4HC3 Human User Interfaces

Chapter 1

1.2 Usability Requirements

- Plasticity – ability of design to be viewed smoothly on multiple display-sizes and variations
- Goals for requirements analysis
    - Get user needs
    - Ensure reliability
    - Promote standardization, integration, consistency, and portability
    - Complete project on schedule within budget
- Standardization – common UI features across many apps
- Integration – consistent file formats for use in many apps
- Portability – share UI for multiple software and hardware environments
- Consistency – common actions, terms, layouts, colors, typography within app

1.3 Usability Measures

- Efficiency and Satisfaction Usability Measures
    - Time to learn – time to learn how to use actions relevant to tasks
    - Speed of performance – time it takes to carry out benchmark tasks
    - Rate of errors – how many errors and types of error
    - Retention – how well do users maintain knowledge
    - Subjective satisfaction – how much did users *like* using the interface (surveys)
- There are forced trade-offs (ex. If rate of errors is to be low, speed of performance may be sacrificed)

1.4 Usability Motivations

- 1.4.1 Life critical systems
    - Ex. Air traffic control, nuclear reactors
    - High-costs but high reliability and effectiveness
    - Lengthy training periods acceptable, subjective satisfaction is not an issue
- 1.4.2 Industrial and commercial use
    - Ex. Banking, insurance, inventory management
    - Training time is expensive, so ease of learning is important and speed of use due to volume of transactions, but burnout is legitimate concern
    - Translation to multiple languages is important
    - Retention through frequent use
- 1.4.3 Office, Home, and Entertainment
    - Ex. Email, ATM, games
    - Ease of learning, low error rates, subjective satisfaction are paramount (competition is fierce)
    - A layered design is one approach to graceful evolution from novice to expert use (ex. Basic and advanced search in search engine)
    - Low cost also important
- 1.4.4 Exploratory, creative, and collab interfaces
    - Ex. Search engines, world wide web, simulations
    - Users may be knowledgeable in task domain, but novice in computer concept
    - Most effective when computer provides direct-manipulation representation of world of action (plus keyboard shortcuts)

1.5 Universal Usability

- Diversity of human abilities/backgrounds challenges UI design.
- Goal – enable creative participation by broadest possible set of users
- 1.5.1 Physical abilities
    - Anthropometry – data about human dimensions
    - Compromises must be made, or multiple versions of a system must be constructed
    - Computer workstations are standardized

        - Work-surface and display height
        - Leg room
        - Work-surface width and depth
        - Adjustable heights for chairs and surfaces
        - Posture
        - Availability of armrests/footrests
    - Physical measures are not enough, dynamic actions must be measured too (reach while seated) and audible cues/tones or touch feedback from keyboard
- 1.5.2 Diverse cognitive and perceptual abilities
    - Classification of human cognitive processes
        - Short-term memory
        - Long-term memory
        - Problem solving and reasoning
        - Decision making and risk assessment
        - Language and comprehension
    - Factors affecting motor performance
        - Arousal
        - Fatigue
        - Mental load
        - Feedback
        - Boredom
        - Drugs
- 1.5.3 Personality differences
    - Myer-Briggs type indicator (four dichotomies of personality)
        - Extroversion vs. Introversion
            - Variety in action vs. familiar patterns
        - Sensing vs. Intuition
            - Good at precise work and apply known skills vs. solving new problems and discovering new relations
        - Perceptive vs. Judging
            - Learn about new situations but have trouble making decisions vs. follow careful plan even if facts change goal
        - Feeling vs. Thinking
            - Aware of feelings of others vs. unemotional but logical
    - Other factors: calm/nervous, closed/open, disorganized/organized, disagreeable/agreeable, risk taking vs. risk avoidance
- 1.5.4 Cultural and International diversity
    - UI-design concerns for internationalization
        - Characters, numerals, special characters
        - Left-to-right vs. Right-to-left, vertical vs. horizontal
        - Date and Time formats
        - Numeric/Currency formats
        - Weights and Measures
        - Policies and Etiquette
- 1.5.5 Users with disabilities
    - Screen Magnification to enlarge display or Text-To-Speech
    - Moving on/off button to the front of computer easier for mobility impaired
- 1.5.6 Older adult users
    - Similar changes like users with disabilities
- 1.5.7 Designing for children
    - Attention to limitations – low dexterity, emerging literacy, low capacity for abstraction, short attention spans, protection against inappropriate material
- 1.5.8 Accommodating hardware and software diversity
    - Backward compatibility in UI and file structures

1.6 Goals for Our Profession

- Three attainable goals:

    - Influence academic and industrial research
    - Provide tools and techniques for commercial developers
    - Raise computer consciousness of public
- 1.6.1 Influencing research
    - Reduce anxiety and fear of computer use
    - Graceful evolution of skill level
    - Input devices
    - Online Help
    - Direct Manipulation
- 1.6.2 Techniques and tools for commercial developers
    - Feedback from users during development can provide useful insight and guidance
- 1.6.3 Computer consciousness
    - People are anxious about damaging equipment or making mistakes
        - Generated because of poor designs or hostile error messages

Chapter 2

2.2 Guidelines

- 2.2.1 Navigating the interface
    - National Cancer Institute Guidelines
        - Standardize task sequences
        - Descriptive embedded links
        - Unique headings
        - Check boxes for binary choices
        - Pages that print properly
        - Thumbnails for preview of large images
- 2.2.2 Organizing display
    - 5 High-level goals for data display:
        - Consistency of data display – terms, abbreviations, formats, colors consistent
        - Efficient info assimilation by user – neat columns of data, aligning data elements, spacing, comprehensible labels
        - Minimal memory load on user – info should not be required to be remembered from one screen for use on another
        - Compatibility of data display – format of info should be linked clearly to format of entry (where possible, output should also be editable input filed, ex. Excel)
        - Flexibility of user control – users should be able to get info the most convenient way possible for them (sorting columns and rows)
- 2.2.3 Getting the user's attention
    - Techniques to get user attention:
        - Intensity – 2 levels only with limited use of high intensity
        - Marking – underline item or use an indicator like a bullet
        - Size – Up to 4 sizes, larger gets more attention
        - Choice off-font – up to 3
        - Blinking – (2-4Hz)
        - Color – Up to 4 colors with additional colors for occasional use
        - Audio – soft tones for positive feedback, harsh emergency conditions
- 2.2.4 Facilitating data entry
    - Consistency of data-entry transactions – similar delimiters, abbreviations, sequence of actions
    - Minimal input actions – fewer input actions means greater operator productivity. Selecting from list of choices eliminates memorizing. Avoid redundant data entry.
    - Minimal memory load on users – no need to memorize lengthy lists of code and syntax
    - Compatibility with display – link closely with data display info
    - Flexibility for user control – ability to sort

2.3 Principles

- Guidelines are narrowly focused, principles tend to be fundamental.

- 2.3.1 Determining user skill levels
    - Understand intended users
    - Types of users:
        - Novice – know little of the task or interface
        - First-Time Users – know task concept but not interface
        - Knowledgeable intermittent users – difficulty retaining structure, so create simple interface with consistent terminology
        - Expert frequent users – power user, seek to get work done quickly, abbreviations and hotkeys are important
    - For multiple classes of users, use multi-layer approach.
- 2.3.2 Identify tasks
    - High level tasks -> Middle level task actions -> atomic actions
    - Atomic executed with single command/menu selection
    - If atomic actions are too small, users will become frustrated
    - Frequent actions use special keys, less frequent use hot-keys or menu pull-downs, infrequent require a sequence of menu selections or form fill-ins (i.e. change printing format)
- 2.3.3 Interaction style
    - Direct Manipulation – visual representation of the world of action (i.e. desktop or games), keyboard entry replaced with pointing devices to select objects. Can be hard to program, and requires graphics display and pointing device. Good for novices.
    - Menu Selection – users select most appropriate item from list. Understandable terminology. Presents danger of many menus, can slow frequent users. Structures decisions.
    - Form Filling – data entry required, menu selection alone is cumbersome. Users enter data where desired, users must understand field labels, permissible values and capable of responding to errors. Consumes screen space.
    - Command language – flexible, appeals to power users, but has poor error handling and requires a lot of training and memorizing.
    - Natural Language – relieves burden of learning syntax, but requires clarification dialog and is unpredictable, and may not show context.
- 2.3.4 Eight golden rules of interface design
    - Strive for consistency
    - Cater to Universal Usability – recognize needs of diverse user groups, facilitate transformation of content
    - Offer informative feedback
    - Design dialogs yield closure – sequence of actions should have beginning, middle, and end with informative feedback at completion
    - Prevent errors – design to prevent users from making serious errors
    - Permit easy reversal of action
    - Support internal locus of control – make users initiators of actions
    - Reduce short-term memory load – keep displays simple, access to codes and abbreviations should be provided
- 2.3.5 Prevent errors
    - Improve error messages provided by interface (constructive and informative)
    - Complete sequences to prevent missing steps
    - Gray out portions of menu until users have met requirements to select item

2.4 Theories

- 2.4.1 Levels of analysis theories
    - Conceptual – mental model of interactive system
    - Semantic – meanings conveyed by user input and computer output
    - Syntactic – how user actions convey semantics to instruct computer to do a task
    - Lexical – device dependencies (i.e. deleting a file using a function key)
- 2.4.4 Consistency through grammars
    - Consistent user interface, command language or set of actions should be orderly, predictable and describable for easy retention

Chapter 3

3.2 Organizational Design to Support Usability

- Design is creative and unpredictable.
- Design is a process
- Design is non-hierarchical
- The process is radically transformational
- Design involves the discovery of new goals

3.3 The Three Pillars of Design

- Guidelines Documents and Process (Models)
- User Interface Software Tools (Algorithms and Prototypes)
- Expert Reviews and Usability Testing (Controlled Experiments)
- 3.3.1 Guidelines documents and processes
    - Guidelines for:
        - Words, icons, graphics
        - Screen layout
        - Input and output devices
        - Actions
        - Training
    - Education – users need training
    - Enforcement – process to verify that an interface adheres to guidelines
    - Exemption – a rapid process for gaining exemption when new tech is used
    - Enhancement – predictable process for review
- 3.3.2 UI Software Tools
    - Prototype of menu system with one or two active paths, instead of a full system
    - For form filling, the prototype might show the fields but not process the information
    - Flash is widely used for prototypes
- 3.3.3 Expert reviews and usability testing
    - Small and large pilot tests of components before release to customers
    - Tests with expert reviewers as well as intended users (use surveys)

3.4 Development Methodologies

- Logical User-Centered Interactive Design Methodology (LUCID)
    - Envision – extreme usability, develop clear, shared product vision
    - Discovery – study users to determine high-level user requirements, terminology
    - Design Foundation – conceptual design and prototype with visual style (revise/repeat)
    - Design Detail – Flesh out high-level design into complete specifications
    - Build – support product through review and later-stage changes
    - Release – develop roll-out plan, transition users, conduct final usability test (out-of-box experience)

3.5 Ethnographic Observation

- Observe users in work or home environment, sometimes participating in activities
- Focus on interfaces for the purpose of changing or improving interface
- Easy to misinterpret observations, to disrupt normal practice, or overlook important info
- Guideline for reporting findings:
    - Preparation – understand policies and work culture, system and history, set goals, gain permission to observe or interview
    - Field study – establish rapport with managers and users, collect subjective and objective quantitative and qualitative data
    - Analysis – compile the collected data in numerical, textual, and multimedia databases, quantify data and compile statistics, refine goals and process
    - Reporting – consider multiple audiences and goals, prepare report

3.6 Participatory Design

- More user involvement brings more accurate information
- User ego (participation) may be the biggest influence on increased user acceptance of final system

- Extensive user participation can be costly and lengthen implementation period
- Take into account the stake user has in interface
- 4 Levels of user participation
    - User – not observed
    - Testers – observed as they tryout designs
    - Informants – comment to designers through interviews and focus groups
    - Design partner – active member of a design team

3.8 Social Impact Statement (circulate among stakeholders)

- Describe new system and benefits – identify stakeholders and benefits and goals of system
- Address concerns and potential barriers – avoid biases, ensure diverse access, anticipate changes in job functions and layoffs, address security issues
- Outline development process – schedule, propose process for decision making, needs for staff/training, plan for migration, plan for measuring success

Chapter 4

4.2 Expert Reviews

- Formal expert reviews are far more effective, need to be part of staff as consultants for rapid reviews on short notice.
- Expert review methods:
    - Heuristic Evaluation – critique interface to determine conformance with a short list of design heuristics like 8 golden rules
    - Guidelines review – interface is checked for conformance with organizational guidelines document
    - Consistency inspection – verify consistency across a family of interfaces, checking for consistency of terminology, colour, layout, input/output formats
    - Cognitive walkthrough – experts simulate users walking through the interface to carry out typical tasks, critical tasks should be walked through as well as high-frequency tasks
    - Formal usability inspection – experts hold courtroom-style meeting with moderator as judge, to present the interface and discuss merits and weaknesses, design team may refute

4.3 Usability Testing and Laboratories

- Speeds up projects and results in cost savings due to feedback
- Staffed by one or more people with expertise in testing and UI design, serving 10-15 projects per year
- Develop set of tasks for usability test
- Participants chosen to represent intended user community, user attributes are carefully selected
- Variant forms of usability testing:
    - Paper mock-up – screen displays on paper to assess user reactions to wording, layout, sequence
    - Discount usability testing – quick-and-dirty, prompt revision, meant to be used while designs are changing substantially
    - Competitive usability testing – compare new interface to previous versions or competitors
    - Universal usability testing – interface is tested with highly diverse users, hardware, software platforms, and networks
    - Field tests and portable labs – puts interfaces to work in realistic environments for a fixed trial period (beta)
    - Remote usability testing – use the web to conduct usability tests inexpensively, large number of participants with varying backgrounds, less control over behaviour, and less chance to observe reactions
    - Can-you-break-this – destructive testing approach, users try to find fatal flaws in the system or try to destroy it, should be considered seriously
- Two limitations of usability testing – emphasizes first-time usage and has limited coverage of interface features

4.4 Survey Instruments

- Written user surveys are familiar, inexpensive, and acceptable companion for usability tests and expert reviews
- Subjective impressions of the interface domain metaphors, action handles, syntax of inputs and design of display as well as personal information from the user (background, experience, job, personality)
- Online/Web-based surveys avoid cost and effort of printing and distributing paper forms

4.5 Acceptance Tests

- Measurable criteria for user interface:
    - Time for users to learn specific functions
    - Speed of task performance
    - Rate of errors
    - User retention of commands
    - Subjective user satisfaction

4.6 Evaluation during Active Use

- Interviews and focus-groups
- Continuous user-performance data logging
- Online consultants
- Online suggestion box or email trouble reporting
- Discussion groups (message boards)

Chapter 5

5.2 Examples of Direct Manipulation

- The tool seems to disappear; user is able to apply intellect directly to the task.
- 5.2.1 Command-line versus display editors versus word processors
    - Command-language approach to text editing allows for history keeping, flexible mark-up, more powerful macros, some tasks are simpler to express (all italics to bold)
    - WYSIWYG standard for word processors – full page of text, document is seen as it will be printed, cursor action is visible, cursor motion is natural, labeled icons make frequent actions rapid, immediate display of results of actions, rapid response and display, easily reversible actions
    - Word processor sprouted
        - Integration - of graphics, spreadsheets, animations and photographs done in the document
        - Desktop-publishing software produced sophisticated print formats with multiple columns and fonts, gray-scales, color
        - Presentation software produce color, text, graphic layout for use directly from computer
        - Hypermedia environments allow users to jump from one page to another with buttons embedded
        - Improved macro facilities – formatting
        - Spell checkers
        - Grammar checkers
        - Document assemblers
- 5.2.4 Video games
    - No syntax to remember
    - Easily reversible
    - Field of action that is visually compelling
- 5.3.1 Problems with direct manipulation
    - Not an improvement for the blind or vision impaired users.
    - DM designs may consume valuable screen space and force valuable info off-screen
    - Users must learn meanings of visual representations, graphic icon may be meaningful to designer but may require more learning time to the user
    - Visual representation may be misleading, may draw incorrect conclusions about permissible actions from the analogical representation
    - Experienced typists may be slower when they need to move a mouse or point a finger to do something
- 5.3.2 OAI model explanation of DM
    - Continuous representations of objects and actions of interest with meaningful visual metaphors
    - Physical actions or presses of labeled buttons instead of syntax
    - Rapid, incremental, reversible actions whose effects on the object of interest are visible immediately
- 5.3.3 Visual thinking
    - Lexical qualities (color, brightness), Syntactics (patterns, size, shape), Semantics (concrete vs. abstract), Pragmatics (legibility, identifiability)
- 5.3.4 DM Programming

    - To create a reliable tool that works in many situations without unpredictable automatic programming, designers must meet (programming in the user interface):
        - Sufficient computational generality
        - Access to data structures and operators
        - Ease in programming and editing
        - Simplicity in invocation and assignment of arguments
        - Low risk (high probability of bug-free programs, repair errors)
- 5.5 Teleoperation
    - Interacting with some computer to control a physical process in a complex environment.
    - Issue is delay on feedback or unanticipated interference
- 5.6 Virtual and Augmented Reality
    - Successful virtual environments will depend on smooth integration of multiple technologies:
        - Visual display (head mounted display for 360 degree coverage)
        - Head-position sensing
        - Hand-position sensing
        - Handheld manipulative
        - Force feedback and haptic
        - Sound input and output
        - Other senses

Chapter 6

6.1 Introduction

- Menus are effective because they offer cues to elicit recognition rather than forcing users to recall the syntax of a command from memory
- Immediate feedback
- Requires little training

6.2 Task-Related Menu Organization

- The primary goal for menu, form fill-in and dialog-box designers are to create a sensible, comprehensible, memorable, and convenient organization relevant to the user's tasks.

6.3 Single Menus

- Require user to choose between two or more items and may allow multiple selections.
- Binary menu – ex. Yes/no
- Radio Buttons support single-item selection from a multiple-item menu
- Check boxes allow the selection of one or more items in a menu
- Ticker Menus – widget scrolls through menu items until an item is selected in view (can be frustrating to wait for item to reappear)
- 6.3.1 Pull-down, pop-up, toolbar, and ribbon menus
    - Pull-down menus are menus that the user can always access by making selection on a top menu bar (cascading pull down menus in photoshop)
    - Pie menus (like in The Sims)
    - Toolbars are customizable menus that can apply actions to displayed objects
    - Pop-up menus appear on display in response to click or tap
- 6.3.2 Menus for long lists
    - Scrolling menus, display first portion of the menu and an additional menu item
    - Combo boxes allow combining scrolling menu with text-entry
    - Fisheye menu makes items near the cursor larger and easier to read
    - Sliders
    - 2D Menus, multiple-column menu, fast and vast, good overview of choices
- 6.3.3 Embedded menus and hotlinks
    - Menus might be embedded in text or graphics and still be selectable (Wikipedia)
    - Contextual display helps keep users focused on their tasks (calendar or map)

6.4 Combinations of Multiple Menus

- Menus can be combined in linear series or presented simultaneously
- Tree structure to organize large menus, or acyclic and cyclic networks
- 6.4.1 Linear menu sequences and simultaneous menus
    - Sequence of interdependent menus can be used to guide users through choices (pizza ordering)
    - Simultaneous menus present multiple active menus on a screen at the same time and allow users to enter choices in any order (require more display space) ex. Tiger direct find by (brands, price)
- 6.4.2 Tree-structured menus
    - Group similar items in a large collection to create a tree (i.e. online grocery store)
    - Several authors urge using breadth over depth
- 6.4.3 Menu maps
    - As depth increases, it becomes harder to navigate menu tree
    - Offer a spatial map to help users stay oriented
- 6.4.4 Acyclic and cyclic menu networks
    - Access to parts of the menu from more than one navigation choice, possibility to navigate back to beginning (cyclic)

6.5 Content Organization

- 6.5.1 Task related grouping in tree structures
    - Groups of logically similar items (grocery items)
    - Form groups that cover all possibilities (age ranges)
    - No overlapping items or terms (i.e. entertainment and events could be the same thing)
    - Use familiar terminology but distinct terms
- 6.5.2 Item presentation sequence
    - Typical bases for sequencing include:
        - Time
        - Numeric ordering
        - Physical properties
        - Alphabetical
        - Most frequently used first
    - Adaptive menus (word font selection)
        - Recently used or most used
    - Adaptable menus are like adaptive except they are user controlled
- 6.5.3 Menu layout
    - Menu Selection Guidelines
        - Use task semantics to organize menus (single, linear, tree, cyclic, acyclic)
        - Prefer broad-shallow to narrow-deep
        - Show position by graphics, numbers, or titles
        - Use items as titles for sub trees
        - Group items meaningfully
        - Sequence items meaningfully
        - Use brief items
        - Use consistent grammar, layout, and terms
        - Allow type ahead, jump ahead, or other shortcuts
        - Enable jump to previous and main menu
    - Phrasing and formatting guidelines
        - Familiar and consistent terminology
        - Ensure distinct items
        - Use concise phrasing
        - Bring keyword to the beginning of the item name
    - Menu components guideline:
        - Titles – centered or left justified
        - Item placement – left justified
        - Instructions – identical in each menu and in same position
        - Error messages – the error should appear in consistent position and should use consistent terminology, graying out unacceptable choices helps reduce errors

6.6 Fast Movement through Menus

- Provide keyboard shortcuts to permit frequent menu users speed through options (i.e. ctrl+z UNDO)
- Bookmarks provide users shortcuts to destinations
- Tear-off menus can be useful to keep list of options visible on screen when frequently being used

6.7 Data Entry with Menus: Form Fill-In, Dialog Boxes and Alternatives

- 6.7.1 Form Fill-In
    - Form Fill-in Guidelines
        - Meaningful title
        - Comprehensible instructions
        - Logical grouping and sequencing of fields
        - Visually appealing layout of form
        - Familiar field labels
        - Consistent terminology and abbreviations
        - Visible space and boundaries for data-entry fields
        - Convenient cursor movement
        - Error correction for individual characters and entire fields
        - Error prevention where possible
        - Error messages for unacceptable values
        - Marking of required fields
        - Explanatory messages for fields
        - Completion signal to support user control
- 6.7.2 Format-specific fields
    - Telephone numbers
    - Social security numbers
    - Dates
    - Times
    - Currency
    - Cursor should jump to the next part of the field when filling out numbers
- 6.7.3 Dialog boxes
    - Dialog box guidelines:
        - Internal layout:
            - Meaningful title, consistent style
            - Top-left to bottom-right
            - Clustering and emphasis
            - Consistent Layout
            - Consistent terminology
            - Standard buttons (OK, Cancel)
            - Error prevention
        - External relationships:
            - Smooth appearance and disappearance
            - Distinguishable but small boundary
            - Size small enough to reduce overlap problems
            - Display close to appropriate items
            - Easy to make disappear
            - Clear how to close
- 6.8.2 Menus for small displays
    - 5 design considerations for information appliances:
        - Account for target domain
        - Dedicated devices mean dedicated user interfaces
        - Allocate functions appropriately (frequency and importance)
        - Simplify (focus on important functions, move secondary features to other screen)
        - Design for responsiveness (plan for interruptions and provide continuous feedback)

Chapter 7

7.1 Introduction

- Basic goals of language design are:
    - Precision
    - Compactness
    - Ease in writing and reading
    - Completeness
    - Speed in learning
    - Simplicity to reduce errors
    - Ease of retention over time
- High level goals include:
    - Close correspondence between reality and notation
    - Convenience in carrying out manipulations relevant to user tasks
    - Compatibility with existing notations
    - Visual appeal
    - Flexibility for novice and expert users
- Constraints
    - Capacity for humans to record notation
    - Match between the recording and display media
    - Convenience in speaking (vocalizing)

7.2 Command-Organization Functionality, Strategies and Structure

- 7.2.1 Strategies
    - First option – each command is chosen to carry out a single task (i.e. look, go, who, rooms, etc.)
    - Second option – follow each command by one or more arguments (indicates object being manipulated i.e. COPY FILEA, FILEB)
    - Third option – set of commands is organized into a tree structure (ex. ACTIONS, OBJECTS, DESTINATION)
- 7.2.2 Structure
    - Order of arguments should be consistent

7.3 Naming and Abbreviations

- 7.3.1 Specificity versus generality
    - Specific preferred over General in terms of user retention
- 7.3.2 Abbreviation strategies
    - Simple truncation – use the first, second, or third letters for the command, each command needs to be distinguishable
    - Vowel drop with simple truncation – eliminate vowels and use some of what remains (should keep first letter if vowel)
    - First and final letter – highly visible
    - First letter of each word in phrase – popular acronym technique
    - Standard abbreviations from other context
    - Phonics – focus attention on sound
- 7.3.3 Guidelines for using abbreviations
    - Simple primary rule should be used to generate abbreviations for most items; a simple secondary for items where there is a conflict (abbreviation exists already)
    - Abbreviations generated by the secondary rule should have a marker incorporated
    - Number of words abbreviated by secondary rule should be minimized
    - Users should be familiar with rules to generate abbreviations
    - Truncation should be used because it's easy to remember
    - Fixed length abbreviations should be used in preference to variable length
    - Abbreviations should not be designed to incorporate endings
    - Computer messages should not be abbreviated
- 7.3.4 Command menus and keyboard shortcuts
    - Command menu – brief prompts of available commands
    - Keyboard shortcuts are a kind of command menu for experienced users

7.4 Natural Language in Computing

- 7.4.1 Natural-language interaction
    - NLI might be defined as the operation of computers by people using familiar natural language (like English) to give instructions
    - No syntax needs to be learned
    - Key impediment of NLI is the habitability of the user interface – how easy it is for users to determine what objects and actions are appropriate. Visual interfaces provide the cues for the semantics of interaction but NLI interfaces depend on assumed user models.
    - NLI can be effective for intermittent users who are knowledgeable about specific tasks and interface concepts but have difficulty retaining syntactic details.
- 7.4.2 Natural language queries and question answering
    - Relational schema contains attribute names and the database contains attribute values both of which are helpful in disambiguating queries.
    - NLQA is where users prepare fact questions and the system returns a set of web pages, the problem with this is the user makes incorrect assumptions about what they are asking. Clarification is important.
- 7.4.3 Text-database searching
    - System parses text grammatically and provides synonyms from a thesaurus, deals with singulars and plurals and handles other grammatical issues, then the analyzer separates the query into standard components and finds the meaningfully related work
    - More realistic scenario is to use the parser to eliminate noise words (the, of, or in) and provide stemming (adding plurals or alternate endings)
    - Another application is extraction where NL parser analyzes stored text and creates a more structured format such as a relational database.
- 7.4.4 Natural Language text generation
    - Creation of structured reports (i.e. weather reports) or computer responses (i.e. medical reports and warnings)
- 7.1 Command Language Guidelines:
    - Create explicit model of objects and actions
    - Choose meaningful, specific, distinctive names
    - Try to achieve a hierarchical structure
    - Provide a consistent structure
    - Support consistent abbreviation rules
    - Offer frequent users the ability to create macros
    - Consider command menus on high-speed displays
    - Limit number of ways of accomplishing a task

Chapter 8

8.2 Keyboards and Keypads

- Primary mode of textual data entry
- 8.2.1 Keyboard Layouts
    - QWERTY layout, frequently used letter pairs are far apart, increasing finger travel distances.
    - Dvorak layout increase the typing rate of expert typists and reduced errors (better than QWERTY)
    - Perceived benefit of change does not outweigh effort to learn new, non-standard interface
    - ABCDE style, alphabetical order,  could be better for non-typists, NO ADVANTAGE (studies show)
    - Hand movements + finger presses on bowls to select letters and control cursor (people with physical disabilities) (orbiTouch)
    - Or rely on pointing devices if typical input doesn't work for user
- 8.2.2 Keys
    - Slightly concave surfaces for contact with fingertips
    - Key gives tactile feedback when pressed
    - Caps-lock, Num-lock need to display current state on keyboard
    - Auto-repeat when holding keys
- 8.2.3 Keyboards and other text entry methods for mobile devices
    - Virtual keyboards lack tactile feedback
    - Device auto-corrects spelling
    - Numeric keypad -> soft keys
    - Handwrite on touch-sensitive surface

8.3 Pointing Devices

- DM approach is attractive, users avoid learning commands, reduce errors, keep attention to display
- 8.3.1 Pointing tasks
    - Select – users choose from set of items
    - Position – users choose a point in 1-2-3 or more dimensional space (drag)
    - Orient – users choose a direction in 1-2-3 or more dimensional space (rotate)
    - Path – combination of position and orient (draw)
    - Quantify – users specify numeric value (volume)
    - Gesture – users indicate an action to perform (swipe)
    - Text – users edit text in 2D space (cursor in word)
- Pointing devices can be grouped into direct control (on screen surface) or indirect control (mouse)
- 8.3.2 Direct-control pointing devices
- 8.1 Pointing Devices
    - Challenging for the vision impaired to use – tactile graphics can be produced using thermal paper expansion and placed on top of touch screens for blind users
    - Direct Control Devices – lightpen, touchscreen, stylus
    - Indirect Control Devices – mouse, trackball, joystick, touchpad
        - Require hand eye coordination
        - Mouse is low cost (high-precision)
        - Eliminate fatigue
    - Non-standard devices – multitouch tablet, eye-trackers, sensors, 3D trackers, foot controls
    - Criteria for success:
        - Speed and accuracy
        - Efficacy for task
        - Learning time
        - Cost and reliability
        - Size and weight
- 8.3.5 Fitts' Law
    - Equation for movement time for a given device
        - $T = a + b\log_2(D/W + 1)$
        - T is movement time, a is start/stop time in seconds, b is inherent speed of device, D is distance users had to move, target size W
    - Precision-pointing movement time
        - T = a + blog2(D/W +1) + clog2(D/W)
        - Third term is for fine tuning
- 8.3.6 Nonstandard interaction devices
    - Mutli-touch touchscreens
    - Bimanual input – nondominant hand sets a frame of reference in which the dominant hand operates
    - Ubiquitous computing – happens around the user (lights, sound, airflow for information)

8.4 Speed and Auditory Interfaces

- Background noise and variations in user speech make speech recognition difficult
- Speech store and forward (information being read to the user) and generation are predictable, low cost and available
- Speech Systems:
    - Opportunities
        - Vision impairments
        - Busy hands
        - Mobility is required
    - Technologies
        - Speech store and forward
        - Discrete-word recognition
            - Recognize individual words spoken by a specific person (90-98% reliability)
            - Speaker-dependent training is part of many systems (users repeat the full vocabulary once or twice)
            - Users with disabilities can use this easily

                - Telephone based services (yes/no answers)
            - Continuous-speech recognition
                - High error rates
                - Speech system can be trained so that semantic interpretation is fixed
                - Can dictate letters, compose reports for automatic transcription
                - Creative writing is not good for this
                - Voice recognition for identification purposes
            - Voice info systems
                - IVR (inter voice response)
                - Voice prompts can guide users
                - Slow pace and scanning for information are issues
                - Telephones
                - Ephemeral nature of speech is also a problem
            - Speech generation
                - Messages displayed by computer to relay info
    - Obstacles
        - Increased cognitive load
        - Interference from noisy environments
        - Unstable recognition between users
    - Obstacles of speech output
        - Slow pace of speech
        - Difficulty scanning/searching

8.5 Displays

- Primary source of feedback
    - Physical dimensions
    - Resolution
    - Number of colors available and color correctness
    - Luminance, contrast, glare
    - Power consumption
    - Refresh rate (allow animation)
    - Cost
    - Reliability
- 8.5.1 Display Technology
    - Cathode ray tubes have mostly been replaced with Liquid crystal display
    - Plasma (bright and visible) displays are similar to LCDs but consume more electricity (flat screen)
    - Light-Emitting Diodes are now available in many colors and are being used in large public displays
    - OLEDs are durable, energy-efficient and can be laid on flexible plastic or metallic foil
    - Paper-like resolution using electronic ink (extended battery life because power is only used when content changes) i.e. KINDLE
- 8.5.2 Large Displays
    - Information wall displays provide shared views to users standing far away
    - Interactive wall displays allow users to walk up to the display and interleave interaction and discussion (SMART board)
    - Multiple-desktop displays allow users to have a larger number of windows and documents visible
- 8.5.3 Heads-up display and Helmet-mounted displays
    - HUD shows info to user while attention can be focused on something else (like window of a car)
    - HMD is used in virtual reality and allows users to see info even when they turn their heads

Chapter 12

- Taxonomy of user documentation and online help tutorials
    - Description of interface objects and actions (syntax)
    - Sequence of actions to accomplish tasks (semantics)
    - Task-domain- specific knowledge (pragmatic)
    - Degree of integration in interface (from less to more)
        - Online documentation and tutorials

        - Online help integrated into the interface (help button)
        - Context-sensitive help a) user controlled (where pointer is) b) system initiated (system makes suggestions)
        - Animated demonstrations right on interface
    - Time of intervention
        - Before starting
        - At the beginning of the interaction
        - During the task
        - After failure
        - When the user returns
    - Media
        - Text
        - Graphics (print screens)
        - Voice recording
        - Video recording of someone using the interface
        - Animation
        - Recording of the interface itself in action
        - Simulation or computer-based training
    - Extensibility
        - Closed system
        - Users can add more info (synonyms, annotations, translations)
- 12.2 Online versus paper
    - Positive for online documentation
        - Physical advantages
            - Info available wherever device is
            - Documentation can be updated electronically at low cost
            - No need to allocate physical workspace to read
        - Navigation features
            - Specific info can be located rapidly (list of figures, table of contents, indexes, etc.)
            - Searching for one page out of a hundred is quicker
            - Linking within texts to guide readers to other material
        - Interactive services
            - Readers can bookmark or annotate the text
            - Authors can use graphics, sound, color and animation
            - Readers can go to online communities for more help
            - Visually impaired readers can use screen readers to listen to instructions
        - Economic advantages
            - Online doc is cheaper to duplicate and distribute
    - Negative side-effects of online documentation:
        - Displays may not be as readable as paper (resolution)
        - Each display may contain less info than a sheet of paper
        - May not be as obvious to use to a novice
        - Extra mental effort required for scrolling through screens
        - Splitting display between work and help reduces work space
        - Small devices may not have enough display space
- 12.3 Reading from paper vs. displays
    - Disadvantages of reading from displays:
        - Fonts may be poor on low-res displays
        - Fuzzy character boundaries
        - Emitted light from display may be more difficult to read than reflected light from paper (more glare on screen)
        - Small displays require frequent page turning
        - Reading distance is not easily adjusted for electronic displays (fixed)
        - Layout and formatting may be poor
        - Unfamiliarity of displays (anxiety navigating text)
- 12.4 Towards minimal manuals
    - Anchor tool in task domain, promote guided exploration (trying out the tool rather than read)
    - User manual guidelines
        - Provide immediate opportunity to act

        - Encourage and support exploration
        - Show numerous examples
        - Design instructional activities that are REAL tasks
        - Present task concepts before interface actions
        - Prevent mistakes whenever possible
        - Provide error info for error prone actions
        - Provide error info that supports detection, diagnosis, and correction
        - Provide on the spot info
        - Be brief
        - Give table of contents
        - Keep writing style clean
        - Provide closure for chapters

Chapter 14

- Information visualization
    - Use of interactive visual representations of abstract data to amplify cognition
- 14.2 Data type by task taxonomy
    - Data Types:
        - 1D Linear – textual documents (dictionaries)
        - 2D map – planar data (newspaper layout, maps)
        - 3D world – (ex. Human body, buildings)
        - Multi-dimensional – multiple attributes, multiple dimensions (many plots representing different attributes on one graph is an example)
        - Temporal – (stock market) items have a start and finish time and items may overlap
        - Tree – each item has a link to a parent, links have multiple attributes (file explorer)
        - Network
    - Tasks:
        - Overview – user gains overview of entire collection
        - Zoom – zoom in on items of interest
        - Filter – filter out uninteresting items
        - Detail-on-demand – select item and get details
        - Relate – view relationships among items
        - History – keep a history of actions to support undo
        - Extract – allow extraction of sub-collections and query parameters
- 14.3 Challenges for Information Visualization
    - Importing and cleaning data – getting data into correct format and filtering out incorrect terms, normalizing attributes and coping with missing data
    - Combining visual representations with textual labels – labels should be visible but not confuse users
    - Finding related information – multiple source of info are often needed to make meaningful judgements
    - Viewing large volumes of data
    - Integrating data mining – can be helpful in finding subtle trends
    - Collaborating with others – ability to send state of info to colleagues with annotations
    - Achieving universal usability – difficult, visually impaired users may need text-based alternatives to visual display

Acoustic and Linguistic analysis

- Acoustic signal transformed into a sequence of letters (acoustic analysis)
- Input text is analysed syntactically and semantically and an appropriate representation of info involved is created (linguistic)
- Redundancy of speech
    - Redundancy reduction
    - Segmentation
    - Classification of segments – because of noise a segment is assigned a group of phonetically similar speech-sounds
    - Forming a text – group of sounds become letters, then sequence of letters compared to a dictionary, results is a text
- NL Understanding is linguistic analysis
    - Input -> text (symbolic representation of acoustic signal)
    - Check -> syntax and semantics
    - Output -> symbolic representation of the information involved in the text (the text is interpreted)

- 1. Morphologic analyser – determines type of each word (noun, verb, ..), singular/plural, tense, …
- 2. Syntax analyser – semantic sense is not checked now
    - Example:
        - <sentence> -> <noun-phrase> <verb-phrase>
        - <noun-phrase> -> <noun>
        - <noun-phrase> -> <adjective> <noun>
        - …
- 3. Semantic analyser
    - Each word has several semantic meanings
    - Semantic ambiguities
    - i.e
        - The postman was killed by the murderer while opening a letter with a knife
            - The letter was opened by the postman or by the murderer?
            - The knife was used for opening the letter or murdering?
- 4. Pragmatic analysis
    - Semantic analyser can't determine correct meaning if a sentence contains "free expressions" like pronouns and adverbs like here, now
    - Pragmatic analysis – find context (specific knowledge) and general knowledge
- 5. Representation of acquired information
    - Interpret information – knowledge
    - Semantic nets (look at example, just looks like they broke up the sentence into really basic definitions and gradually become more specific)