Chapter 2

Guidelines, Principles, and Theories

Topics

- Guidelines
- Principles
- Theories

Introduction

- The cluttered displays, complex procedures, inadequate functionality, inconsistent sequences of actions, and insufficient informative feedback can generate stress and anxiety.
- It is perfectly understandable that users whose network connections drop as they are completing lengthy online purchase orders may become frustrated even angry.
- These experiences can lead to poor performance, job dissatisfaction, and consumer frustration.
- Guidelines, principles and theories which can provide remedies and prevention have matured in recent years.

Guidelines

- Guidelines are based on experience
  - Record best practices derived from practical experience or empirical studies with appropriate examples, work of graphics designers
- Promote consistency among multiple designers in terminology, appearance, and action sequences
  - Apple and Microsoft guidelines for desktop applications
  - Guidelines for the web and mobile devices
- Critics (reviewers)
  - Too specific, incomplete, hard to apply, and sometimes wrong
- Proponents (One who argues in support of something)
  - Building on experience from design leaders contributes to steady improvements

Both groups recognise the value of discussion in promoting awareness

Some UI design guidelines

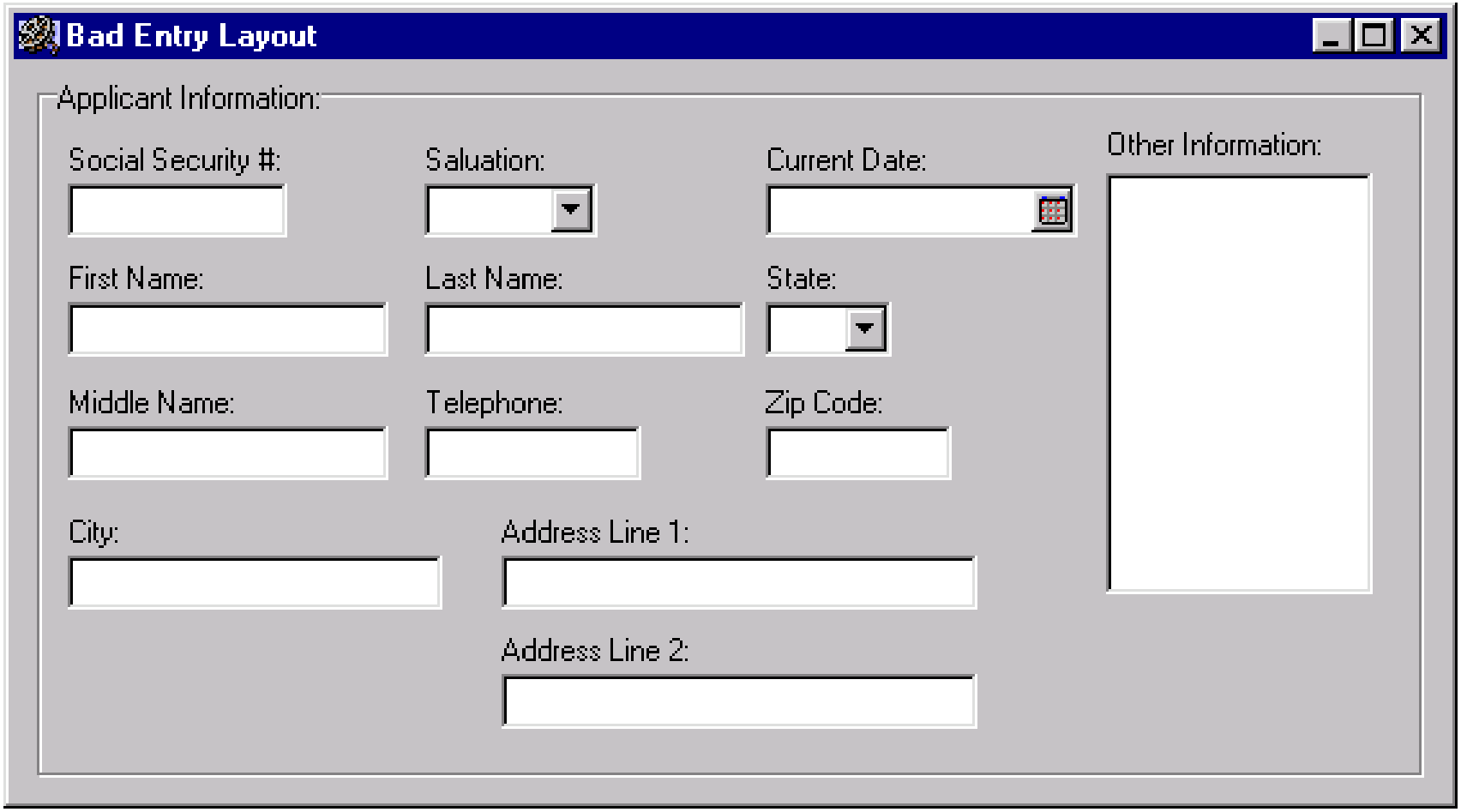
- Navigating the interface
- Organizing the display
- Getting the user's attention
- Facilitating data entry

Navigating the interface

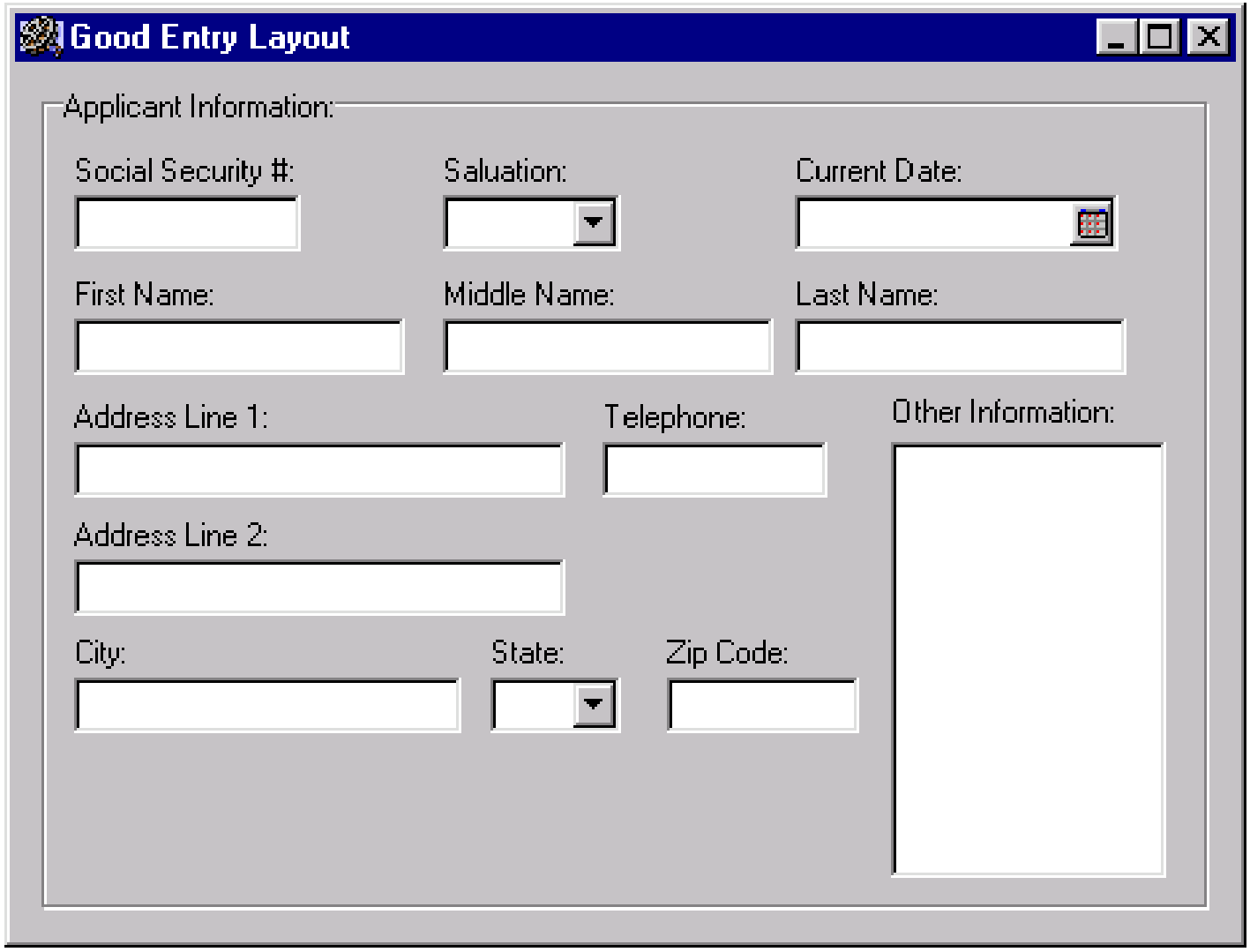
- Standardize task sequences: Allow users to perform tasks in the same sequence
- Ensure that embedded links are descriptive: The link text should accurately describe the link's destination
- Use unique and descriptive headings
- Use check boxes for binary choices: choice between "on" or "off".
- Develop pages that will print properly
- Use thumbnail images to preview larger images: When viewing full-size images is not critical, first provide a thumbnail of the image

Detailed guidelines on www.usability.gov

Navigating the interface



Navigating the interface



Accessibility guidelines

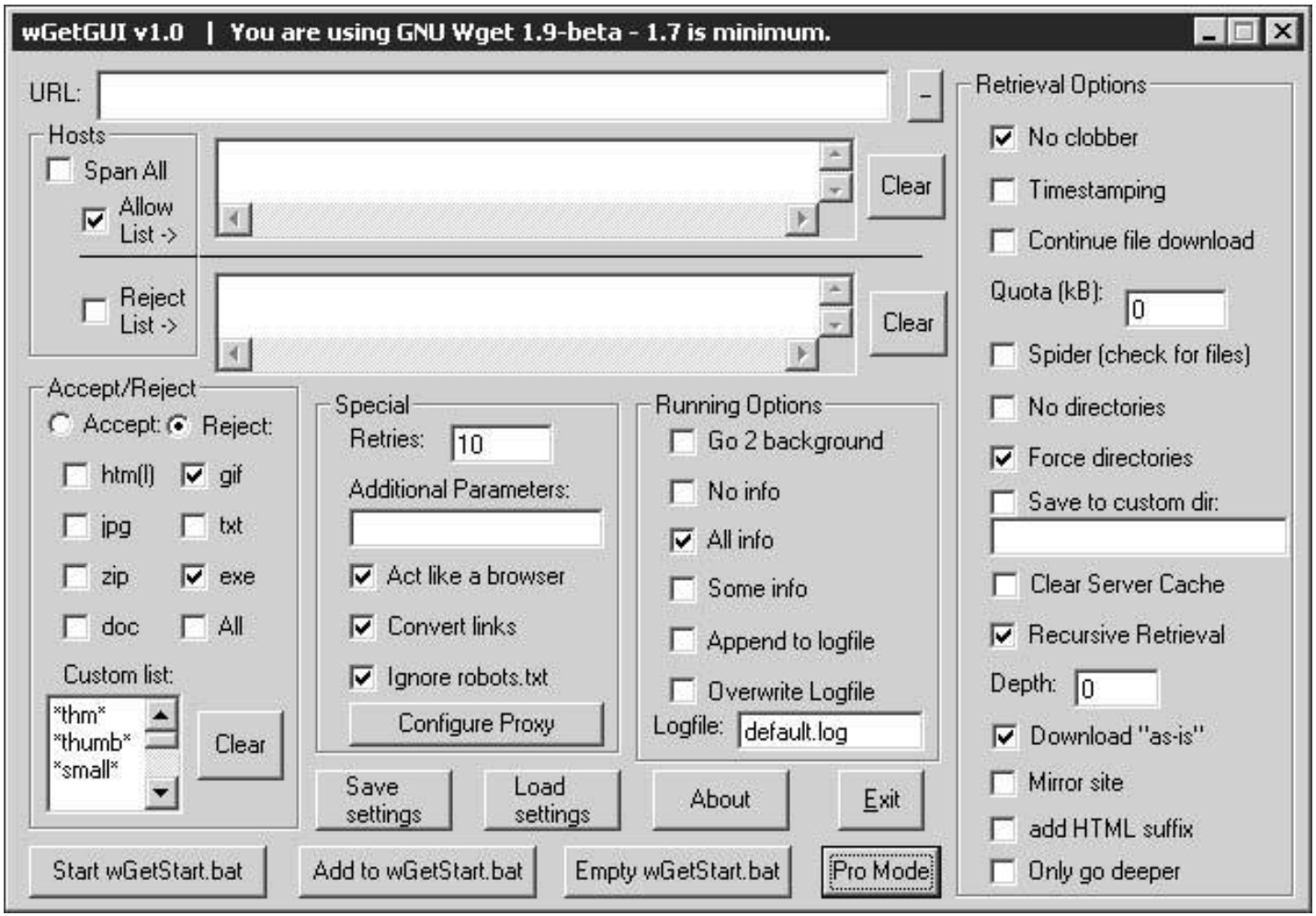
- Access Board (www.access-board.gov/508.htm), a US agency, adapted guidelines about accessibility for people with disabilities.
- A few of Accessibility Guidelines are:
  - Provide a text equivalent for every non-text element
  - For any time-based multimedia presentation (i.e. movies), synchronize equivalent alternatives (i.e. caption, auditory description)
  - Information conveyed with color should also be conveyed without it
  - Title each frame to facilitate frame identification and navigation

Detailed guidelines on www.w3.org/TR/WCAG20/

Organizing the display

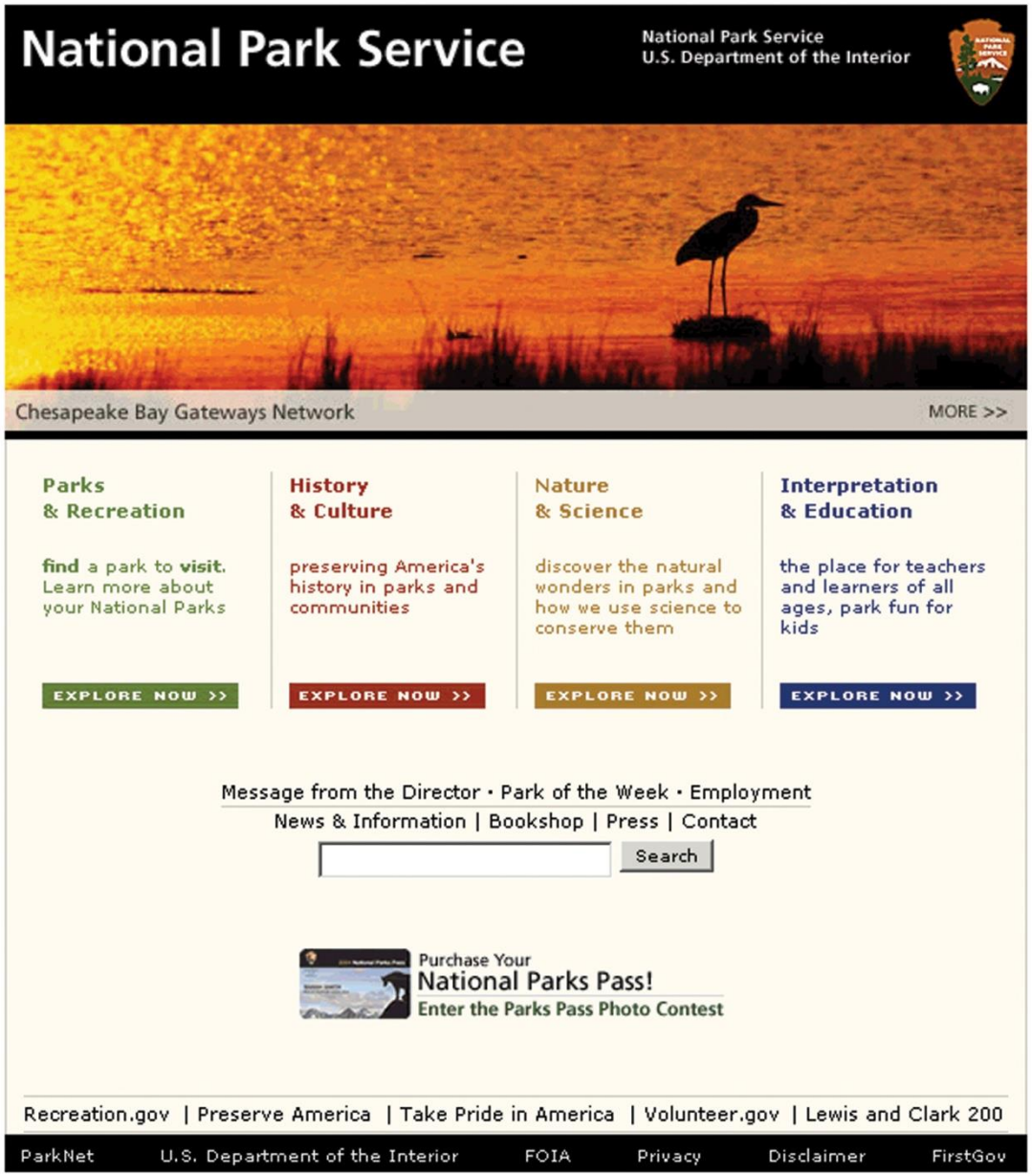
- Consistency of data display
  - Terminology, abbreviations, formats, colors, etc.
- Efficient information assimilation (adjustment) by the user
  - Neat columns, L/R justification, lining up of decimals points, spacing, labeling, number of decimal digits etc.
- Minimal memory load on the user
  - No memory requirement from one screen to another
  - Tasks completion occur with few actions only
  - Labels & common formats should be provided for novice and intermediate users
- Compatibility of data display with data entry
  - Output format should be linked to the format of data entry
- Flexibility for user control of data display
  - Flexibility of order of columns, sorting of rows, etc.

Organizing the display



- Bad Example - Functional overload

Organizing the display



Getting the user's attention

- Marking:
  - underlining, box, arrow, asterisk, bullet, dash, plus sigh, or X
- Size:
  - up to four sizes only, with larger sizes attracting more attention
- Choice of fonts:
  - up to three fonts only
- Inverse video (inverse coloring)
- Blinking:
  - use with great care and in limited areas
- Color:
  - up to four
- Audio:
  - soft tones for regular positive feedback, harsh for rare emergency conditions

☞ *Overusing these techniques may result in cluttered displays*

Some UI design guidelines

- Navigating the interface
- Organizing the display
- Getting the user's attention
- Facilitating data entry

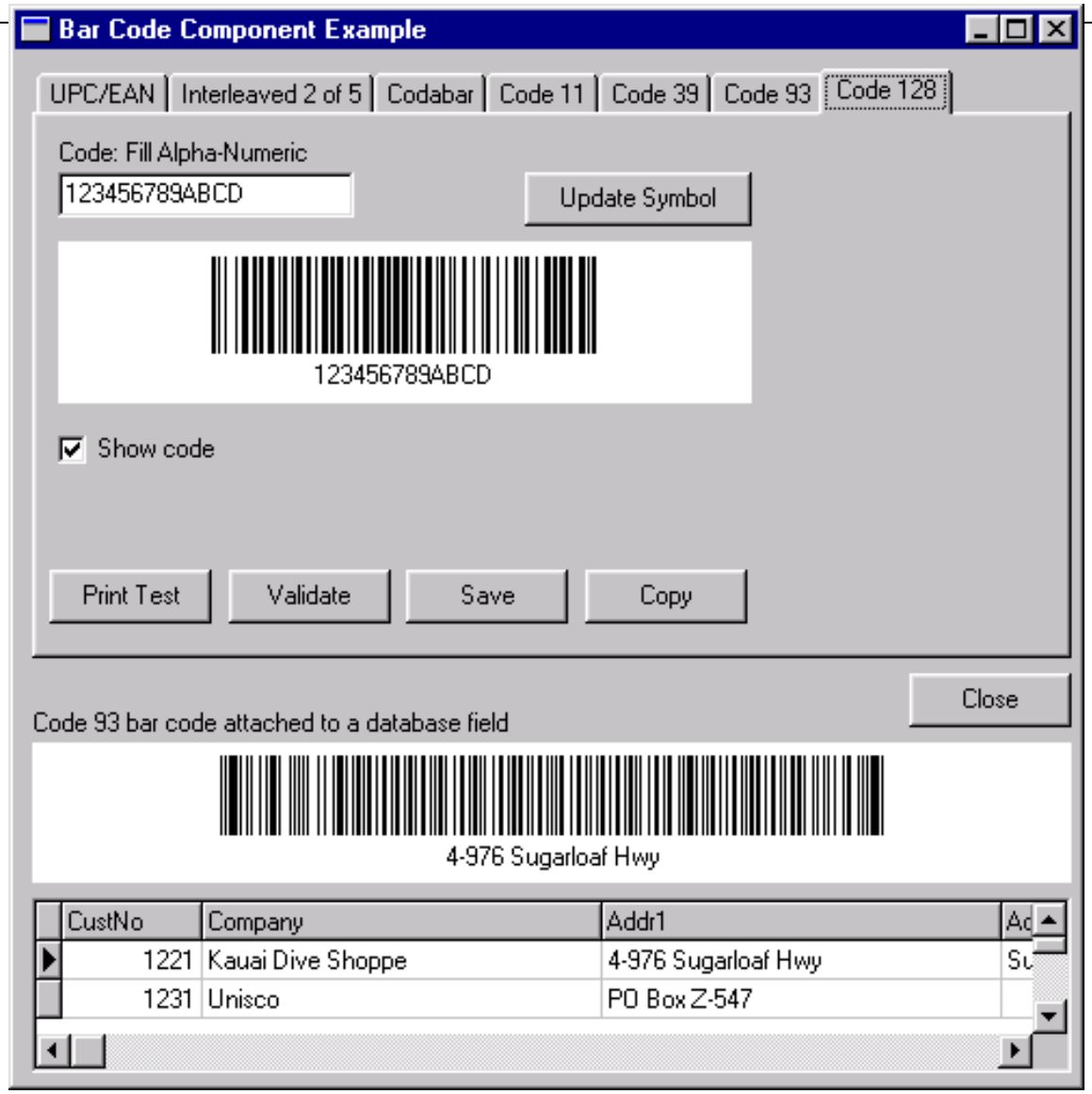
Facilitating data entry

- Consistency of data-entry transactions
  - Similar sequences of actions under all conditions
  - Similar abbreviations, and so on.
- Minimal input actions by user (increases productivity)
  - Making a choice by a single key, mouse etc rather than by typing in a lengthy string.
  - Selecting from the list of choice eliminates need for memorisation
  - Avoid frequent movement between keyboard & mouse
  - Avoid redundant data-entry
- Minimal memory load on users
  - Lengthy list of codes, complex commands
- Compatibility of data entry with data display

Facilitating data entry

- Suggest one way to improve data entry (i.e., data entry of an item without any error)

Facilitating data entry – bard code



Topics

- Guidelines
- Principles
- Theories

Principles

- While guidelines are narrowly focused, principles tend to be more fundamental, widely applicable, and enduring than guidelines
- Fundamental principles
  - Determine user's skill levels
  - Identify the tasks
  - Five primary interaction styles
  - Eight golden rules of interface design
  - Prevent errors
  - Simplicity
  - Structure
  - Consistency
  - Tolerance

Determine user's skill levels

- "Know thy user" was the first principle in Hansen (1971) classic list of user-engineering principles.
- All designs should begin with an understanding of the intended users
  - Age, gender, physical and cognitive abilities, education, cultural or ethnic background, training, motivation, goals and personality
  - Other variables: location (e.g. urban vs. rural), economic profile, disabilities, and attitude towards using technology
- An understanding of users' skills with interfaces and with the application domain is also important

► Determine user's skill levels

- Separation of users into various groups might lead to different design goals. e.g.
  - Novice or first-time users:
    - For examples grandparents sending their first email to a grandchild. Limitations can be overcome by instructions, dialog box and online help.
    - Number of actions should be small.
    - Careful design of user manuals is required.
  - Knowledgeable intermittent users
    - For example managers using word processing to create templates for travel reimbursements. They have stable tasks concept but they have difficulty of locating different features of word processing.
    - This can be addressed by consistent terminology and ordering different features.
  - Expert frequent users
    - They demand rapid response time and shortcuts to perform different tasks

Identify the tasks

- The set of tasks must be determined before design can proceed
- Task analysis usually involve long hours observing and interviewing users
- Task analysis is a long and difficult process
- This helps designers to understand tasks frequencies and sequences and make the tough decisions about what tasks to support

Identify the tasks

- Decomposition of high level tasks
  - High level tasks can be decomposed into middle level tasks which can be further refined into atomic actions that users execute with a single command
- Relative task frequencies: frequent vs. infrequent

	TASK				
Job title	Query by Patient	Update Data	Query across Patients	Add Relations	Evaluate System
Nurse	0.14	0.11			
Physician	0.06	0.04			
Supervisor	0.01	0.01	0.04		
Appointment personnel	0.26				
Medical-record maintainer	0.07	0.04	0.04	0.01	
Clinical researcher			0.08		
Database programmer			0.02	0.02	0.05

Choose an interaction style

- Direct Manipulation
  - When a clever designer can create a visual representation of the world, the users' tasks can be simplified, e.g. dragging a file to a trash can is a familiar example of direct manipulation
- Menu selection
  - Users read a list of items, select the one most appropriate to their tasks and observe the effect
  - Appropriate for novice and intermittent users
- Form fillin
  - Users must understand the fields labels, know the permissible values and the data entry methods and be capable of responding to error messages.
- Command language
  - User learn the syntax and can perform tasks rapidly. Error messages and online assistance are hard to provide. Suitable for experienced computer programmers.
- Natural language
  - Natural language interaction usually provides little context for issuing the next command, requires clarification dialog and may be slower

Direct manipulation advantages

- Users feel in control of the computer and are less likely to be intimidated by it
- User learning time is relatively short
- Users get immediate feedback on their actions so mistakes can be quickly detected and corrected

Direct manipulation problems

- Not good for vision-impaired users
- Direct manipulation interfaces can be complex to program and make heavy demands on the computer system
- Spatial or visual representations can be too spread out forcing valuable information off-screen causing scrolling or multiple actions
- The visual representation may be misleading
- Typing commands with the keyboard my be faster
- Web-based implementers face further challenges because of the limitations of HTML

Menu Systems

- Users make a selection from a list of possibilities presented to them by the system
- The selection may be made by pointing and clicking with a mouse, using cursor keys or by typing the name of the selection
- May make use of simple-to-use terminals such as touchscreens

Menu Systems Advantages

- Users need not remember command names as they are always presented with a list of valid commands
- Typing effort is minimal
- User errors are trapped by the interface
- Context-dependent help can be provided. The user's context is indicated by the current menu selection

Menu Systems Disadvantages

- Menu systems are best suited to presenting a small number of choices. If there are many choices, some menu structuring facility must be used
- Experienced users find menus slower than command language

Command Interfaces

- User types commands to give instructions to the system e.g. UNIX
- Users have to learn and remember a command language. Command interfaces are therefore unsuitable for occasional users
- Users make errors in command. An error detection and recovery system is required
- System interaction is through a keyboard so typing ability is required
- May be provided as an alternative to menu commands (keyboard shortcuts).
- Often preferred by experienced users because they allow for faster interaction with the system

Natural Language

- The user types a command in a natural language. Generally, the vocabulary is limited and these systems are confined to specific application domains (e.g. timetable enquiries)
- NL processing technology is now good enough to make these interfaces effective for casual users but experienced users find that they require too much typing

Choose an interaction style

Interaction style	Main advantages	Main disadvantages	Application examples
Direct manipulation	Fast and intuitive interaction Easy to learn	May be hard to implement Only suitable where there is a visual metaphor for tasks and objects	Video games CAD systems
Menu selection	Avoids user error Little typing required	Slow for experienced users Can become complex if many menu options	Most general-purpose systems
Form fill-in	Simple data entry Easy to learn	Takes up a lot of screen space	Stock control, Personal loan processing
Command language	Powerful and flexible	Hard to learn Poor error management	Operating systems, Library information retrieval systems
Natural language	Accessible to casual users Easily extended	Requires more typing Natural language understanding systems are unreliable	Timetable systems WWW information retrieval systems

Choose an interaction style

Advantages	Disadvantages
Direct manipulation	
Visually presents task concepts	May be hard to program
Allows easy learning	May require graphics display and pointing devices
Allows easy retention	
Allows errors to be avoided	
Encourages exploration	
Affords high subjective satisfaction	
Menu selection	
Shortens learning	Presents danger of many menus
Reduces keystrokes	May slow frequent users
Structures decision making	Consumes screen space
Permits use of dialog-management tools	Requires rapid display rate
Allows easy support of error handling	
Form fillin	
Simplifies data entry	Consumes screen space
Requires modest training	
Gives convenient assistance	
Permits use of form-management tools	
Command language	
Is flexible	Has poor error handling
Appeals to "power" users	Requires substantial training and memorization
Supports user initiative	
Allows convenient creation of user-defined macros	
Natural language	
Relieves burden of learning syntax	Requires clarification dialog
	May not show context
	May require more keystrokes
	Is unpredictable

Choose an interaction style

Blending several interaction styles may be appropriate when the required tasks and users are diverse.

The eight golden rules of interface design

1. Strive for consistency: Terminology, sequence, menu, help etc
2. Cater to universal usability: Novices, experts, disabilities, age ranges,
3. Offer informative feedback: System feedback
4. Design dialogs to yield closure: Sequence start, middle and closure
5. Prevent errors: Grey out menus not appropriate
6. Permit easy reversal of actions
7. Support internal locus (the place where some action occurs) of control: Experienced users want more control and want system should respond to their actions
8. Reduce short term memory load

Prevent errors

- Prevent errors in the first place. If a user makes an error, present a good error message
  - Make error messages specific, positive in tone, and constructive
- Techniques to reduce errors:
  - Make it difficult or impossible to take an incorrect action
    - Gray out inappropriate actions
  - Selection rather than freestyle typing
  - Automatic command completion, i.e. users type the first few letters and the systems complete it
  - Style formats in word processors
  - Macros and subroutines

Automation and human control

- Successful integration:
  - Users can avoid:
    - Routine, tedious, and error prone tasks
  - Users can concentrate on:
    - Making critical decisions, coping with unexpected situations, and planning future actions

Automation and human control (cont.)

- Supervisory control needed to deal with real world open systems
  - For example, in the air-traffic systems the controllers must be present to deal with the highly variable and unpredictable emergency situation.
  - Federal Aviation Authority stresses that a design should place the user in control and automate only to improve system performance, without reducing human involvement

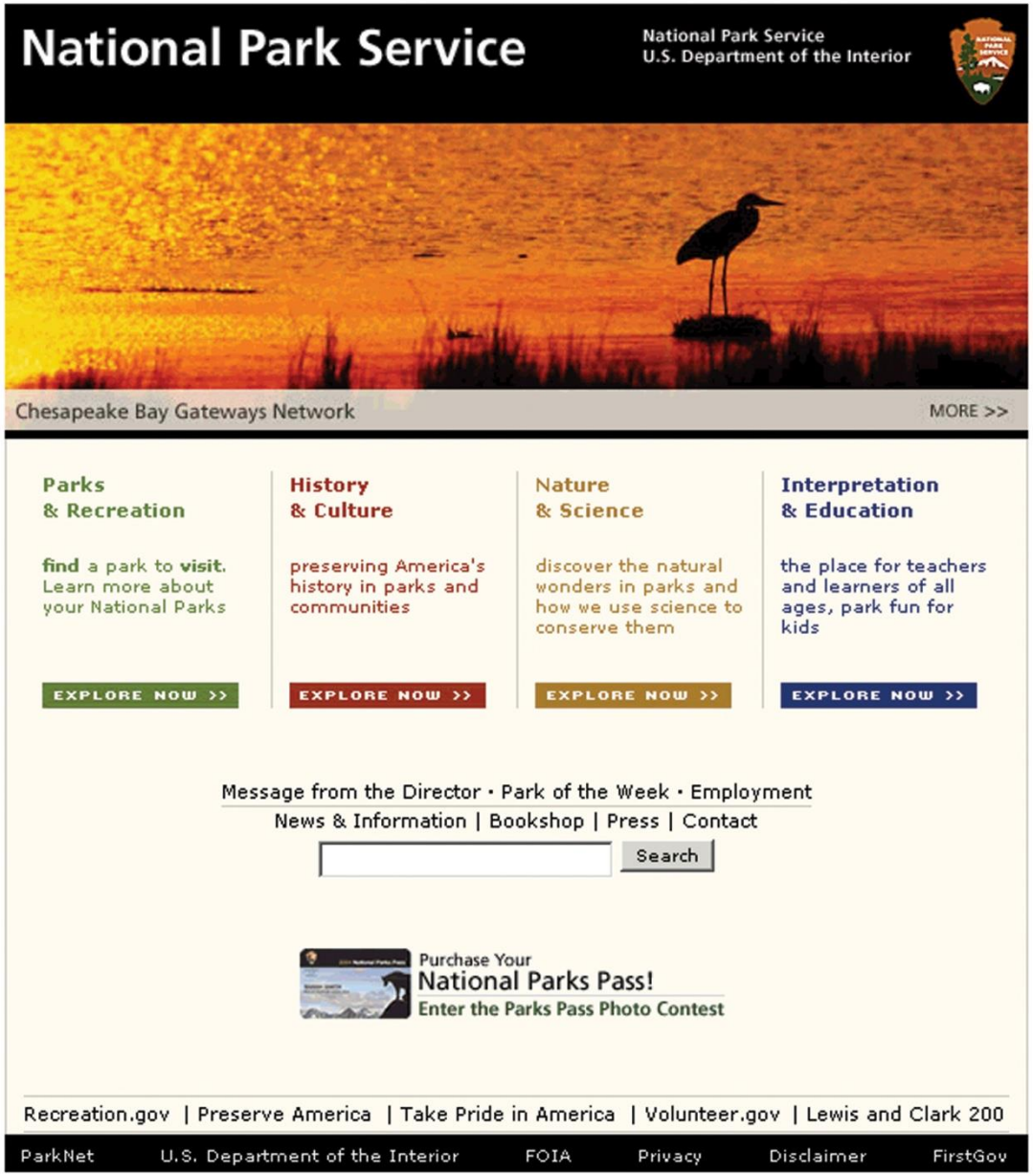
Simplicity

- Simplicity is a design principle which emphasizes the importance of keeping the UI as simple as possible.
  - The UI should be communicated clearly and simply in the users' own language.

- To keep the UI simple …
  - The UI designer should employ actions, icons, words, and user interface controls that are natural to the users.
  - Complex tasks should be broken into simpler subtasks, to keep the behavior and the UI appearance as natural as possible for the user.

Example

- The home page for the National Park Service in the United States is simple, uncluttered, and well structured.
- The graphic at the top reflects the theme of the site, and it refreshes to show a view of a different park each time you visit.
- The various navigation links from the home page (Explore Now, Message from the Director, Park of the Week, Bookshop, News & Information, etc.) are mostly worded in such a way that they are simple to understand and easily differentiable.

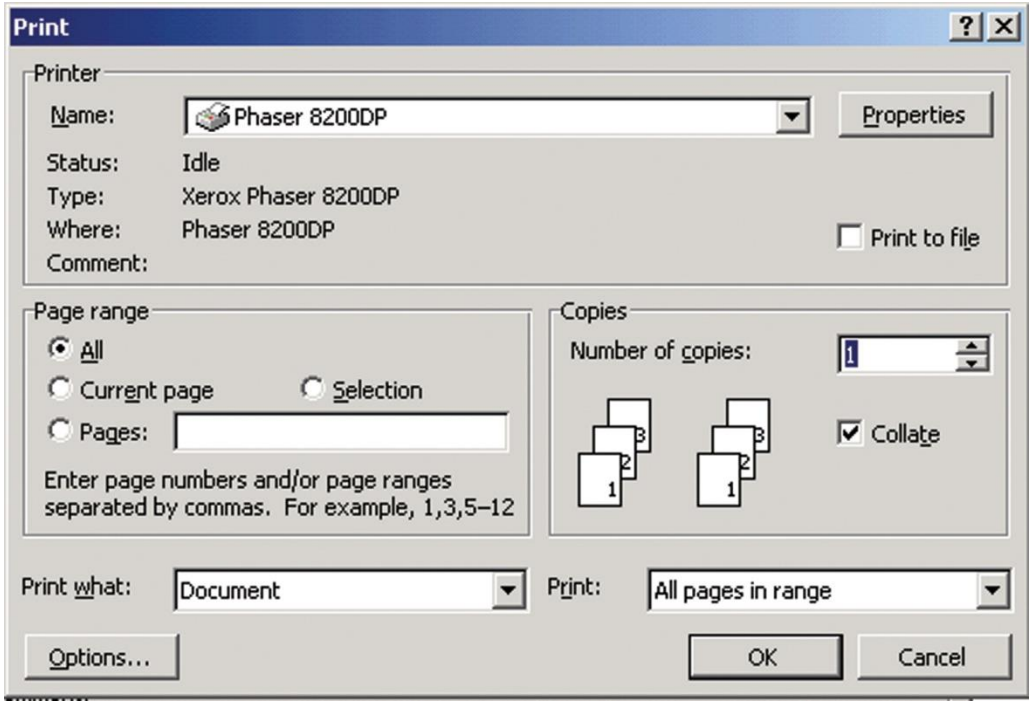


Structure

- Structure is a design principle that emphasizes the importance of organizing the UI in a meaningful and useful way.
  - Features that users think of as related should appear together on the UI.

Example: Print dialog in Word 97

- The layout of the dialog box's window shows how related information can be grouped into frames, for example Printer, Page range, and Copies.
- This grouping of information helps the users to anticipate that a particular frame will contain all the controls needed for a set of related tasks.

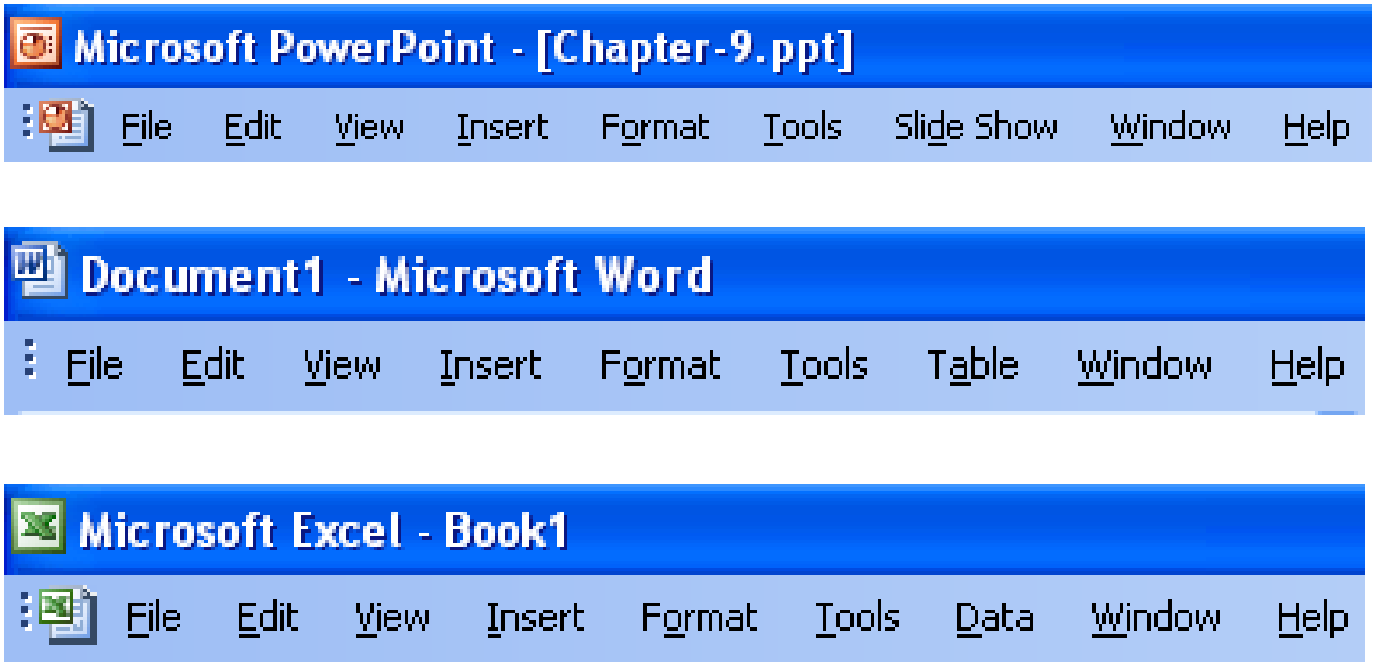


Consistency

- Consistency is a design principle that emphasizes the importance of uniformity in appearance, placement, and behavior within the UI to make a system easy to learn and remember.
- Users develop a mental model of the UI and then use the model to predict how subsequent screens will appear and how the UI will behave.
- One way to ensure consistency is through reuse.

Example: Microsoft office suite

- Similar look and feel, and the arrangement and labels of most of the menu items are similar.



Theories

- **Descriptive and Explanatory theories:**
  - These theories are helpful in developing consistent terminology for objects and actions, thereby supporting collaboration and training.
- **Predictive theories:**
  - Enable designers to compare proposed designs for execution time or error rates

Consistency through grammars

Consistent	**Inconsistent A**	**Inconsistent B**
delete/insert character	delete/insert character	delete/insert character
delete/insert word	remove/bring word	remove/insert word
delete/insert line	destroy/create line	delete/insert line
delete/insert paragraph	kill/birth paragraph	delete/insert paragraph

Consistency through grammars (cont.)

Inconsistent action verbs

- Take longer to learn
- Cause more errors
- Slow down users
- Harder for users to remember

Class Activity

- Direct Manipulation
- Menu selection
- Form fillin
- Command language
- Natural language

- Suggest a new interaction style which can be used in future

Topics

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