Course Overview

- Introduction
- Understanding Users and Their Tasks
- Principles and Guidelines
- Interacting with Devices
- Interaction Styles
- **UI Design Elements**
- Visual Design Guidelines
- UI Development Tools
- Iterative Design and Usability Testing
- Project Presentations & Selected Topics
- Case Studies
- Recent Developments in HCID
- Conclusions

Chapter Overview UI Design Elements

- Motivation
- Objectives
- Evaluation Criteria
- Windows
  - Window Components
  - Controls
  - Menus
  - Dialogs
  - Cursors
- Web Pages
  - Pages
  - Frames
  - Links
- Important Concepts and Terms
- Chapter Summary

Motivation

- the use and popularity of UI design elements depends on available technology, usability, and other factors like price, market share, or applications
- currently windows are the most important UI design element
  - windows can be used to overcome some of the limitations of physical I/O devices
  - for the programmer, windows introduce a level of abstraction from the hardware I/O devices
- Web pages have become an important interaction style
  - especially for navigation in collections of documents

Objectives

- to be familiar with the most relevant UI design elements
  - based on current technology and usage
- to know the advantages and drawbacks of important UI design elements
  - especially windows and Web pages
- to be able to evaluate the suitability of a set of design elements for a specific function or task
  - comparison between alternatives
  - selection of the most suitable ones

UI Design Elements

- conceptual objects for interaction between user and system
- building blocks for programmers to implement user interfaces
- closely related to interaction styles

Examples of UI Design Elements

- hardware controls
  - switches, buttons, lights, dials
- stacks of punch cards
- paper printout
- command line
- full-screen editor
- menus
- windows

Physical Devices

- mainly for input and output functions
- exist whether or not the system is turned on
- may not be functional unless the system is on
- examples
  - mouse, screen, keyboard

Virtual Devices

- exist only when the system is operating
- input devices
  - e.g. buttons & touch-sensitive areas
- output devices
  - e.g. dials, lights, & gauges
- others are both
  - e.g. sliders, control panels, & calculators
- some virtual devices are sometimes referred to as widgets
  - e.g. check boxes, sliders, menus, buttons

Windows as UI Design Elements

- user's perspective
  - abstraction of terminals
    - extends limitations of physical devices
  - more effective resource utilization
    - in particular screen space
  - consistent interaction style within and across applications
- programmer's perspective
  - abstraction of device drivers
  - management of multiple streams of interaction
  - re-use of interaction components

History of Windows

- 1960s
  - Douglas Engelbart designs a computer with windows, mouse, and hypertext features at the Stanford Research Institute (SRI)
- 1970s
  - Smalltalk environment contains overlapping and movable windows (Alan Kay et al. at Xerox PARC)
  - some mainframe OSs and applications support virtual terminals
    - screen is split into separate areas
      - usually alphanumerical
      - not overlapping
      - stationary

History of Windows (cont.)

- 1980s
  - Apple Macintosh is the first widely used computer with a graphical user interface incorporating windows
    - some commercially less successful predecessors
      - Apple Lisa, Xerox Star, workstations
  - IBM and Microsoft introduce graphical user interfaces as extensions to or replacement of DOS
    - OS/2 Presentation Manager
    - MS Windows
  - graphical user interfaces for Unix
    - vendor-specific
      - SunView, HPView, ...
    - X Windows
      - vendor-independent system developed at MIT

History of Windows (cont.)

- 1990s
  - GUIs turn into the dominant interaction style for computers
    - Windows 3.1 in 1992, Windows 95
  - Macintosh
  - X Windows with presentation managers
    - OpenLook, OSF/Motif
  - WWW makes browsing a very popular interaction style
    - graphical interface
    - consistent naming scheme (URLs)
    - hyperlinks for navigation

Windows

- the overall display area ("screen estate") is divided into virtual displays
  - overlapping, movable, resizable
  - almost always rectangular
  - can be used to display any kind of visual output
    - text, graphics, video
  - different windows may belong to the same or different applications
    - frequently windows are mapped to processes or threads at the OS level
  - input is directed to the respective application/process

Window Properties

- unique name or title
- size in height & length
- state
  - accessible/active, or not accessible
    - only active windows can have their contents altered
- visibility
  - the portion that can be seen
  - a window may be partially or fully hidden by other windows
- location
  - relative to the display background

Window Properties

- presentation
  - arrangement relative to other windows
  - may be tiled, overlapping, or cascading
- management capabilities
  - manipulation of the window on the screen
- highlight
  - part that is active (selected)
- function, task, application and process with which it is affiliated

Window Systems

- sets of windows, controls, libraries and development tools with a consistent user interface ("look and feel")
  - Macintosh, MS Windows, X11 with presentation managers
- standard components of most window systems
  - windows
  - menus
  - controls & control panels
  - dialog boxes
  - cursors

Window Components

- borders
  - boundary to define shape, usually rectangular, may be sizable
  - If sizable, contains control points to resize
  - sometimes also known as a frame
- title bar
  - top line
  - standard in all primary & secondary windows
- title bar icon
  - small version of of the object icon being viewed
  - access point for controls that apply to the object
    - e.g., Restore, Minimize, Close
- title bar button
  - shortcuts to specific commands
    - e.g., Minimize, Maximize, Close

Window Components (cont.)

- menu bar
  - provides basic & common application controls
    - e.g. File, Edit, View, Help
- status bar
  - access to status information about what is being displayed in the window
- scroll bar
  - standard control to support scrolling
- size grip
  - control for sizing window
    - also known as resizing handle

Primary Window

- is the main window in which a user interacts with an object or application
- is the one through which all other windows in an application are generated
- remains open until the user takes a specific action to close it
- is typically the only window through which an application can be closed

Secondary Window

- generated through a primary window
- contains information that is dependent on the information in the primary window
- always associated with a primary window
  - clarifies actions to take
  - displays messages
  - closes when a user closes a primary window
  - hides when a user minimizes (or hides) a primary window
  - re-displays when the primary window is restored

Benefits of Window Systems

- limited display space can be optimized
- users can use multiple sources on the screen at once to carry out a task
- users can interact with any one of several views of one item of interest on the screen at the same time
- only one set of input devices for different purposes can be coordinated in a uniform way
- users are shielded from complicated command languages; all they have to do is point & select
- the way in which an interface works can be more easily standardized across many applications, making it easy to learn how to operate new ones
- the organization of windows on the user's desktop can be customized to meet the needs of that user

Drawbacks of Window Systems

- may be confusing for novice users
- user may lose focus of the active window
- visibility
- too many open windows
- arrangement of windows
- loss of space for window controls
- performance
  - adds another intermediate layer
  - e.g. games, real-time display

Menus Overview

- pull-down menus
- pop-up menus
- option menus
- toggle menus
- cascading menus
- pie menus
- palette menus
- embedded menus
- dynamic menus

Menus

- list of items from which one or more selections can be made by the user
- play two critical roles in GUIs:
  - major form of navigation through the UI
  - convey a mental model of the UI to the user
- most windowing systems provide a system of menus
  - frequently pull-down & pop-up menus
- the main categories of a menu are frequently shown in a menu bar
  - always visible
  - anchor for pull-down menus

Pull-Down Menus

- menus that the user can "pull down" from the menu bar
- access to the major functionality of a system
  - such as Open, Print, Save, Close a file, create a New folder, Undo the previous action, Quit the application
- explicit, by definition, because the user must always initiate an action
- on some platforms (e.g., MS-Windows), they are called "drop-down"
  - the user does not have to hold the mouse button for the menu to remain visible

Pop-Up Menus

- may appear in different places on the screen
- are triggered by the user clicking on appropriate interface components
  - icons, menu bars, window controls
- context-sensitive
  - items displayed in the menu depend on where the pointer was located when the button was pressed
    - e.g. control panels, tool boxes, color palettes, ...

Option Menus

- look much like a field (e.g., in a form)
  - current value visible
- other values appear in a list menu when the user depresses the mouse button over the visible field
- often used for the selection of input parameters
- the choice of options may be determined dynamically
  - see also dynamic menus

Toggle Menus

- similar to an option menu with its current value visible
- rotate through all possible choices, one at a time, as the user clicks the mouse button over the field in which a selection of the menu appears
  - e.g. temporal information
    - time of day, days of the week, etc.
  - tan also be used for offering binary decisions
    - Yes/No, am/pm

Cascading Menus

- look & behave much like a sequence of pull-down menus
- user goes down several cascading levels until the selection is made
- choices on the menus that lead to other menus are usually indicated by a visual cue
  - arrow or wedge marker

Pie Menus

- display choices in a circular or semi-circular arrangement of labeled pie wedges
  - e.g. selecting a color (hue, saturation, & intensity) on a color wheel
- useful when the choices can be displayed continuously in two dimensions
- shorter distances between alternatives than with many other types of menus

Palette Menus

- choices are represented as graphical icons, rather than as words, on push buttons that are grouped together
- choices are usually mutually exclusive.
  - e.g. selecting patterns, colors, shapes, ...
- similar to pie menus
  - also useful for discrete items
- frequently can be detached from the menu bar
  - “floating palettes”

Embedded Menus

- some of the objects in the window itself are selectable
  - indicated by highlighting, underlining
- selecting such an object initiates an action
  - often navigation to the next “page”
- frequently found in hypermedia applications

Dynamic Menus

- contain choices that are run-time dependent
  - simple
    - unavailable choices are dimmed or grayed out so that the user cannot select them
  - medium
    - context-dependent pop-up menus
  - complex
    - real-time flight schedule

Toolbars

- serve as a menu shortcut, or as a way to present controls that would be hard to convey in words
  - e.g., drawing tools, colors, text parameters
- allow the presentation of many choices
- can be detachable into floating palettes
  - e.g., Drawing, Formatting, Standard
- may be collapsible
  - to save space when not needed
- drawback
  - showing many options may be intimidating for novice users
  - icons should be meaningful to the user
  - little used options use up screen space

Tabbed Dialogs

- modeled after the index card metaphor
- permit users to move quickly through different categories of information relating to one object
- the row that the user clicks on jumps to the front
- tabs can also be used to switch among different views of data (e.g., Lotus Notes).
- popular conceptual model in recent GUIs
- increasingly more common
  - e.g. Microsoft Word 6.0 and later, Netscape Navigator
- can replace lengthy sequences of dialog boxes

Controls Overview

- control panel
- control widgets
- buttons
- check boxes
- sliders
- gauges and dials
- status indicators
- boxes

Controls

- a general term for describing interface components used to adjust certain aspects
  - sliders, buttons, check boxes, dials, ...
- window systems typically provide standard controls for manipulating windows
  - moving, re-sizing, closing, change of focus, scrolling
- many of the controls provided by window systems allow users to master unfamiliar systems
  - build on their everyday knowledge of how buttons and switches work on physical objects
  - cognitive mapping between physical and virtual world

Control Panel

- typically consist of a collection of controls and displays grouped into one assembly
  - show the user the state of some objects of interest
  - allow various parameters to be altered interactively
  - e.g. date & time setting & calibration, choice of background color, preference settings for volume, brightness, etc.

Control Widgets

- user interface elements used for control purposes
- special case of virtual devices
- can be used for both input & output
- include buttons, sliders, gauges/dials, status indicators

Buttons

- control widget to control or select options
  - ON/OFF, select alternatives
- may also initiate actions
  - Open file, Continue, Confirm Action
- mimic the appearance and function of physical buttons
- most frequent types are
  - push buttons
  - radio buttons

Push Buttons

- also referred to as command buttons
- usually appear on a panel (like a dialog box) with some sort of label or icon inside
- primary way for users to initiate actions
- alternatives are indicated by separate buttons
- buttons are typically visible while a choice is made
  - e.g., OK, Close, Quit, Exit, Help
- when the user activates a push button, the action is usually carried out immediately
- sometimes a panel will have a default button
  - appears with an enhanced border
  - activated when selected or the Enter key is pressed

Radio Buttons

- also referred to as option buttons
  - small circles with some sort of label beside them
    - a black dot inside the circles indicates that that the button is selected
  - only one button can be pressed at the same time
    - similar to an old-fashioned car radio
  - choices are usually exhaustive and mutually exclusive
    - e.g., Font type (Helvetica, Times), Font size (10, 12, 14 point)

Check Boxes

- let users select an item independently of any other check boxes
  - not mutually exclusive
  - may be applied simultaneously (e.g., font types can be both bold & italics at the same time).
- a check mark √ or **x** appears in the box when selected
  - box is empty when deselected
  - use √ rather than **x**
    - the latter may be interpreted as “crossed out”
- never used to initiate an action or conclude an action
  - only to set choices

Sliders

- long box with a control that the user is able to slide one way or the other
- used to display & adjust values on continuous dimensions such as volume, speed, brightness
- can be relative or absolute
- provide visual feedback on the input value
  - e.g. “close to the maximum value”

Gauges and Dials

- virtual device areas that show the state and/or progression of some event
- typically circular or oval
  - e.g. clock, fuel level, altimeter, ...
- usually used for output purposes
  - sometimes adjustable

Status Indicators

- provide information about important system aspects
  - working/broken, specific actions, presence or absence of items, etc.
- indicate the effect of a user action on the system
  - e.g. the system is still working
    - animated cursor
  - should only be active (moving) when the system is actually working
- may indicate temporal aspects of actions
  - how long the process has taken so far
  - how long is left before the task is complete

Boxes

- rectangular, delineated screen areas
  - used for messages, text entry, commands, selection, & user control
- some boxes appear as a result of user actions
  - e.g. list boxes to select options
- others are displayed by the system
  - e.g. message boxes to inform the user about an event
- make temporary use of screen space
- occlude the part of the screen on which they appear
- types of boxes
  - list boxes, entry boxes, dialog boxes, message boxes, spin boxes

List Boxes

- let users choose an item from a list
  - can also be viewed as menus
- if the list is not visible, it is called a drop-down list
- if it is visible (list contains more than one item), users can click on the entry, or highlight it
- open lists can be variable in length, and sometimes are dynamic
  - i.e, choices are updated or refreshed at run time
- usually incorporate a horizontal and/or vertical scroll bar for user navigation

Entry Boxes

- allow a user to enter text
- usually have basic text-editing functions
  - wrap-around, inserting or deleting text
  - do not always provide full I/O functionality
    - keyboard maps, drag & drop
- can be both vertically and horizontally scrollable.
- can support a single or multiple lines
- should only be used for short and simple entries

Dialog Boxes

- on-screen controls to provide contextual information
- allow users to
  - make a related set of choices
  - type in some information
  - choose from a set of options that may change depending on the context
  - acknowledge a piece of information before proceeding
- two basic types
  - modal dialog boxes
  - modeless dialog boxes

Modal Dialog Boxes

- require the user to respond before continuing to work in the current application or in other applications
  - can be very annoying
  - may cause deadlocks
    - information that the user needs to continue is obscured by the box
- also known as preemptive boxes
  - application
    - e.g. application requires more memory to run
  - system
    - e.g., memory low, close windows to proceed, impending fatal system error
- should be used only for very important requests

Modeless Dialog Boxes

- offer information or request some action
  - do not restrict the actions of the user
- leave user in control
  - can be moved, re-sized, dealt with, or ignored
- also known as non-preemptive boxes
  - application examples: shareware reminders, ...
  - system examples: new mail, print job completed, ...
- should not be used for routine events
  - autosave, spelling corrections
- user should be able to select feedback mode
  - dialog box, audible warning, icon change, status bar

Message Boxes

- special kind of dialog box initiated by the system rather than the user
- typically, they do not allow the action that led to their appearing to be reversed;
  - only allow a single acknowledgment

Modality of Message Boxes

- modeless
  - information messages
    - “Finished checking selection,” “You have new mail”
  - working messages
    - “Automatic generation in progress…” -> OK, Cancel, Help
- modal
  - warning messages
    - “The application X cannot be found” -> OK, Cancel, Help
  - critical messages
    - “Unable to connect to server” -> Retry, Cancel, Help
  - question messages
    - “Do you want to continue?” -> Yes, No, Help

Spin Boxes

- used for selection of input values from a large number of options with some frequently used ones
  - boxes contain some value, with up & down arrows on one side, and generally a label on the other
  - users can input data either by typing it in or by clicking the area up or down
  - by clicking the arrow up or down, different values appear in the box
  - the entire range can be cycled if the up or down arrows are clicked enough times
  - example: setting the time

Cursors

- indicate the point of action or insertion on the screen,
  - often act as a virtual manipulator for on-screen objects
- indicate the state of a system
  - e.g., watch or hourglass cursors => short pause
- important, but often overlooked components of GUIs
- types of cursors
  - mouse cursor
    - shows the user where the current position of the mouse is with respect to the windows on the screen
  - text cursor
    - used with windows that are specialized to deal with text
    - shows where input from the keyboard will be placed

Text Fields

- text fields and areas allow users to enter text
  - input typically by typing
- text fields are used for single data
- text areas are used for blocks of text

Common Tasks in Window Systems

- managing input
- changing window focus
- managing single windows
- managing multiple windows

Managing Input

- the input needs to be directed from the input device to the right process
  - responsible for the execution of the application
  - in control of the currently active window
- may be confusing for inexperienced or inattentive users

Button Overload

- mouse input and the button overload problem
- most mice have one, two, or three buttons
  - with multiple-button mice, the user must remember which button performs which action in any given context
- can present a real problem to untrained users
  - alleviated by assigning each button a standard role
    - e.g. three-button mouse
      - button 1: select & activate
      - button 2: move & copy
      - button 3: custom menu
- four primitive actions that can be carried out with any mouse button
  - point, click/double-click, press, drag

Changing Focus

- it must be easy for a user to direct output to any desired window
- visual feedback must show the user to which window output is currently being directed
- active window
  - indicated in most windowing systems by some alteration in the appearance of the title bar
  - usually the top window
    - easier to understand
    - less flexible, may impose limitations on experienced users

Managing Single Windows

- the user can move windows
  - selecting the title bar or border and dragging the window
- scrolling gives the user control over which part of the information is shown
  - use of scroll arrows, one line at a time or continuous scrolling
  - scrolling lists
    - elements that appear in a box with a scroll bar on the side
    - allow the user to move up/down through the elements
    - clicking on an element in the list selects the element
    - a list can allow multiple selections
      - can be either contiguous or non-contiguous

Managing Multiple Windows

- often not all windows fit on the screen at once
  - facilities are provided to iconify, tile, or overlap windows
- iconification
  - inactive windows can be reduced to icons
  - icons act as a visual reminder of the window
    - e.g. X-Windows, Office 95, ...
- tiling
  - all windows are visible, arranged side by side
  - some systems do not provide facilities for overlapping windows, just tiling
  - some provide both

Overlapping

- probably the most popular form of window management
- based on the idea of overlapping documents arranged on a desk
- top window obscures the ones below
  - it is usually the active window.
- overlapping can be very flexible
  - it can also lead to problems of clutter and disorganization
- cascaded windows
  - leaves small parts of each window visible
  - version of overlapping that can help avoid disorganization

Recent Developments

- in UI design elements
  - MS Windows
  - MacOS
  - Unix
  - handheld computers
- mostly incremental changes
  - merging of Web browsing and file management
  - better configurability to suit users' preferences
  - tabbed dialog boxes for application options

Windows 95

- Internet Explorer (IE) integrated with OS
  - everything item on the desktop and every folder acts as just another Web page
- windows loaded into Web page via URL
  - every UI window can act as a Web browser window
- windows task bar
  - icons for open applications at the bottom of the screen
- active desktop
  - background of the Windows desktop can be a HTML file, GIF, JPEG, or bitmap
  - any number of desktop components may be added to the desktop
    - e.g. channels, streaming stock ticker, ...

Windows 98

Windows ???

MacOS 8

- mostly minor changes
  - better dialog boxes
  - better windows management

MacOS X

- merges some features of the NextStep UI with the traditional Macintosh UI
  - more capabilities for experienced users
  - better match with underlying functionality
  - possible confusion for novice or regular users

Unix

- very few changes to UI design elements
- relies mainly on presentation managers for X Windows
- integration of Web browsing with other applications
  - e.g. for Help systems

Handheld Computers

- severe limitations
  - small screen
  - no or few colors
  - no keyboard
  - pen as input and pointing device

Web Design

- mostly a subset of windows-based design
- integrates hyperlinks as navigation element
- Web design elements
  - pages
  - frames
  - links

Web Pages

- user's view of information on the screen
- basic unit of navigation
  - what you get when you click on a link or activate a navigation action like a bookmark
- provide a textual address as unique identifier to retrieve information over the net (URL)
- place where information is stored on the server

Frames

- similar to tiled windows
  - divide the page into sub-pages
  - each frame contains its own page
- user's view of information on the screen is determined by a sequence of navigation actions
- can help with the navigation of complex Web sites
- unique to Web pages (so far)

Links

- pointers to other locations
  - other pages
  - different location within the same page
- main navigation mechanism for the user
- very easy to understand and use
- user may become disoriented
  - context information gets easily lost

Web Design vs. GUI Design

- essential differences between the design of system based on the Web and traditional GUIs
  - device diversity
  - navigation
  - environment

Device Diversity

- users may use a diversity of different devices and modalities to access the Web
  - devices: PC, WebTV, PDA, cellular phone, etc
  - modalities: GUI, alphanumeric, B&W, audio
  - designer control over the appearance of Web pages is difficult to maintain
    - "WYSIWYG is dead"
- brand discrimination
  - "looking different is a feature, not a bug"

Navigation

- almost exclusively under the control of the user
  - in traditional GUI design, the designer can control where the user can go
    - e.g. graying out menu options that are not applicable in the current state, putting up a dialog box that stays there until the user responds, etc.
  - on the Web, the user fundamentally controls the navigation through the pages
    - some designer control can be imposed through frames, JavaScript, Java applets
  - need to accommodate and support user-controlled navigation
    - make the best out of a difficult situation for designers

Environment

- Internet as communication infrastructure
- network delays
  - navigating from one page to another in a Web application takes longer than moving from a main window to a dialog box in a traditional application
  - delays add to users' cognitive load
    - they have to keep contextual information in their heads while waiting
- access limitations
  - essentially read-only access for remote sites
  - write access only with special authorization
  - remote execution of programs is limited

Important Concepts and Terms

- box
- button
- controls
- cursor
- desktop
- dialog
- display
- focus
- frame
- graphical user interface (GUI)
- hyperlink
- input/output device
- link
- menu
- mouse
- page
- palette
- presentation manager
- toolbar
- usability
- user interface design
- Web page
- What You See Is What You Get" (WYSIWYG)
- widget
- window

Chapter Summary

- commonly used UI design elements help users with familiarity within and across applications, and support UI development through abstraction and reuse
- the most important design element at this point is the window
  - it helps overcome limitations of physical devices by providing virtual terminals
  - it improves resource utilization by letting users interact with different applications concurrently
  - it is easy to understand and use, and flexible enough to be used for many types of applications
- Web pages have emerged as a variation of windows with special support for navigation in large information spaces like the World Wide Web