User Interfaces

Chapter 9
Key Definitions

- The user interface defines how the system will interact with external entities
- The system interfaces define how systems exchange information with other systems
Key Definitions

- The **navigation mechanism** provides the way for users to tell the system what to do.
- The **input mechanism** defines the way the system captures information.
- The **output mechanism** defines the way the system provides information to users or other systems.
Key Definitions

Graphical user interface (GUI) is the most common type of interfaces most students are likely to use personally and for developing systems.
PRINCIPLES FOR USER INTERFACE DESIGN
Principles for User Interface Design

- Layout
- Content awareness
- Aesthetics
- User experience
- Consistency
- Minimize user effort
Layout Concepts

- The screen is often divided into three boxes
  - Navigation area (top)
  - Status area (bottom)
  - Work area (middle)

- Information can be presented in multiple areas
  - Like areas should be grouped together
More Layout Concepts

- Areas and information should minimize user movement from one to another.
- Ideally, areas will remain consistent in:
  - Size
  - Shape
  - Placement for entering data
  - Reports presenting retrieved data
Content Awareness

- All interfaces should have titles
- Menus should show
  - where you are
  - where you came from to get there
- It should be clear what information is within each area
- Fields and field labels should be selected carefully
- Use dates and version numbers to aid system users
(a) Horizontal Flow

(b) Vertical Flow
Aesthetics

- Interfaces need to be functional and inviting to use
- Avoid squeezing in too much, particularly for novice users
- Design text carefully
  - Be aware of font and size
  - Avoid using all capital letters
More Aesthetics

Colors and patterns should be used carefully

- Test quality of colors by trying the interface on a black/white monitor
- Use colors to separate or categorize items
Form Example
User Experience

- How easy is the program to learn?
- How easy is the program to use for the expert?
- Consider adding shortcuts for the expert
- Where there is low employee turnover, some training can lessen the impact of less precise interfaces
Consistency

- Enables users to predict what will happen
- Reduces learning curve
- Considers items within an application and across applications
- Pertains to many different levels
  - Navigation controls
  - Terminology
  - Report and form design
Minimize User Effort

Three clicks rule

Users should be able to go from the start or main menu of a system to the information or action they want in no more than three mouse clicks or three keystrokes.
User Interface Design Process
Use Scenario Development

- An outline of steps to perform work
- Presented in a simple narrative tied through the related use case and DFD
- Document the most common paths through the use case so interface designs will be easy to use for those situations
Interface Structure Design

- A diagram showing how all screens, forms, and reports are related
- Shows how user moves from one to another
- Similar to DFD in using boxes and lines
- Boxes denote screens
- Lines show movement from one to another
- Different from DFD in having no standard rules or format
Interface Structure Diagram
Example
Interface Standards Design

- The basic elements that are common across individual screens, forms, and reports within the application
- Interface metaphor
  - Desktop, checkbook, shopping cart
- Interface objects
- Interface actions
- Interface icons
- Interface templates
Interface Design Prototyping

- A mock-up or simulation of screen, form, or report

- Common methods include
  - Paper
  - Storyboarding
  - HTML prototype
  - Language prototype
Storyboard Example

Client Menu
Add Client
Find Client
List Clients

Add a Client
First Name: 
Last Name: 
Address: 
City: 
State: 
Zip Code: 

Find a Client
(Type in information to search on)
First Name: 
Last Name: 
Address: 
City: 
State: 
Zip Code: 

Client List
(Click on a client for more information)
Adams, Jane
Adams, John
Baker, Robin

Client Information
First Name: 
Last Name: 
Address: 
City: 
State: 
Zip Code: 

Copyright 2009 © John Wiley & Sons, Inc. All rights reserved.
HTML Prototype

Built with the use of Web pages created in HTML

The user uses HTML to create a series of Web pages that show the fundamental parts of the system.

The users have the ability to interact with the pages by clicking on buttons and entering pretend data.
Language Prototype

An interface design prototype built in the actual language or by the actual tool that will be used to build the system.

Language prototypes are designed in the same ways as HTML prototypes.
Interface Evaluation

- Heuristic evaluation
  - Compare design to checklist

- Walkthrough evaluation
  - Team simulates movement through components

- Interactive evaluation
  - Users try out the system

- Formal usability testing
  - Expensive
  - Detailed use of special lab testing
NAVIGATION DESIGN
Basic Principles of Navigation Design

- Assume users
  - Have not read the manual
  - Have not attended training
  - Do not have external help readily at hand

- All controls should be clear and understandable and placed in an intuitive location on the screen.
Basic Principles of Navigation Design

- Prevent mistakes
  - Limit choices
  - Never display commands that can’t be used (or “gray them out”)
  - Confirm actions that are difficult or impossible to undo

- Simplify recovery from mistakes

- Use consistent grammar order
Types of Navigation Control

- **Languages**
  - Command language
  - Natural language

- **Menus**
  - Generally aim at broad shallow menu
  - Consider using “hot keys”

- **Direct Manipulation**
  - Used with icons to start programs
  - Used to shape and size objects
  - May not be intuitive for all commands
Types of Menus

**Menu Bar**
List of commands at the top of the screen. Always on screen.

**Drop-Down Menu**
Menu that drops down immediately below another menu. Disappears after one use.

**Hyperlink Menu**
A set of items arranged as a menu, usually along one edge of the screen.

**Embedded Hyperlinks**
A set of items embedded and underlined in text.

**Pop-up Menu**
Menu that pops up and floats over the screen. Disappears after one use.

**Tab Menu**
Multiple-page menu with one tab for each page that pops up and floats over the screen. Remains on screen until closed.

**Tool Bar**
Menu of buttons (often with icons) that remains on the screen until closed.

**Image Map**
Graphical image in which certain areas are linked to actions or other menus.

---

- **Menu Bar**
  - Main menu for system
  - Use the same organization as the operating system and other packages (e.g., File, Edit, View)
  - Menu items are always one word, never two
  - Menu items lead to other menus, rather than performing action
  - Never allow users to select actions they can't perform (instead use grayed-out items)

- **Drop-Down Menu**
  - Second level menu, often from menu bar
  - Menu items are often multiple words
  - Avoid abbreviations
  - Menu items perform action or lead to another cascading drop-down menu, popup menu, or tab menu
  - Most users are familiar with hyperlink menus on the left edge of the screen, although they can be placed along any edge
  - Menu items are usually only one or two words

- **Hyperlink Menu**
  - Main menu for Web-based system
  - As a link to ancillary, optional information
  - Used sparingly to provide additional information because they can complicate navigation
  - Usually open a new window that is closed once the action is complete so the user can return to the original use scenario
  - Often (not always) invoked by a right-click in Windows-based systems
  - Menu choices vary depending on pointer position
  - Often overlooked by novice users, so usually should duplicate functionality provided in other menus
  - Menu items should be short to fit on the tab label
  - Avoid more than one row of tabs because clicking on a tab to open it can change the order of the tabs and in virtually other case does selecting from a menu rearrange the menu itself.

- **Pop-up Menu**
  - As a shortcut to commands for experienced users
  - When user needs to change several settings or perform several related commands
  - All buttons on the same tool bar should be the same size
  - If the labels very dramatically in size, then use two different sizes (small and large)
  - Buttons with icons should have a tool tip—an area that displays a text phase explaining the button when the user pauses the pointer over it
  - Image should convey meaning to show which parts perform an action when clicked
  - Tool tips can be helpful
Message Tips

- Should be clear, concise, and complete
- Should be grammatically correct and free of jargon and abbreviations (unless they are the users)
- Avoid negatives and humor
# Types of Messages

<table>
<thead>
<tr>
<th>Type of Messages</th>
<th>When to Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Error message</strong></td>
<td>When user does something that is not permitted or not possible</td>
<td>Always explain the reason and suggest corrective action. Traditionally, error messages have been accompanied by a beep, but many applications now omit it or permit users to remove it.</td>
</tr>
<tr>
<td><strong>Confirmation message</strong></td>
<td>When user selects a potentially dangerous choice, such as deleting a file</td>
<td>Always explain the cause and suggest possible action. Often include several choices other than “OK” and “cancel.”</td>
</tr>
<tr>
<td><strong>Acknowledgment message</strong></td>
<td>Seldom or never; users quickly became annoyed with all the unnecessary mouse clicks</td>
<td>Acknowledgment messages are typically included because novice users often like to be reassured that an action has taken place. The best approach is to provide acknowledgment information without a separate message on which the user must click. For example, if the user is viewing items in a list and adds one, then the updated list on the screen showing the added item is sufficient acknowledgment.</td>
</tr>
<tr>
<td><strong>Delay message</strong></td>
<td>When an activity takes more than seven seconds</td>
<td>This message should permit the user to cancel the operation in case he or she does not want to wait for its completion. The message should provide some indication of how long the delay may last.</td>
</tr>
<tr>
<td><strong>Help message</strong></td>
<td>In all systems</td>
<td>Help information is organized by table of contents and/or keyword search. Context-sensitive help provides information that is dependent on what the user was doing when help was requested. Help messages and online documentation are discussed in Chapter 13.</td>
</tr>
</tbody>
</table>
INPUT DESIGN
Basic Principles of Input Design

- The goal is to simply and easily capture accurate information for the system
- Reflect the nature of the inputs
- Find ways to simplify their collection
Online versus Batch Processing

- **Online processing** immediately records the transaction in the appropriate database.
- **Batch processing** collects inputs over time and enters them into the system at one time in a batch.
- **Batch processing** simplifies data communications and other processes, master files are not updated real time.
Capture Data at the Source

☑ Reduces duplicate work
☑ Reduces processing time
☑ Decreases cost
☑ Decreases probability of error
Source Data Automation

- Can be obtained by using the following technologies:
  - bar code readers
  - optical character recognition
  - magnetic stripe readers
  - smart cards
  - RFID (radio frequency identification tags)

How can internet be used for source data automation?
Minimize Keystrokes

Never ask for information that can be obtained other ways

- Lookups
- Dropdown lists
- Default values
Types of Inputs

- Data items linked to fields
- Text
- Numbers
- Selection boxes
  - Check boxes
  - Radio buttons
  - On-screen list boxes
  - Drop-down list boxes
  - Combo boxes
  - Sliders
Types of Input Forms

![Sample Input Form]

Text Box
- Name:

Radio Buttons
- MIS
- Accounting
- Marketing
- Computer Science
- Management

Check Boxes
- Word
- WordPerfect
- Excel
- Lotus 1-2-3
- Access

On-Screen List Box

Drop-Down List Box

Slider
- Hair Color:
- Interest Score:

Select where you were born:
- Eastern Canada
- Central Canada
- Western Canada
- Northern Canada
- Eastern U.S.
- Central U.S.
- Southern U.S.
- Western U.S.
- Pacific U.S.
- Hawaii, Alaska
- Other U.S.
- Mexico
- Non-North America
# Types of Selection Boxes

<table>
<thead>
<tr>
<th>Type of Box</th>
<th>When to Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check box</td>
<td>When several items can be selected from a list of items</td>
<td>Check boxes are not mutually exclusive. Check box labels should be placed in some logical order, such as that defined by the business process, or failing that, alphabetically or most commonly used first. Use no more than ten check boxes for any particular set of options. If you need more boxes, group them into subcategories.</td>
</tr>
<tr>
<td>Radio button</td>
<td>When only one item can be selected from a set of mutually exclusive items</td>
<td>Use no more than six radio buttons in any one list; if you need more, use a dropdown list box. If there are only two options, one check box is usually preferred to two radio buttons, unless the options are not clear. Avoid placing radio buttons close to check boxes to prevent confusion between different selection lists.</td>
</tr>
<tr>
<td>On-screen list box</td>
<td>Seldom or never—only if there is insufficient room for check boxes or radio buttons</td>
<td>This type of box can permit only one item to be selected (in which case it is an ugly version of radio buttons). This type of box can also permit many items to be selected (in which case it is an ugly version of check boxes), but users often fail to realize they can choose multiple items. This type of box permits the list of items to be scrolled, thus reducing the amount of screen space needed.</td>
</tr>
<tr>
<td>Drop-down list box</td>
<td>When there is insufficient room to display all choices</td>
<td>This type of box acts like radio buttons but is more compact. This type of box hides choices from users until it is opened, which can decrease ease of use; conversely, because it shelters novice users from seldom-used choices, it can improve ease of use. This type of box simplifies design if the number of choices is unclear, because it takes only one line when closed.</td>
</tr>
<tr>
<td>Combo box</td>
<td>Shortcut for experienced users</td>
<td>This type of box acts like drop-down list but is faster for experienced users when the list of items is long.</td>
</tr>
<tr>
<td>Slider</td>
<td>Entering an approximate numeric value from a large continuous scale</td>
<td>The slider makes it difficult for the user to select a precise number. Some sliders also include a number box to enable the user to enter a specific number.</td>
</tr>
</tbody>
</table>
## Types of Input Validation

<table>
<thead>
<tr>
<th>Type of Validation</th>
<th>When to Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness check</td>
<td>When several fields must be entered before the form can be processed</td>
<td>If required information is missing, the form is returned to the user unprocessed.</td>
</tr>
<tr>
<td></td>
<td>Ensures all required data have been entered</td>
<td></td>
</tr>
<tr>
<td>Format check</td>
<td>When fields are numeric or contain coded data</td>
<td>Ideally, numeric fields should not permit users to type text data, but if this is not possible, the entered data must be checked to ensure it is numeric. Some fields use special codes or formats (e.g., license plates with three letters and three numbers) that must be checked.</td>
</tr>
<tr>
<td></td>
<td>Ensures data are of the right type (e.g., numeric) and in the right format (e.g., month, day, year)</td>
<td></td>
</tr>
<tr>
<td>Range check</td>
<td>With all numeric data, if possible</td>
<td>A range check permits only numbers between correct values. Such a system can also be used to screen data for &quot;reasonableness&quot;—e.g., rejecting birth dates prior to 1880 because people do not live to be a great deal over 100 years old (most likely, 1900 was intended).</td>
</tr>
<tr>
<td></td>
<td>Ensures numeric data are within correct minimum and maximum values</td>
<td></td>
</tr>
<tr>
<td>Check digit check</td>
<td>When numeric codes are used</td>
<td>Check digits are numbers added to a code as a way of enabling the system to quickly validate correctness. For example, U.S. Social Security Numbers and Canadian Social Insurance Numbers assign only eight of the nine digits in the number. The ninth number—the check digit—is calculated using a mathematical formula from the first eight numbers. When the identification number is typed into a computer system, the system uses the formula and compares the result with the check digit. If the numbers don't match, then an error has occurred.</td>
</tr>
<tr>
<td></td>
<td>Check digits are added to numeric codes</td>
<td></td>
</tr>
<tr>
<td>Consistency checks</td>
<td>When data are related</td>
<td>Data fields are often related. For example, someone's birth year should precede the year in which he or she was married. Although it is impossible for the system to know which data are incorrect, it can report the error to the user for correction. Data are compared against information in a database (or file) to ensure they are correct. For example, before an identification number is accepted, the database is queried to ensure that the number is valid. Because database checks are more &quot;expensive&quot; than the other types of checks (they require the system to do more work), most systems perform the other checks first and perform database checks only after the data have passed the previous checks.</td>
</tr>
<tr>
<td>Database checks</td>
<td>When data are available to be checked</td>
<td></td>
</tr>
</tbody>
</table>
OUTPUT DESIGN
Basic Principles

- Understand report usage
  - Reference or cover-to-cover?
  - Frequency?
  - Real-time or batch reports?

- Manage information load
  - All needed information, no more

- Minimize bias
# Types of Reports

<table>
<thead>
<tr>
<th>Type of Reports</th>
<th>When to Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detail report</strong></td>
<td>When user needs full information about the items</td>
<td>This report is usually produced only in response to a query about items matching some criteria. This report is usually read cover to cover to aid understanding of one or more items in depth.</td>
</tr>
<tr>
<td><strong>Summary report</strong></td>
<td>When user needs brief information on many items</td>
<td>This report is usually produced only in response to a query about items matching some criteria, but it can be a complete database. This report is usually read for the purpose of comparing several items to each other. The order in which items are sorted is important.</td>
</tr>
<tr>
<td><strong>Turnaround document</strong></td>
<td>When a user (often a customer) needs to return an output to be processed</td>
<td>Turnaround documents are a special type of report that are both outputs and inputs. For example, most bills sent to consumers (e.g., credit card bills) provide information about the total amount owed and also contain a form that consumers fill in and return with payment.</td>
</tr>
<tr>
<td><strong>Graphs</strong></td>
<td>When users need to compare data among several items</td>
<td>Well-done graphs help users compare two or more items or understand how one has changed over time. Graphs are poor at helping users recognize precise numeric values and should be replaced by or combined with tables when precision is important. Bar charts tend to be better than tables of numbers or other types of charts when it comes to comparing values between items (but avoid three-dimensional charts that make comparisons difficult). Line charts make it easier to compare values over time, whereas scatter charts make it easier to find clusters or unusual data. Pie charts show proportions or the relative shares of a whole.</td>
</tr>
</tbody>
</table>
Bias in Graphs

Unbiased Graph with scale starting at 0

Biased Graph with scale starting at 90
The user interface should be designed to make the user’s work easier and more effective.

Principles for good interface design include concern for content and context for navigation through activities, aesthetic considerations, assistance for novices and experts, consistency, and minimizing user effort.

The design process focuses on user actions, diagramming the structure, setting up standards and a template, then evaluating interface designs.
Summary

- The fundamental goal of navigation design is to make the system as simple to use as possible.
- The goal of input mechanism is to simply and easily capture accurate information.
- The goal of the output mechanism is to provide accurate information to users that minimize information overload and bias.