

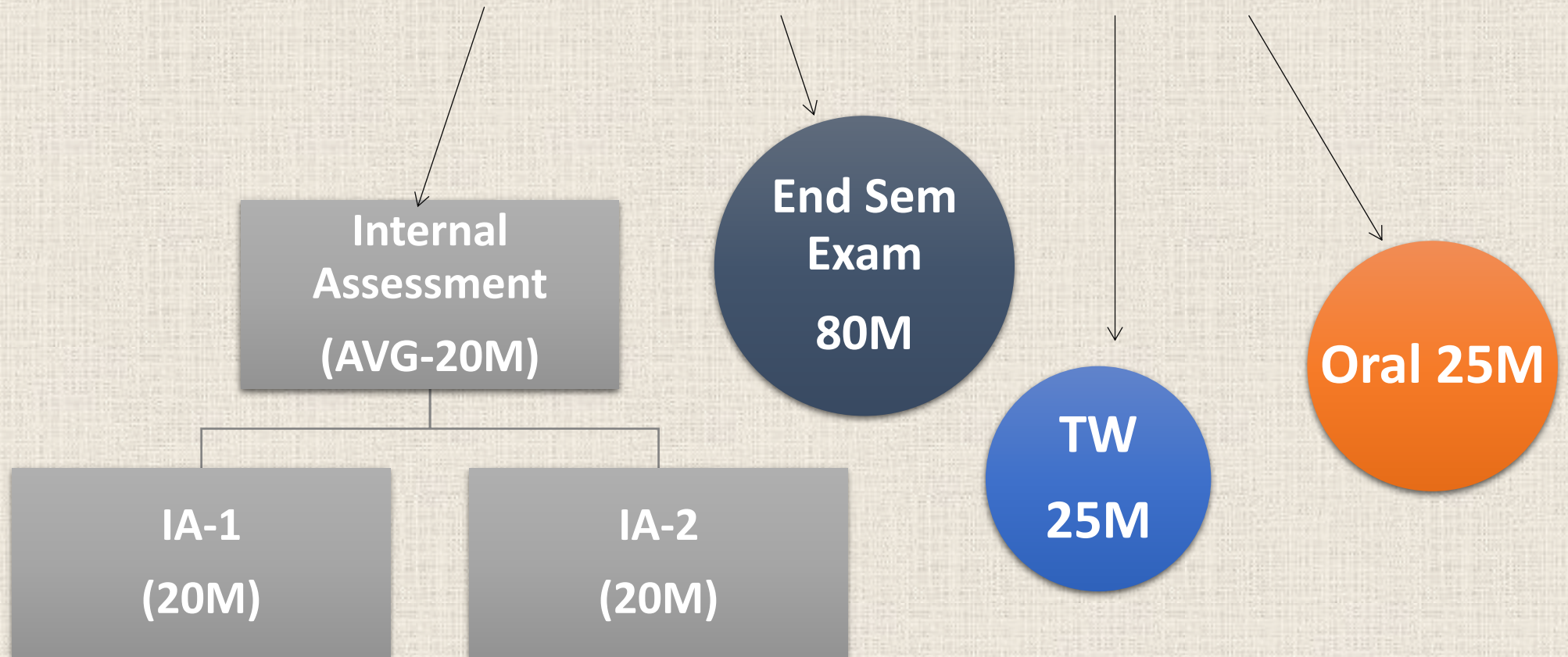


# **HUMAN MACHINE INTERACTION**

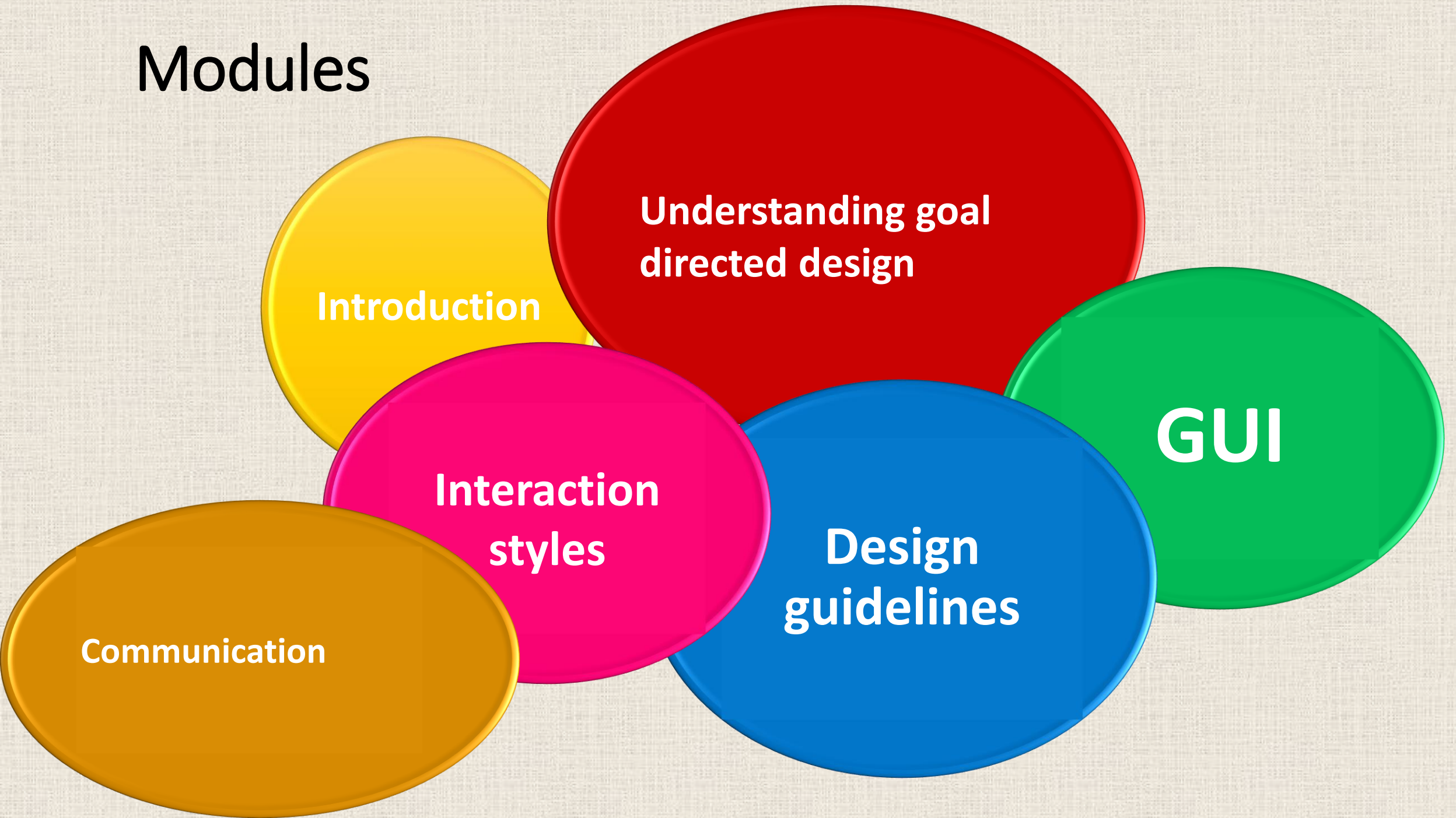
**DEPARTMENT OF COMPUTER ENGINEERING  
SEMESTER VIII**

# Examination Scheme

**Total- 150M**



# Modules



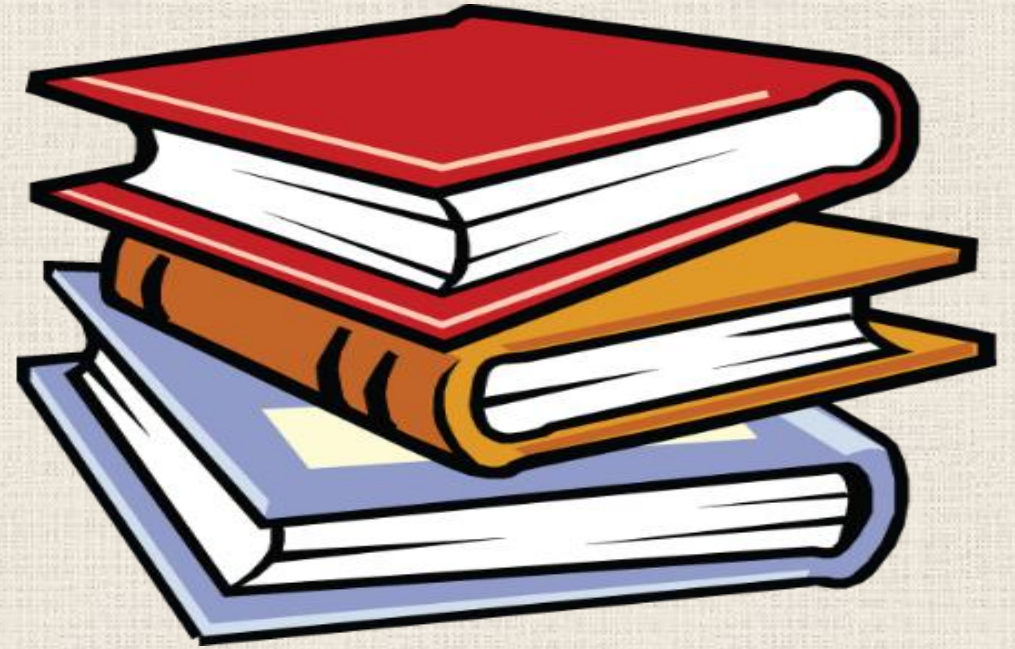
# Text Books/Reference Book

## **Textbooks:**

1. Galitz's, "Human Machine Interaction", Dr. Dhananjay R. Kalbande, Wiley Publication
2. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.

## **Reference Books:**

1. Donald A. Norman, "The design of everyday things", Basic books.



# CHAPTER 1- INTRODUCTION

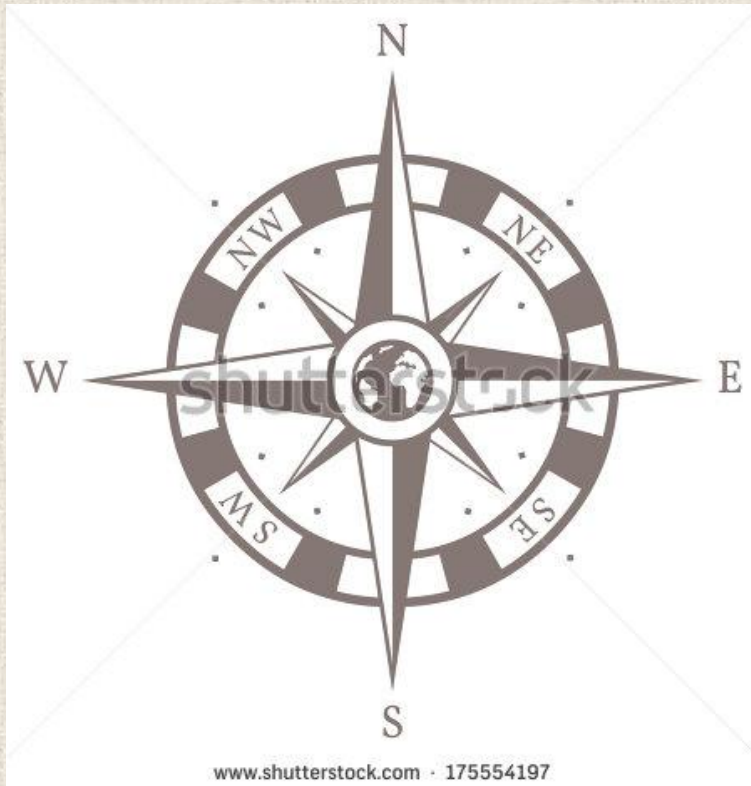
IT IS THE WAY IN WHICH THE  
MACHINE IS PRESENTED TO THE  
HUMAN

# Generations

- First Generation: Machine that reduce Physical labor



- Second Generation: Machines that displayed output



- Third Generation: Machines that provided output with feedback



- Fourth Generation: Machines with computing power



- Fifth Generation: Intelligent Machines



## Future: Augmented Reality



# Hardware, Software and Operating Environments

## 1. Hardware

- Most important utility
- Used to drive software
- Today we choose hardware as per our requirements
- Plenty hardware options are available and no need to compromise

# Hardware, Software and Operating Environments

## 2. Software

- Tool to create an effective user interface
- Based on requirements and hardware we need to choose software
- It can use LLL, Assembly language or HLL
- Many front end development tools using audio/visual experience to user

# Hardware, Software and Operating Environments

## 3. Operating environment

- Fulfill user level acceptance test and can provide modification
- Key points of user interface
  - ✓ Friends, family members, colleagues are not representatives of target users
  - ✓ User requirements should be understood by a team and not by an individual
  - ✓ Goal should be to minimize user difficulties
  - ✓ The hardware (device) and software balance should be maintained

# The Psychopathology of everyday things

## Human-Centered Design

- Considering different users and their aspects  
Experience, knowledge, intelligence of users
- Conceptual Model or mental model
  1. Feedback
  2. Constraints
  3. Affordances (Convey the rules by leaving visual clues)
  4. Power of observation

# Norman's Fundamental Principles of Interaction

- Affordance
- Signifiers
- Perceived Affordance
- Mapping
- Feedback
- Conceptual Models



# Seven Stages of Action

1. Forming the goal

## **Execution**

2. Forming the intention (plan)

3. Specifying an action (specify)

4. Executing the action (perform)

## **Evaluation**

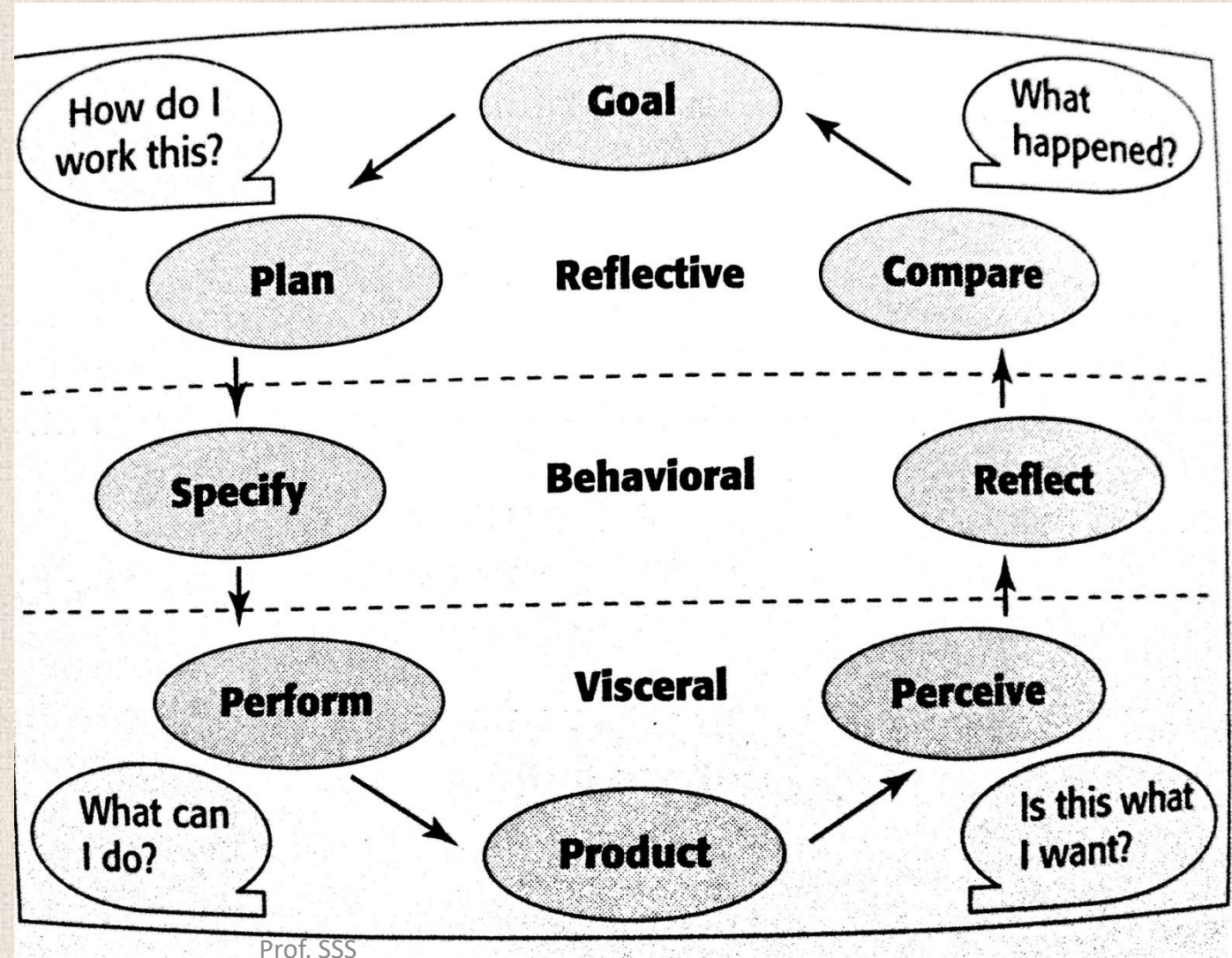
5. Perceiving the state of the world (perceive)

6. Interpreting the state of the world (reflect)

7. Evaluating the outcome (compare)

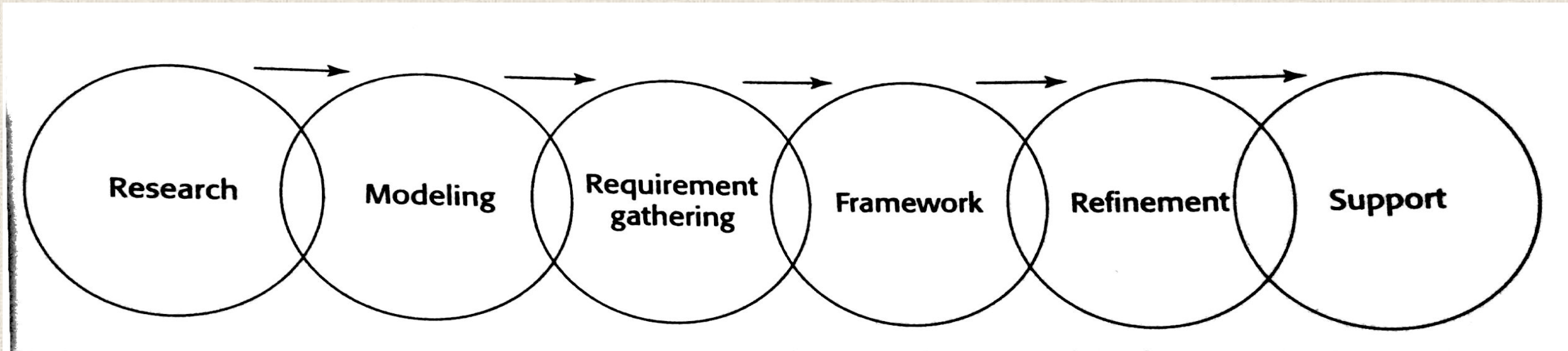
# Three levels of Processing

1. Visceral level
2. Behavioral level
3. Reflective level



# CHAPTER 2- GOAL DIRECTED DESIGN

## Goal Directed Design Process



# Implementation Model and Mental Model



## **Beginners, Experts and Intermediates**

Most users are neither beginners nor experts

Skill spectrum dynamics

Accommodating beginners

Intermediates

Accommodating experts

## Quantitative versus Qualitative research

Quantitative Research	Qualitative Research
<b>It is statistics of human activities</b>	<b>The detailed information that provides the knowledge about behaviour, attitude of the user</b>
<b>It helps to forecast the use of the interface</b>	<b>It helps to identify any existing same or similar products are available</b>
<b>It will try to resolve the quantity of copies of product to be delivered to users</b>	<b>It helps in environmental contexts of the product being designed</b>
<b>It will help in earlier dialog between the developers and end users</b>	<b>It helps the design team as the design decisions are traced from the quantitative research</b>

# **Value of Qualitative research**

## **Stakeholder Interview**

1. Primary vision of product
2. Budget and the schedule
3. Technical and non technical issues
4. Business drivers
5. Stakeholder perceptions

## **SME Interviews**

1. SMEs are often expert users
2. SMEs are experts but they are not designers
3. SME help in regulating the standards
4. SMEs will be a valuable resource throughout the design process

## **Customer Interviews**

1. Goal
2. Current difficulties
3. Who makes a decision
4. What is decision making channel
5. What is business logic

## **User Observation and Ethnographic interviews**

1. Context
2. Partnership
3. Interpretation
4. Focus

# Persona

- Helps to determine, communicate, build consequences, measure and contribute the design quality of product
- Goals

## **Steps in constructing personas:**

1. Identify behavioral variables
2. Map interview subjects to behavioral variables
3. Identify behavioral patterns
4. Synthesize characteristics and relevant goals
5. Check for redundancy and completeness
6. Expand description of attributes and behaviors
7. Designate persona

# CHAPTER 3- GUI

## The Concept of Direct Manipulation

Characteristics:

1. The system should portrayed as an extension of the real world
2. Continuous visibility of objects and actions
3. Actions should rapid and incremental with visible display and results
4. Incremental actions should easily reversible

# Graphical Systems:

## Advantages:

1. Symbols recognized faster than text
2. Faster learning
3. Faster use and problem solving
4. Easier remembering
5. More natural
6. Fewer errors
7. Less difficult for new user
8. More attractive
9. Replaces natural languages
10. Low typing requirements

## Disadvantages

1. Greater design complexity
2. Learning still necessary
3. Not always familiar
4. Human comprehension limitations
5. Window manipulation requirements
6. Production limitations
7. Inefficient for expert users
8. Increased chances of clutter and confusion
9. May consume more memory space
10. Hardware limitations

# Characteristics of Graphical user interface

1. Sophisticated visual presentation
2. Pick and click interaction
3. Restricted set of interface options
4. Visualization
5. Object orientation
  1. Collection
  2. Constraints
  3. Composites
  4. Container
6. Use of recognition memory
7. Concurrent performance of functions

# Characteristics of Web user interface

1. Device
2. Data/ Information
3. User tasks
4. Interaction
5. Response time
6. Visual style
7. System capability
8. Consistency
9. Security
10. Reliability

# Principles of User interface design

1. Visual pleasing
2. Clarity
3. Compatibility
4. Comprehensibility
5. Configurability
6. Directness
7. Efficiency
8. Familiarity
9. Flexibility
10. Forgiveness
11. Predictability
12. Recovery
13. Responsiveness
14. Simplicity
15. Transparency

# CHAPTER 6- COMMUNICATION

Words, Sentences, Messages and text

Words

1. Jargon
2. Abbreviations or acronyms
3. Short familiar words
4. Complete words
5. Positive terms
6. Consistent words

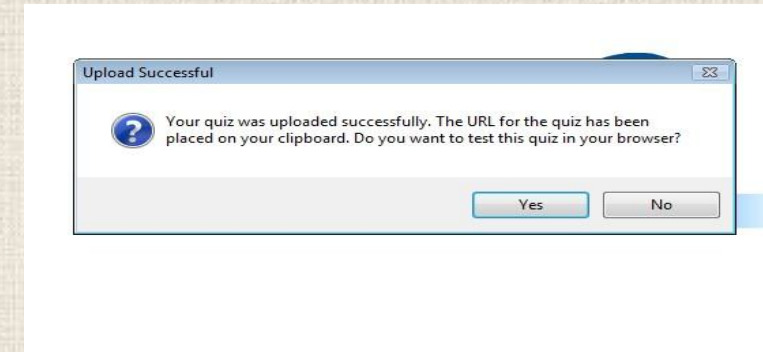
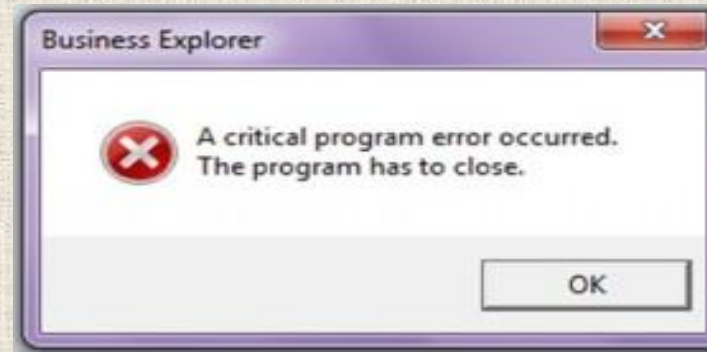
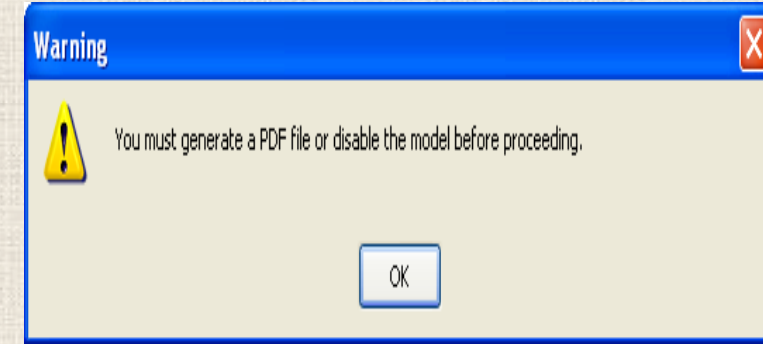
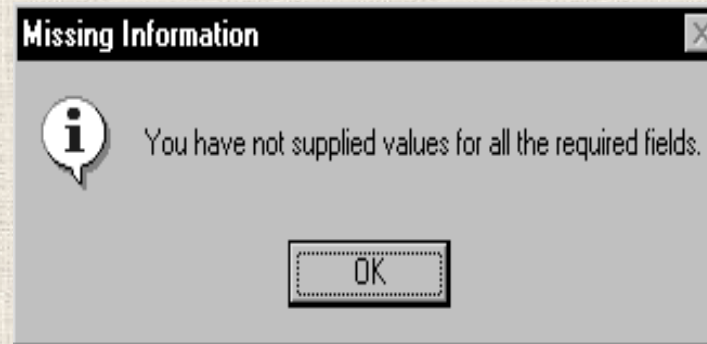
## Sentences

1. Brief and simple
2. Directly and immediately usable
3. Affirmative statement
4. Active voice
5. Temporal sequence
6. Main topic at beginning
7. Non authoritarian
8. Non threatening
9. Punishment and humor

# Messages

## A. System messages

1. Status messages
2. Informational messages
3. Warning messages
4. Critical messages
5. Question messages



## B. Instructional messages

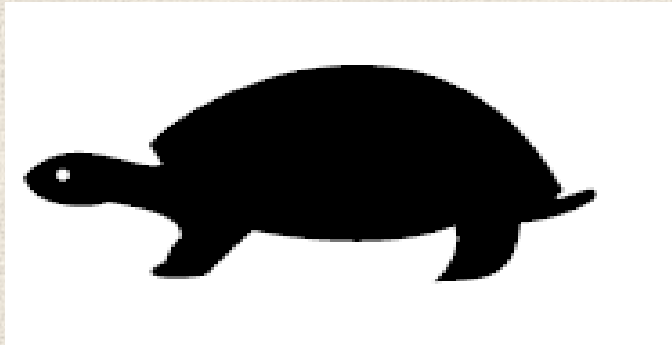
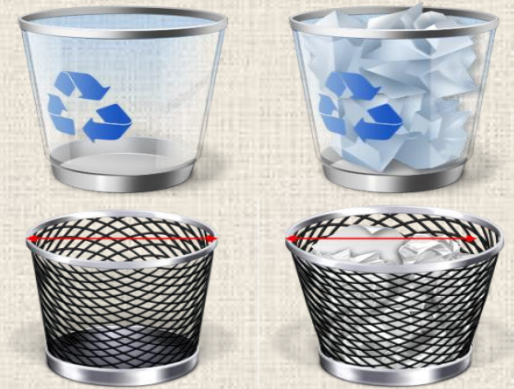


# Icons and Multimedia

## Icons

### A. Kinds of icons

1. Resemblance
2. Symbolic
3. Exemplar
4. Arbitrary
5. Analogy



# Icons

## B. Technical qualities

1. Syntactics
2. Semantics
3. Pragmatics

# Icons

## C. Characteristics

1. Clarity
2. Familiarity
3. Simplicity
4. Consistency
5. Directness
6. Efficiency
7. Discriminability
8. Expectancies

# Icons

## D. Choosing icons

1. A successful icons
2. Size
3. Color
4. Icon selection
5. Hot zone

## E. Choosing images

1. Existing icons
2. Nouns
3. Traditional images
4. Cultural or social norms

# Icons

## F. The design process

1. Define purpose
2. Collect, evaluate and sketch ideas
3. Draw in black and white
4. Test for expectations, recognition and learning
5. Test for legibility
6. Register new icon in the system registry

# Multimedia

## A. Graphics

Types:

1. Navigational
2. Representational
3. Organizational
4. Explanative
5. Decorative

Characteristics:

1. Supplement textual content
2. Convey information not possible using text
3. Limit long loading graphics
4. Enhance navigation

# Multimedia

## B. Images

1. Standard images
2. Consistency
3. Legibility
4. Descriptive text or labels
5. Navigational and decorative images
6. Minimize number of images
7. Minimize size of an image
8. Thumbnail size
9. Minimize animation
10. Minimize the number of colors
11. Appropriate format

# Multimedia

## C. Photographs/Pictures

1. Use
2. Guidelines

## D. Videos and audios

1. Use
2. Disadvantages
3. Guidelines

# Multimedia

## E. Diagrams and drawings

1. Use
2. Guidelines

## F. Animation

1. Use
2. Disadvantages
3. Guidelines

# Colors

## A. Possible problems with colors

1. High attention getting capacity
2. Interference with use of other screens
3. Varying sensitivity of the eyes to different colors
4. Color viewing deficiencies
5. Cross disciplinary and cross cultural differences

# Colors

## B. Choosing colors

1. Choosing colors for categories of information
2. Discrimination and harmony
3. Emphasis
4. Common meanings
5. Location
6. Ordering
7. Foreground and background
8. Color palette, defaults and customization
9. Gray scale
10. Monochromatic screens
11. Consistency
12. Cultural, disciplinary considerations

# CHAPTER 5- INTERACTION STYLES

Characteristics of device based controls

1. To point an object on the screen
2. To select the object
3. To drag an object across the screen
4. To draw something on the screen
5. To track or follow a moving object
6. To orient or position an object
7. To enter or manipulate data or information

# Device based controls

## Trackball

### Description

### Advantages

1. Direct relationship between hand and pointer
2. Does not obscure vision on screen
3. Does not require additional desk space

- Disadvantages

1. Movement is in different plane from screen
2. Requires large degree of eye-hand coordination
3. Requires hand to be removed from keyboard keys
4. Requires additional desk space if not mounted on keyboard
5. May be difficult to control

# Joystick

## Description

## Advantages

1. Direct relationship between hand and pointer movement in terms of direction
2. Does not obscure vision on screen
3. Does not require additional desk space if mounted on keyboard

## Disadvantages

1. Movement is different from screen
2. Requires large degree of eye-hand coordination
3. Requires hand to be removed from keyboard keys
4. Requires different hand movements to use
5. Requires additional desk space if not mounted on keyboard
6. May be difficult to control
7. May be slow and inaccurate

# Graphic Tablet

## Description

## Advantages

1. Direct relationship between touch movements and pointer movement in terms of direction, distance and speed
2. Does not obscure vision on screen
3. More comfortable horizontal operating plane

## Disadvantages

1. Requires hand to be removed from keyboard keys
2. Requires different hand movements to use

# Touch Screen

## Description

### Advantages

1. Direct relationship between touch movements and pointer movement in terms of direction, distance and speed
2. Movement is direct, in the same plane as screen
3. Requires no additional desk space
4. Stands up well in high use environments

### Disadvantages

1. Fingers may obscure part of screen
2. Requires moving the hand far from the keyboard to use
3. Fingers may be too large for accuracy with small objects
4. May soil or damage the screen

## Design Guidelines

1. Screen object should be at least  $3/4'' \times 3/4''$  in size
2. Object separation should be at least  $1/8''$
3. Provide visual or audio feedback
4. Sometimes requires confirmation
5. Provide an instructional invitation to begun using.

# Light Pen

## Description

## Advantages

1. Direct relationship between hand and pointer movement in terms of direction, distance and speed
2. Movement is direct, in the same plane as screen
3. Requires no additional desk space
4. Stands up well in high use environments
5. More accurate than finger touching

## Disadvantages

1. Hand may obscure part of screen
2. Requires moving the hand far from the keyboard to use
3. Requires picking it up to use

# Voice

## Description

## Advantages

1. Simple and direct
2. Useful for people who cannot use a keyboard
3. Useful when user's hands are occupied

## Disadvantages

1. High error rates
2. Slower throughput than with typing
3. Difficult to use in noisy environment
4. Impractical to use in quite environment

# Mouse

## Description

## Advantages

1. Direct relationship between touch movements and pointer movement in terms of direction, distance and speed
2. Permits a comfortable hand resting position
3. Selection mechanisms are included on mouse
4. Does not obscure vision of the screen

## Disadvantages

1. Movement is different from screen
2. Requires hand to be removed from keyboard
3. Requires additional desk space
4. May requires long movement distances
5. Requires a degree of eye-hand coordination

# Keyboard

## Description

## Advantages

1. Familiar
2. Accurate
3. Useful for entering text, inserting text, keyed shortcuts

## Disadvantages

1. Slow for non-touch typist
2. No direct relationship between finger or hand movement on the keys and cursor movement on screen in terms of speed and distance

# Selection of device based controls

1. Keyboard versus mouse
2. Control research
  - a. For stationary target-Touch screen and light pen
  - b. For accuracy in stationary target-Mouse, trackball, graphic tablet
  - c. For slowest operations-Joystick
  - d. For small and slowly moving targets-Mouse, trackball , graphic tablet

# Guidelines for selecting the proper device based control

## 1. Task characteristics

### a. Keyboard

b. Mouse	Pointing	Selecting	Drawing	Dragging
c. Joystick		Selecting		Tracking
c. Trackball	Pointing	Selecting		Tracking
d. Touch screen	Pointing	Selecting		
e. Graphic tablet	Pointing	Selecting	Drawing	Dragging

2. User characteristics and preferences
3. Environmental characteristics
4. Hardware characteristics
5. The device in relation to the application
6. Flexibility
7. Minimizing eye and hand movements

# Pointer guidelines

## A. General

1. Visible
2. Contrast with its background
3. Maintain its size
4. Hotspot should be easily locate
5. Location should not warp

## B. Shape

1. Indicate its purpose and meaning
2. Already defined shapes
3. Not used for any other purpose than defined
4. Not many shapes

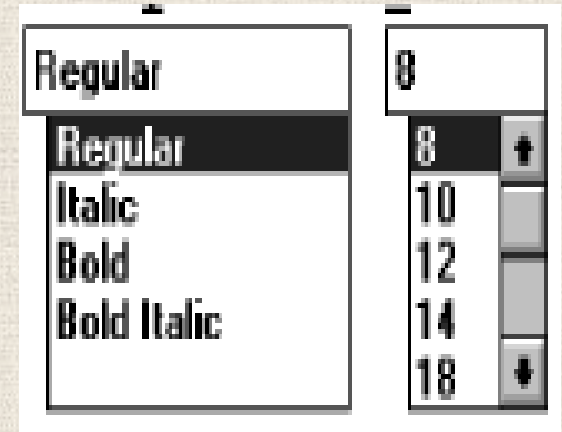
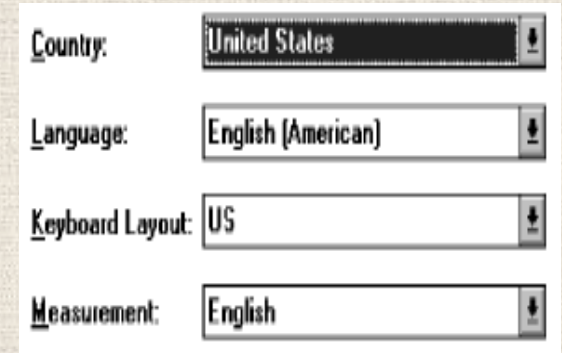
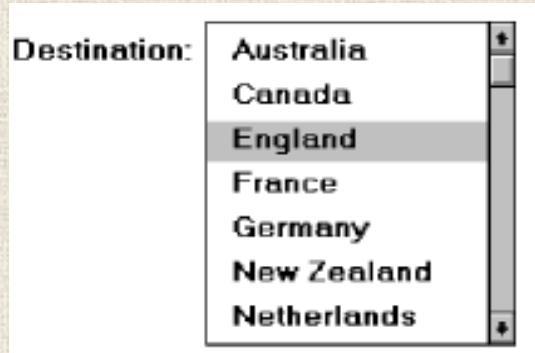
## C. Animation should not get distracted

# Characteristics of screen based controls

1. Permit the entry or selection of a particular value
2. Permit the changing or editing of a particular value
3. Display only a particular piece of text, value or graphic
4. Cause a command to be performed
5. Possess a contextual pop-up window

# Screen based controls

1. Buttons and command buttons
2. Text entry/ read only controls
  - a. Text boxes
  - b. Multiple line text boxes
3. Selection controls
  - a. Radio buttons
  - b. Check boxes
  - c. Palettes
  - d. List boxes
  - e. Drop down list boxes
4. Combination entry
  - a. Spin boxes
  - b. Combo boxes

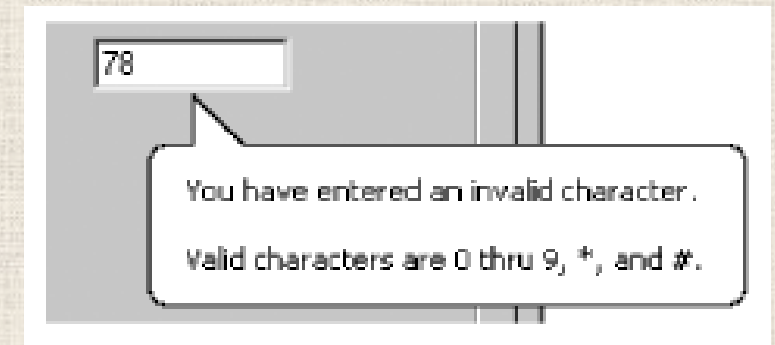
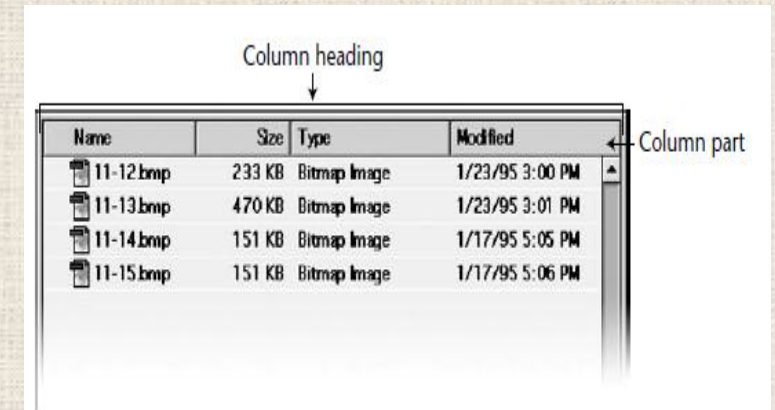


5. Other operable controls

- a. Slider
- b. Tabs
- c. Date picker
- d. Tree view
- e. Scroll bars

6. Presentation controls

- a. Group boxes
- b. Column headings
- c. Tooltips
- d. Balloon tips
- e. Progress indicators
- f. Sample box



# Selection of screen based controls

1. Selecting the proper control
  - a. Choose familiar controls
  - b. Consider the task
  - c. Reduce the number of clicks
  - d. Display as many control choices as possible
2. Entry versus selection
  - a. Choosing a type of control
  - b. Aided versus unaided entry

# Control selection criterion

1. Data considerations
  - a. Mutually exclusive or non exclusive
  - b. Discrete or continuous
  - c. Limited or unlimited in scope
  - d. Data ordered in predictable or unpredictable fashion
  - e. Represented pictorially or not
2. Task considerations
  - a. How often is an item entered or selected?
  - b. How often is an item changed?
  - c. How precisely must the item be entered or selected?

### 3. User considerations

- a. How much training in control operation will be provided?
- b. How meaningful or known is the property or data to the user?
- c. How easily remembered or learned by the user is the property or data?
- d. How frequently used will the system be?
- e. Is the user an experienced typist?

### 4. Display considerations

How much screen space is available to display the various controls?

# CHAPTER 4- DESIGN GUIDELINES