces, including GUI and Web. These principles are general characteristics of the interface, and they apply to all aspects.

1. **Aesthetically Pleasing**

- Provide visual appeal by following these presentation and graphic design principles:
  – Provide meaningful contrast between screen elements.
  – Create groupings.
  – Align screen elements and groups.
  – Provide three-dimensional representation.
  – Use color and graphics effectively and simply.

2. **Clarity**

- The interface should be visually, conceptually, and linguistically clear, including.
  – Visual elements
  – Functions
  – Metaphors
  – Words and text.

3. **Compatibility**

- Provide compatibility with the following:

– The user
– The task and job
– The product

- Adopt the user's perspective.

4. **Comprehensibility**

- A system should be easily learned and understood. A user should know the following:
  – What to look at
  – What to do

  - When to do it
  - Where to do it
  - Why to do it
  - How to do it.
- The flow of actions, responses, visual presentations, and information should be in a sensible order that is easy to recollect and place in context.

5. Configurability

- Permit easy personalization, configuration, and reconfiguration of settings.
  - Enhances a sense of control.
  - Encourages an active role in understanding.

6. **Consistency**

- A system should look, act, and operate the same throughout. Similar components should:
  a. Have a similar look.
  b. Have similar uses.
  c. Operate similarly.
- The same action should always yield the same result.
- The function of elements should not change.
- The position of standard elements should not change.

7. Control

- The user must control the interaction.
  a. Actions should result from explicit user requests.
  b. Actions should be performed quickly.
  c. Actions should be capable of interruption or termination.
  d. The user should never be interrupted for errors.
- The context maintained must be from the perspective of the user.

- The means to achieve goals should be flexible and compatible with the user's skills, experiences, habits, and preferences.
- Avoid modes since they constrain the actions available to the user.
- Permit the user to customize aspects of the interface, while always providing a proper set of defaults.

8. Directness

- Provide direct ways to accomplish tasks.
  - Available alternatives should be visible.
  - The effect of actions on objects should be visible.

9. Efficiency

- Minimize eye and hand movements, and other control actions.
  - Transitions between various system controls should flow easily and freely.
  - Navigation paths should be as short as possible.
  - Eye movement through a screen should be obvious and sequential.
- Anticipate the user's wants and needs whenever possible.

10. Familiarity

- Employ familiar concepts and use a language that is familiar to the user.
- Keep the interface natural, mimicking the user's behaviour patterns.
- Use real-world metaphors.

11. Flexibility

- A system must be sensitive to the differing needs of its users, enabling a level and type of performance based upon:
  - Each user's knowledge and skills.
  - Each user's experience.
  - Each user's personal preference.
  - Each user's habits.

– The conditions at that moment.

12. Forgiveness

- Tolerate and forgive common and unavoidable human errors.
- Prevent errors from occurring whenever possible.
- Protect against possible catastrophic errors.
- When an error does occur, provide constructive messages.

13. Predictability

- The user should be able to anticipate the natural progression of each task.
  - Provide distinct and recognizable screen elements.
  - Provide cues to the result of an action to be performed.
- All expectations should be fulfilled uniformly and completely.

14. Recovery

- A system should permit:

– Commands or actions to be abolished or reversed.

– Immediate return to a certain point if difficulties arise.

- Ensure that users never lose their work as a result of:

– An error on their part.

– Hardware, software, or communication problems.

15. Responsiveness

- The system must rapidly respond to the user’s requests.
- Provide immediate acknowledgment for all user actions:
  - Visual.
  - Textual.

16. Simplicity

- Provide as simple an interface as possible.

- Five ways to provide simplicity:
  - – Use progressive disclosure, hiding things until they are needed.
    - Present common and necessary functions first.
    - Prominently feature important functions.
    - Hide more sophisticated and less frequently used functions.
  - – Provide defaults.
  - – Minimize screen alignment points.
  - – Make common actions simple at the expense of uncommon actions being made harder.
  - – Provide uniformity and consistency.

17. Transparency

- Permit the user to focus on the task or job, without concern for the mechanics of the interface.

  – Workings and reminders of workings inside the computer should be invisible to the user.

18. Trade-Offs

- Final design will be based on a series of trade-offs balancing often-conflicting design principles.
- People's requirements always take precedence over technical requirements.

13. List and explain the principles of Xerox STAR

These principles established the foundation for graphical interfaces.

The illusion of manipulable objects. Displayed objects that are selectable and manipulable must be created. A design challenge is to invent a set of displayable objects that are represented meaningfully and appropriately for the intended application. It must be clear that these objects can be selected, and how to select them must be self-evident. When they are selected should also be obvious, because it should be clear that the selected object will be the focus of the next action.

Visual order and viewer focus. Attention must be drawn, at the proper time, to the important and relevant elements of the display. Effective visual contrast between various components of the screen is used to achieve this goal (STAR was mono-chromatic so color was not used). Animation is also used to draw attention, as is sound. Feedback must also be provided to the user. Since the pointer is usually the focus of viewer attention, it is a useful mechanism for providing this feedback (by changing shapes).

Revealed structure. The distance between one's intention and the effect must be minimized. Most often, the distance between intention and effect is lengthened as system power increases. The relationship between intention and effect must betightened and made as apparent as possible to the user. The underlying structure is often revealed during the selection process.

Consistency. Consistency aids learning. Consistency is provided in such areas as element location, grammar, font shapes, styles, and sizes, selection indicators, and contrast and emphasis techniques.

Appropriate effect or emotional impact. The interface must provide the appropriate emotional effect for the product and its market. Is it a corporate, professional, and secure business system? Should it reflect the fantasy, wizardry, and bad puns of computer games?

A match with the medium. The interface must also reflect the capabilities of the de- vice on which it will be displayed. Quality of screen images will be greatly affected by a device's resolution and color-generation capabilities.

14. Differentiate between printed pages and web pages.

Major differences between print and Web page design, Implications for Web page design.

Page size. Printed pages are generally larger than their Web counterparts. They are also fixed in size, not variable like Web pages. A printed page can be designed as one entity, the designer being assured that the completed final product will possess an integrated and complete look. Web pages, while usually designed as a complete entity, are presented in pieces, pieces whose dimensions differ depending on the user's technology. The visual impact of the printed page is maintained in hard-copy form, while on the Web that entire usually exists are snapshots of page areas.

Page rendering. Printed pages are immensely superior to Web pages in rendering. Printed pages are presented as complete entities, and their entire contents are available for reading or review immediately upon appearance. Web pages elements are often rendered slowly, depending upon things like line transmission speeds and page content. Dozens of seconds may be consumed waiting for a page to completely appear. Impatient users may not wait, moving on to somewhere else. Design implications: Provide page content that downloads fast, and give people elements to read immediately so the sense of passing time is diminished.

Page layout. With the printed page, layout is precise with much attention given to it. With Web pages layout is more of an approximation Design implication: Understand the restrictions and design for the most common user tools.

Page resolution. Today, the resolution of displayed print characters still exceeds that of screen characters, and screen reading is still slower than reading from a document. Design implication: Provide an easy way to print long Web documents.

User focus. Printed pages present people with entire sets of information. Estimations of effort needed to deal with the document are fairly easily made, size and the nature of the material being strong contributors. Design implications: Create easy to scan pages and limit the word count of textual content. Also, provide overviews of information organization schemes, clear descriptions of where links lead, and estimations of sizes of linked pages and materials.

Page navigation. Navigating printed materials is as simple as page turning. Navigating the Web requires innumerable decisions concerning which of many possible links should be followed. Design implications are similar to the above provide overviews of information organization schemes and clear descriptions of where links lead.

Sense of place. With paper documents you derive a sense of where you are through a mixture of graphic and editorial organization, and size cues supplied by the de- sign of the document. Paging through printed material is an orderly process, sequential and understandable. Electronic documents provide none of these physical cues. Design implication: Build cues into Web pages to aid the user in maintaining a sense of place.

Interactivity. Printed page design involves letting the eyes traverse static information, selectively looking at information and using spatial combinations to make page elements enhance and explain each other. Web design involves letting the hands move the information (scrolling, pointing, expanding, clicking, and so on) in conjunction with the eyes.

Page independence. Because moving between Web pages is so easy, and almost any page in a site can be accessed from anywhere else, pages must be made free standing. Every page is independent, and its topic and contents must be explained with- out assumptions about any previous page seen by the user. Printed pages, being sequential, fairly standardized in organization, and providing a clear sense of place, are not considered independent. Specific types of content are easily found in well-established document locations. Design implication: Provide informative headers and footers on each Web page.

15. Brief popularity web.

The graphical user interface revolutionized the user interface, the Web has revolutionized computing. It allows millions of people scattered across the globe to communicate, access information, publish, and be heard. It allows people to control much of the display and the rendering of Web pages. Aspects such as typography and colors can be changed, graphics turned off, and decisions made whether or not to transmit certain data over nonsecure channels or whether to accept or refuse cookies. Nowhere in the history of computing has the user been given so much control.

Web usage has reflected this popularity. The number of Internet hosts has risen dramatically. In 1984, hosts online exceeded 1,000; in 1987, 10,000; in 1989, 100,000, in 1990, 300,000; in 1992 hosts exceeded one million. Commercialization of the Internet saw even greater expansion of the growth rate. In 1993, Internet traffic was expanding at a 341,634 percent annual growth rate. In 1996, there were nearly 10 million hosts online and 40 million connected people.

User control has had some decided disadvantages for some Web site owners as well. Users have become much more discerning about good design. Slow download times, confusing navigation, confusing page organization, disturbing animation, or other undesirable site features often results in user abandonment of the site for others with a more agreeable interface. People are quick to vote with their mouse, and these warnings should not go unheeded.