CMR INSTITUTE OF TECHNOLOGY

USN | | | | | | | | | | |

Internal Assessment Test -2 – Dec. 2021

Sub:	Principles of User Interface Design							Sub Code:	18MCA552	
Date:	20/12/2021	Duration:	90 min's	Max Marks:	50	Sem:	V	Branch:	MCA	

Note : Answer FIVE FULL Questions, choosing ONE full question from each Module

		MARKS	OBE	
			CO	RBT
	PART I	[10]	CO1	L1
1	Discuss the various models of response time impacts. Explain user productivity			
	OR			
2	Write briefly about coordinating multiple windows supported by interface developers.	[10]	CO2	L2
	PART II	[10]	CO2	L2
3	Write short notes on i. Keyboard Layout ii. Voice Information System iii. List Direct-control pointing devices iv. List Indirect pointing devices			
	OR			
4	Explain color guidelines for interactive interface.	[10]	CO1	L1

	PART III			
5	List and explain the seven types of interaction task used for pointing devices.	[10]	CO2	L2
	OR			
6	Explain any five examples of direct manipulation.	[10]	CO2	L1
	PART IV			
7	Explain the basis for preparing error messages.	[10]	CO2	L1
	OR			
8	Explain the advantages of WYSIWYG word processor and Briefly explain about naming and abbreviations	[10]	CO3	L2
	PART V			
	Discuss about the combination of multiple menus	[10]	CO3	L3
	OR			
10	Discuss command Language strategies and structure	[10]	CO1	L2

1) **Explain the advantages of WYSIWYG word processor**

Ans.

• Users see a full page of text. Showing 20 to 60 lines of text simultaneously gives the reader a clearer sense of context for each sentence, while permitting easier reading and scanning of the document. By contrast, working with the one line view offered by line editors is like seeing the world through a narrow cardboard tube. Modern displays can support two or more full pages of text, set side by side.

• The document is seen as it will appear when printed. Eliminating the clutter of formatting commands also simplifies reading and scanning of the document. Tables, lists, page breaks, skipped lines, section headings, centred text, and figures can be viewed in their final form. The annoyance and delay of debugging the format commands are almost eliminated because the errors are usually immediately apparent.

• Cursor action is visible. Seeing an arrow, underscore, or blinking box on the screen gives the operator a clear sense of where to focus attention and to apply action.

• Cursor motion is natural. Arrow keys or cursor-motion devices-such as a mouse, trackpad, or tablet-provide natural physical mechanisms for moving the cursor. This setup is in marked contrast to commands, such as UP 6,that require an operator to convert the physical action into a correct syntactic form that may be difficult to learn and hard to recall, and thus may be a source of frustrating errors.

• Labelled icons make frequent actions rapid. Most word processors have labelled icons in a toolbar for frequent actions. These buttons act as a permanent menu-selection display to remind users of the features and to enable rapid selection.

• Immediate display of the results of all action. When users press a button to move the cursor or centre text, the results are shown immediately on the screen. Deletions are apparent immediately: the character, word, or line is erased, and the remaining text is rearranged. Similarly, insertions or text movements are shown after each keystroke or function-key press. In contrast, with line editors, users must issue print or display commands to see the results of changes.

• Rapid response and display. Most display editors operate at high speed; a full page of text appears in a fraction of a second. This high display rate, coupled with short response time, produces a satisfying sense of power and speed. Cursors can be mewed quickly, large amounts of text can be scanned rapidly, and the results of actions can be shown almost instantaneously. Rapid response also reduces the need for additional commands and thereby simplifies design and learning.

• Easily reversible actions. When users enter text, they can repair an incorrect keystroke by merely backspacing and retyping. They can make simple changes by moving the cursor to the problem area and inserting or deleting characters, words, or lines. A useful design strategy is to include natural inverse actions for each action (for example, to increase or decrease type sizes). An alternative offered by many display editors is a simple undo action to return the text to the state that it was in before the previous action. Easy reversibility reduces user anxiety about making a mistake or destroying the file.

2) **Discuss about the combination of multiple menus**

Ans:

- Traditionally, training and reference material often written by junior member of development team
    - manuals were often poorly written
    - were not suited to the background of the users
    - were delayed or incomplete
    - were not tested adequately
- The benefits of well-designed manuals include shorter learning times, better user performance, increased user satisfaction, and few calls for support

Choose an action-oriented approach

- Provide an immediate opportunity to act.
- Encourage and support exploration and innovation.
- Respect the integrity of the user's activity.
- Show numerous examples.

Let users' tasks guide organization

- Select or design instructional activities that are real tasks.
- Present task concepts before interface objects and actions.
- Create components of instructions that reflect the task structure.

Support error recognition and recovery

- Prevent mistakes whenever possible.
- Provide error information when actions are error-prone or correction is difficult.
- Provide error information that supports detection, diagnosis, and correction.
- Provide on-the-spot error information.

Support reading to do, study, and locate

- Be brief; don't spell out everything.
- Provide a table of contents, index, and glossary.
- Keep the writing style clean and simple.
- Provide closure for chapters.

1 Towards minimal manuals

Minimal manuals encourage active involvement with hands-on experiences

Carroll's *guided exploration*

- choose an action-oriented approach
- anchor the tool in the task domain
- support error recognition and recovery
- support reading to do, study, and locate

- Show numerous well-chosen screen prints that demonstrate typical uses (*predictive model*)
- Table of contents and index required
- Glossaries for clarifying technical terms
- Appendices for error messages

2 Organization and writing style

Precise statement of educational objectives
Present concepts in a logical sequence with increasing order of difficulty
Ensure that each concept is used in subsequent sections
Avoid forward references
Construct sections with approximately equal amounts of new material
Need sufficient examples and complete sample sessions
Choice of words and phrases important
Style guides for organizations attempt to ensure consistency and high quality
Writing style should match users' reading ability

3) Discuss command Language strategies and structure

Ans. Strategies

- Several strategies for command organization have emerged. A unifying interface concept or metaphor aids learning, problem solving, and retention.

- Electronic-mail enthusiasts conduct lively discussions about the metaphoric merits of such task-related objects as file drawers, folders, documents, memos, notes, letters, or messages.
- The appropriate interface actions (CREATE, EDIT, COPY, MOVE, DELETE) and the choice of action pairs such as LOAD/SAVE (too much in the computer domain), READ/WRITE (acceptable for letters, but awkward for file drawers), or OPEN/CLOSE (acceptable for folders, but awkward for notes).

- Designers often err by choosing a metaphor closer to machine domain than to the user's task domain.
    - **Simple command set**
        - Each command is chosen to carry out a single task. The number of commands match the number of tasks.
        - For small number of tasks, this can produce a system easy to learn and use.
        - E.g. the vi editor of Unix.
    - **Command plus arguments/options**
        - Follow each command by one or more arguments that indicate objects to be manipulated, e.g.
            - COPY FILEA, FILEB
            - DELETE FILEA
            - PRINT FILEA, FILEB, FILEC
        - Keyword labels for arguments are helpful for some users, e.g. COPY FROM=FILEA TO=FILEB.
        - Commands may also have options to indicate special cases, e.g.:
            - PRINT/3,HQ FILEA
            - PRINT (3, HQ) FILEA
            - PRINT FILEA -3, HQ

            to produce 3 copies of FILEA on the printer in the headquarters building.
        - Error rates and the need for extensive training increase with the number of possible options.
    - **Hierarchical command structure**
        - In the third option, the set of commands is organized into a tree structure, like a menu tree. The first level might be the command action, the second might be an object argument, and the third might be a destination argument:

Action	Object	Destination
CREATE	File	File
DISPLAY	Process	Local printer
REMOVE	Directory	Screen
COPY		Remote printer
MOVE		

Structure

- Human learning, problem solving, and memory are greatly facilitated by meaningful structure.
- Meaningful structure is beneficial for *task concepts*, and *syntactic* details of command languages.
- **Consistent argument ordering**: Several studies have shown that there are benefits associated with using a ***consistent*** order for arguments. For example, when presented

with commands with ***inconsistent*** and consistent argument ordering, users performed significantly faster with the consistent argument ordering.

Inconsistent	**order of argument**	**Consistent order of arguments**	
SEARCH	file no, message id	SEARCH	message id, file no
TRIM	message id, segment size	TRIM	message id, segment size
REPLACE	message id, code no	REPLACE	message id, code no
INVERT	group size, message id	INVERT	message id, group size

- **Symbol versus keywords:** Command structure affects performance

Symbol editor	Keyword editor
FIND: /TOOTH/; -1	BACKWARD TO "TOOTH"
LIST: 10	LIST 10 LINES
RS: / KO / , / OK/;*	CHANGE ALL "KO" TO "OK"

4) Briefly explain about naming and abbreviations

Ans.

Naming and Abbreviations

- There is often a lack of consistency or obvious strategy for construction of command abbreviations.
- Abbreviations, shortcut and function keys, special characters, and more fill the lexicon of knowledge intermittent to expert users.
- In Unix, such as mkdir (make directory), cd (change directory), ls (list directory)

.1 Specificity versus generality

- Names are important for learning, problem solving, and retention over time.
- When it contains only a few names, a command set is relatively easy to master;
- *Specific* terms can be more descriptive than general ones are, and if they are more distinctive, they may be more memorable. *General* terms may be more familiar and therefore easier to accept. Two weeks after a training session with 12 commands, subjects were more likely to recall and recognize the meanings of specific commands than those of general commands
- Two of the commands-the commands for inserting and deleting text-are shown here in all seven versions:

Infrequent, discriminating words	insert	delete
Frequent, discriminating words	add	remove
Infrequent, non discriminating words	amble	perceive
Frequent, non discriminating words	walk	view
General words (frequent, non discriminating)	alter	correct
Non discriminating non words (nonsense)	GAC	MIK
Discriminating non words (icons)	abc-adbc	abc-ab

- The "infrequent, discriminating" command set resulted in faster learning and superior recall than did other command sets. The general words were correlated with the lowest performance. The nonsense words did surprisingly well, supporting the possibility that, with small command sets, distinctive names are helpful even if they are not meaningful.

.2 Abbreviation strategies

- Even though command names should be meaningful for human learning, problem solving, and retention, they must satisfy another important criterion: They must be in harmony with the mechanism for expressing the commands to the computer.
- The phenomenon of preferring to use the full command name also apperred in our study of bibliographic retrieval.
- Novices preferred typing the full name, such as BROWSE or SELECT, rather than the tradition four-letter abbreviations BRWS or SLCT.
- Efforts have been made to find optimal abbreviation strategies.
- Here are six potential strategies

    - *Simple truncation*: The first, second, third, etc. letters of each command.
    - *Vowel drop with simple truncation:* Eliminate vowels and use some of what remains.
    - *First and last letter*: Since the first and last letters are highly visible, use them.
    - *First letter of each word in a phrase*: Use with a hierarchical design plan.
    - Standard abbreviations from other contexts: Use familiar abbreviations such as QTY for quantity, PRT for PRINT.
    - *Phonics*: Focus attention on the sound. For example, uses XQT for execute.

.3 Guidelines for using abbreviations

1. A *simple* primary rule should be used to generate abbreviations for most items; a *simple* secondary rule should be used for those items where there is a conflict.
2. Abbreviations generated by the secondary rule should have a marker (for example, an asterisk) incorporated in them.
3. The number of words abbreviated by the secondary rule should be kept to a minimum.
4. Users should be familiar with the rules used to generate abbreviations.
5. Truncation should be used because it is an easy rule for users to comprehend and remember. However, when it produces a large number of identical abbreviations for different words, adjustments must be found.
6. Fixed-length abbreviations should be used in preference to variable-length ones.
7. Abbreviations should not be designed to incorporate endings (ING, ED, s).
8. Unless there is a critical space problem, abbreviations should not be used in messages generated by the computer and read by the user.

.4 Command menus and keyboard shortcuts

- To relieve the burden of memorization of commands, some designers offer users brief prompts of available commands, in a format called a *command menu*. For example, the text-only web browser called lynx displays this prompt
  - H)elp O)ptions P)rint G)o M)ain screen Q)uit
    I=search [delete]=history list
- **Command-language guidelines.**

- Create explicit model of objects and actions.
- Choose meaningful, specific, distinctive names.
- Try to achieve hierarchical structure.
- Provide consistent structure (hierarchy, argument order, action-object).
- Support consistent abbreviation rules (prefer truncation to one letter).
- Offer frequent users the ability to create macros.
- Consider command menus on high-speed displays.
- Limit the number of commands and ways of accomplishing a task.

5) List and explain the types of interaction task used for pointing devices.

Ans. Pointing devices are applicable in six types of interaction tasks:

1. **Select:**
   - user chooses from a set of items.
   - used for traditional menu selection, identification of a file in a directory, or marking of a part in an automobile design.
2. **Position:**
   - user chooses a point in a one-, two-, three-, or higher-dimensional space
   - used to create a drawing, to place a new window, or to drag a block of text in a figure.
3. **Orient:**
   - user chooses a direction in a two-, three-, or higher-dimensional space.
   - direction may simply rotate a symbol on the screen, indicate a direction of motion for a space ship, or control the operation of a robot arm.
4. **Path:**
   - user rapidly performs a series of position and orient operations.
   - may be realized as a curving line in a drawing program, the instructions for a cloth cutting machine, or the route on a map.
5. **Quantify:**
   - user specifies a numeric value.
   - usually a one-dimensional selection of integer or real values to set parameters, such as the page number in a document, the velocity of a ship, or the amplitude of a sound.
6. **Text:**
   - user enters, moves, and edits text in a two-dimensional space. The
   - pointing device indicates the location of an insertion, deletion, or change.
   - more elaborate tasks, such as centering; margin setting; font sizes; highlighting, such as boldface or underscore; and page layout.

6) Write short notes on

Keyboard Layout

i) Keyboard Layout (6M)

- The Smithsonian Nation Museum of American History in Washington D.C. has a remarkable exhibit on the development of typewriter.
- At the middle of 19th century, many attempts were made to build typewriters.
- *Qwerty layout* was much suitable for finger travel distains, hence became the widespread standard.
- The development of electronic keyboards eliminated the mechanical problems of typewriters and led to the twentieth-century with new Dvorak layout. This could increase the typing rate of expert typists from about 150 words per minute to 200 words and reduced errors.
- The failure of this, is due to the effort required to learn a new, non-standarad interface.

- The Third keyboard layout is ABCDE style has 26 letters of English alphabet in order.
- Non-typists can easily locate letters. No advantage for ABCDE style, users with little QWERTY experience are eager to acquire but latter lost interest.
- Number pads are still controversial,
- Telephones use 1-2-3 keys on top row, but calculators place 7-8-9 keys on the top rows.
- Studies have shown the advantage of the telephone layout, but most keyboards use the calculator layout.
- Some researchers have recognized that the wrist and hand placement required for standard keyboards is awkward and have proposed ergonomic keyboard.

QWERTY layout

- 1870
- Christopher Latham Sholes
- good mechanical design and a clever placement of the letters that slowed down the users enough that key jamming was infrequent
- put frequently used letter pairs far apart, thereby increasing finger travel distances

Dvorak layout

- 1920
- reduces finger travel distances by at least one order of magnitude
- Acceptance has been slow despite the dedicated efforts of some devotees
- it takes about 1 week of regular typing to make the switch, but most users have been unwilling to invest the effort

ABCDE style

- 26 letters of the alphabet laid out in alphabetical order nontypists will find it easier to locate the keys

Additional keyboard issues

- IBM PC keyboard was widely criticized because of the placement of a few keys
  - backslash key where most typists expect SHIFT key
  - placement of several special characters near the ENTER key
- Number pad layout
- wrist and hand placement

ii) **Voice Information System (6M)**

Voice information systems

- Stored speech commonly used to provide information about tourist sites, government services, after-hours messages for organizations
- Low cost
- Voice prompts
- Deep and complex menus frustrating
- Slow pace of voice output, ephemeral nature of speech, scanning and searching problems
- Voice mail
- Handheld voice recorders
- Audio books
- Instructional systems

Direct-control pointing devices

Touch screen, light pen, Stylus

Indirect pointing devices

Mouse, trackball, joystick, graphics tablet, touchpad

7) Explain the basis for preparing error messages

Error Messages

- Error messages are key part of an overall interface design strategy of guidance for the user. The strategy should ensure integrated, coordinated error messages that are consistent across one or multiple applications.
- Avoid
  - imperious tone that condemns user
  - messages that are too generic (e.g. WHAT? or SYNTAX ERROR)
  - messages that are too obscure (e.g. FAC RJCT 004004400400)

.1 Specificity

- Messages that are too general make it difficult for the novice to know what has gone wrong. Simple and condemning messages are frustrating because they provide neither enough information about what has gone wrong nor the knowledge to set things right. The right amount of specificity therefore is important.

User-centered phrasing

Suggests user controls the interface, initializing more than responding

User should have control over amount of information system provides e.g. screen tips; a help button for context-sensitive help or an extensive online user manual

Telephone company, "We're sorry, but we are unable to complete your call as dialed. Please hang up, check your number, or consult the operator for assistance", versus "Illegal telephone number. Call aborted. Error number 583-2R6.9. Consult your user manual for further information.'

Appropriate physical format

use uppercase-only messages for brief, serious warnings

avoid code numbers; if required, include at end of message

debate over best location of messages. E.g. Could be:

- near where problem arose
- placed in consistent position on bottom of screen
- near to, but not obscuring relevant information

Poor	Better
SYNTAX ERROR	Unmatched left parenthesis
ILLEGAL ENTRY	Type first letter: **S**end, **R**ead, or **D**rop
INVALID DATA	Days range from 1 to 31
BAD FILE NAME	File names must begin with a letter

11.2.2 Constructive guidance and positive tone

- Messages should, where possible, indicate what users should do to correct the problem.
- Unnecessarily hostile messages using violent terminology can disturb non-technical users:
  - FATAL ERROR, RUN ABORTED
  - CATASTROPHIC ERROR: LOGGED WITH OPERATOR
  - Negative terms such as ILLEGAL, ERROR, INVALID, BAD should be eliminated or used infrequently

- audio signals useful, but can be embarrassing - place under user control

- Development of effective messages
  - Messages should be evaluated by several people and tested with suitable participants
  - Messages should appear in user manuals and be given high visibility
  - Users may remember the one time when they had difficulties with a computer system rather than the 20 times when everything went well
- Recommendations
    - Increase attention to message design
    - Establish quality control
    - Develop guidelines
      - Have a positive tone
      - Be specific and address the problem in the user's terms
      - Place the users in control of the situation
      - Have a neat, consistent, and comprehensible format
    - Carry out usability test
    - Collect user performance data

8) Write briefly about coordinating multiple windows supported by interface developers.

Ans

- Designers may break through to the next generation of window managers by developing coordinate windows, in which windows appear, change contents, and close as a direct result of user actions in the task domain
- Such sequences of actions can be established by designers, or by users with end-user programming tools
- A careful study of user tasks can lead to task-specific coordinations based on sequences of actions
- Important coordinations:
    1. **Synchronized Scrolling**: A simple coordination is synchronized scrolling, in which the scroll bar of one window is coupled to another scroll bar, and action on one scroll bar causes the other to scroll the associated window contents in parallel. This technique is useful for comparing two versions of a program or document. Synchronization might be on a line-for-line basis, on a proportional basis, or keyed to matching tokens in the two windows.

2. **Hierarchical browsing**. Coordinated windows can be used to support hierarchical browsing. For example, if one window contains a book's table of contents, selection of a chapter title by a pointing device should lead to the display, in an adjoining window, of the chapter contents. Hierarchical browsing was nicely integrated in Windows Explorer to allow users to browse hierarchical directories, in Outlook and in many other applications.

3. **Opening/closing of dependent windows**. An option on opening a window might be to simultaneously open dependent windows in a nearby and convenient location. For example, when users are browsing a program, if they open a main procedure, the dependent set of procedures could open up automatically.

4. **Saving/opening of window state.** A natural extension of saving a document or a set of preferences is to save the current state of the display, with all the windows and their contents. This feature might be implemented by the simple addition of a "Save screen as... " menu item to the "File" menu of actions.

5. **Tabbed browsing:** Browser tabs allow you to view multiple web pages in the same browser without the need to open a new browser session.

6. **Tiled windows:** Windows can automatically be resized and arranged so that they do not overlap each other.

7. **Ribbon interface:** The Microsoft office interface is designed to make it easier for users to find the features they need to get their work done.

9) Explain any five examples of direct manipulation.

Command line vs. display editors and word processors

- Training times with display editors are much less than line editors
- Line editors are generally more flexible and powerful
- The advances of WYSIWYG word processors:
- Display a full page of text
- Display of the document in the form that it will appear when the final printing is done
- Show cursor action
- Control cursor motion through physically obvious and intuitively natural means
- Use of labeled icon for actions
- Display of the results of an action immediately
- Provide rapid response and display
- Offer easily reversible actions

The VISICALC spreadsheet and its descendants Spatial data management

- In some cases, spatial representations provide a better model of reality
- Successful spatial data-management systems depend on choosing appropriate:
  - Icons
  - Graphical representations
  - Natural and comprehensible data layouts

Video games

- Field of action is visual and compelling
- Commands are physical actions whose results are immediately shown on the screen
- No syntax to remember

Computer-aided design Office automation

- HyperCard
- Quicken

10.Discuss the various models of response time impacts. Explain user productivity

For users, the main experience of Quality of Service is the computer's response time

Response time is the number of seconds it takes from the time a user initiates an action until the computer presents the results.

User think time The number of seconds the user thinks before entering the next action.
Simple Stages of Action Model

1. initiation of an action
2. Wait for computer's response
3. Observe while results appear
4. Think about results

This simple model is not very realistic because users plan while they are initiating an action (typing/clicking), waiting for results to appear, and interpreting results. Because users are able to use this time to plan, it is very difficult to obtain precise measurements of user think time.

- Response Time is usually easier to estimate
  - Many times pop-up messages are displayed immediately after the initiation of an action so the response time doesn't seem as long.
  - Delays greater than 160 milliseconds are noticed and become annoying. However, users have come to accept delays from networked devices.

Designers and network managers who seek to provide high QoS have to consider several factors including: technical feasibility, costs, tasks complexity, user expectations, speed of task performance, error rates, and error-handling procedures.

- Most users prefer rapid interactions
    - Response times that are longer than 15 seconds can be detrimental to productivity, can increase error rates and decrease satisfaction.
    - Rapid interactions, faster than 1 second, can increase productivity, but may also increase error rates for complex tasks.

Web-site display performance was studied by evaluating delay, familiarity, and breadth to examine interaction effects on user performance, attitudes, stress, and behavioral intentions. Lab-tests were conducted to determine "acceptable" delays in two cultures, U.S. and Mexico. Although not all results have been published, conclusions show that user impatience is high, especially in the U.S. as compared to Mexico.

- **Refresh Rates** - can lead to user frustration if too slow and can be very pleasing when operating speedily
    - In web applications screen refresh rate may be limited by network transmission or server performance. Images may appear in fragments over several seconds.

- **Network Connection Speeds**
    - There are several network options for consumers to purchase from 56-Kbps dial-up to 50-Mbps Fiber Optic Service (FiOS) that will affect the quality of service that the user receives.
    - Internet service providers (ISP) have typically offered plans with a much greater download speed than upload speed because most users download more content than they upload. However, with the current "user-generated" content era, it is increasingly important for upload speeds to keep up with download speeds.
    - There are tools available that allow users the check their connection speeds and have a better idea of the quality of service they are receiving from their current ISP. However, they need to understand that network traffic and server loads can also have an effect on their connection speeds, especially during peak usage times.

- Reading textual information from a screen is often a challenging cognitive and perceptual task
    - Users tend to relax, pace themselves, and work productively when the screen fills with text instantly
    - Users often scan the documents to find the information they are looking for
    - Because of these facts, it is useful to display text first and leave space for graphics that are slower to load
    - As display quality improves, as more people are going 'green', and as online books and newspapers become increasing available, there is an increasing demand for rapid display of textual and graphical data.

- **Limitations of short-term and working memory**
    - Magic number seven - plus or minus two
        - The average person can rapidly recognize seven 'chunks' of information at any given time
            - They can hold this information for 15 to 30 seconds in short-term memory
            - The size of the chunks of information depends on the person's knowledge and experience about the material
        - Performing a distracting task during this time, erases the chunks
        - If a person focuses on retaining the information it can be transferred to long-term memory

    - Short-term memory and working memory are used together to process information and solve problems
        - Short-term memory processes perceptual input
        - Working memory generates and implements solutions
    - People tend to combine several lower-level concepts into a single higher-level chunk to help them remember complex problems
    - Short term and working memory are both highly volatile
        - Disruptions can cause loss of memory
        - Delays may require that the memory be refreshed

- What causes **errors**?
    - After a user is able to construct a solution to a problem, he/she must then record or implement the solution.
        - The potential for errors increases and the pace of work slows when the solutions have to be recorded
    - When using an interactive computer system, users formulate plans and then have to wait while each step of the plans are executed. If the execution takes too long or if an unexpected result is obtained, the users may forget a portion of the plan and therefore be forced to continually review the plan. This can cause slowed productivity and more errors.
    - Longer response times cause users to become anxious because the penalty for an error increases
        - When users are anxious, their performance slows and errors increase.
    - Response times that are too short could cause the user to skip or fail to understand important materials or even obtain incorrect results

- Paced vs. Un-paced tasks

- Car driving analogy
    - Higher speeds increase the potential for accidents, so speed limits are provided to lower the risk of the dreadful consequences. "When incorrect use of computer systems can lead to damage to life, property, or data, should not speed limits be provided?"
    - Talking on a cell phone while driving has shown to increase accident rates. Computer users who tend to multitask make more mistakes. GPS systems are available to aid drivers in getting to their destination. Agents and wizards guide novice users to successful conclusions, but will this grow in the near future?

- **Progress indicators** tend to shorten perceived elapsed time and heighten satisfaction by reassuring the user that the process is underway:
    - Graphical indicators (usually better than static, blinking, or numeric)
    - Blinking messages
    - Numeric seconds left for completion

- **Conditions for Optimum Problem Solving**
    - Users can achieve rapid task performance, low error rates, and high satisfaction if all the following criteria are met:
        - Users must have sufficient knowledge of the objects and actions necessary to complete the task
        - The solution plan can be carried out without delays
        - Distractions are eliminated
        - User anxiety is low
        - Feedback is given about progress toward solution
        - Errors can be avoided or easily handled
    - Other conjectures that play a role in choosing the optimum interaction speed
        - Novices prefer to work at slower speeds so they normally exhibit better performance with slower response times
        - When there is little penalty for an error, users prefer to work faster

        - When the task is familiar and easily comprehended, users prefer more rapid action
        - If users have experienced rapid performance previously, they will expect and demand it in future situations

In order to better evaluate user productivity, researchers have extended models to include tempting distractions and unavoidable interruptions, such as arriving e-mail, instant messages, phone calls, and other requests.

Expectations and Attitudes

- **Response Times**
    - What are acceptable response times?
    - The 2 second limit is appropriate for many circumstances, but sometimes a tenth of second is necessary.
        - Ex. 2s -v- .1s response times of dial tones and key presses

- **Factors that influence acceptable response times**
    - Expectations
    - User tolerance for delays
    - Task complexity

- **Expectations**
    - Once you go broadband, you never go back.
    - If tasks are completed quicker than expected, people will be pleased, and vice versa. (traffic lights)
    - One way to reduce network complaints is by using a response-time choke.
        - When the load is light the system can perform slower to give uniform speed to all users.
        - Disruptions frustrate users who develop a working style based on a certain level of responsiveness.
        - Some users refuse to work when response times are slow.
    - Users expect a rapid startup for laptops/cameras, and are annoyed with waiting times.

- **User tolerance for delays**
    - Novices have more patience.
    - Variations in acceptable waiting times.
        - Personality (Laid back/Demanding)
        - Cost (Twitter/Air traffic control)
        - Age (Young/Old)
        - Mood (Carefree/Upset)
        - Cultural context (Mexico/US)
        - Time if delay (1:00pm/4:30pm)
        - Noise (Quiet/Loud)
        - Perceived pressure to complete a task (No pressure/Deadlines)

- **Task complexity**
    - Repetiitive tasks demand faster response times.
    - Complex tasks with longer response times allow for users to plan ahead.
    - With complex tasks, users will adapt their working sytle to multitask duing delays.
    - Even so, excessively long delay will cause user dissatisfaction.

- **Tasks that demand rapid system performance:**

1. Video games
2. Flight simulators

3. Graphic design
4. Dynamic queries
5. VoIP
6. Streaming multimedia

These tasks require no perceived delay (<100 milliseconds)

Long response times in the WWW lead users to view the company negatively and find the content less interesting. Use of Ajax and other dynamic techniques increase responsiveness and user expectations.

User controlled pace settings can benefit expert users as well as those who are older or disabled. It also allows companies to charge a premium for faster internet service.

User Productivity

Productivity can in many ways be related to the amount of work accomplished in a given period of time. Therefore, in order to improve user productivity, the efficient use of response times is vital.

Shorter response times can lead to increased productivity. However, long response times may give users opportunities to work on concurrent processes, reducing the effort and/or time required to finish a task. The opposite of this may also occur. Working too quickly because of fast response times, can result in errors, reducing productivity.

Because of these two extremes designers must carefully assess each situation to determine appropriate response times for optimal levels of user productivity. For occasional tasks the importance of this is less critical. But for tasks that occur frequently, determining proper response times should be given greater priority in order to prevent loss of productivity.

An alternative to forcing users to sit through longer response times is to hide the delay. Designers can display important or critical information while other information or processes are still loading. This technique is very useful for websites in order to keep users engaged while they wait for the rest of the content to be loaded in the browser.

The nature of a task strongly influences decisions about adjusting response time. Faster response times can allow users to work more quickly, but decisions may be less than optimal. However, this faster pace might also allow a user to quickly reverse actions and try new ones, reducing the penalty for errors. Users may also learn how to use a system faster since shorter response times would allow for easy exploration of alternatives.

Users adopt various strategies for data entry depending on the response time of a system.

Response Time	**User Strategies**	**Result**
Less Than 1 Second	Work without checking to see if the system is ready for input.	Increased Errors

Between 1 and 2 Seconds	Work is paced. Wait until system is ready for input.	Appropriate time is given for the system to accept inputs
Greater Than 2 Seconds	Increased monitoring of system	Users make sure system is ready for input

For complicated problem-solving, users adapt their work style to the response time. Changes in response time between 0.1 and 5 seconds do not impact productivity because of this. Simple and habitual tasks receive the greatest benefits in productivity due to faster response times.

In the case of complex tasks, shorter response times result in hurried decisions and increased errors. Longer response times increase the frustration a user may already be experiencing while trying to solve a problem, placing a burden on short-term memory.

11. Explain color guidelines for interactive interface.

- **Color can**
  - Soothe or strike the eye
  - Add accents to an uninteresting display
  - Facilitate subtle discriminations in complex displays
  - Emphasize the logical organization of information
  - Draw attention to warnings
  - Evoke string emotional reactions of joy, excitement, fear, or anger
- **Guidelines**
  - Use color conservatively
  - Limit the number and amount of colors
  - Recognize the power of color to speed or slow tasks
  - Color coding should support the task
  - Color coding should appear with minimal user effort
  - Color coding should be under user control
  - Design for monochrome first
  - Consider the needs of color-deficient users
  - Color can help in formatting
  - Be consistent in color coding
  - Be alert to common expectations about color codes
  - Be alert to problems with color pairings
  - Use color changes to indicate status changes
  - Use color in graphic displays for greater information density