USER INTERFACE

Usability of Interactive Systems

HISTORY

Computer grounded in ideas from 1700's & 1800's

- mechanical calculating devices – abacus, slide rule…

Technology became available after the 1940's

- mechanical, electro-mechanical computers…

The "user" (interaction) concept is relatively new

- personal computing, multi-users, multi-tasks…

THE PAST

Beginnings – Computing in 1940's

- **Harvard Mark I – IBM, 1944 (55f L, 8f H, ~5 tons)**
- 3 additions/subtractions in a second, 6 seconds for multiplication…
- Program-controlled by 24-channel punched paper tape

THE PAST : BIG COMPUTERS (MAIN FRAME)

Batch processing

- Computer had one task, performed *sequentially*
- Serial operations
- Punch cards, tapes for input
- No “**interaction”** between operator and computer after starting the run
- Simple printed reports no direct User Interface

NEAR PAST

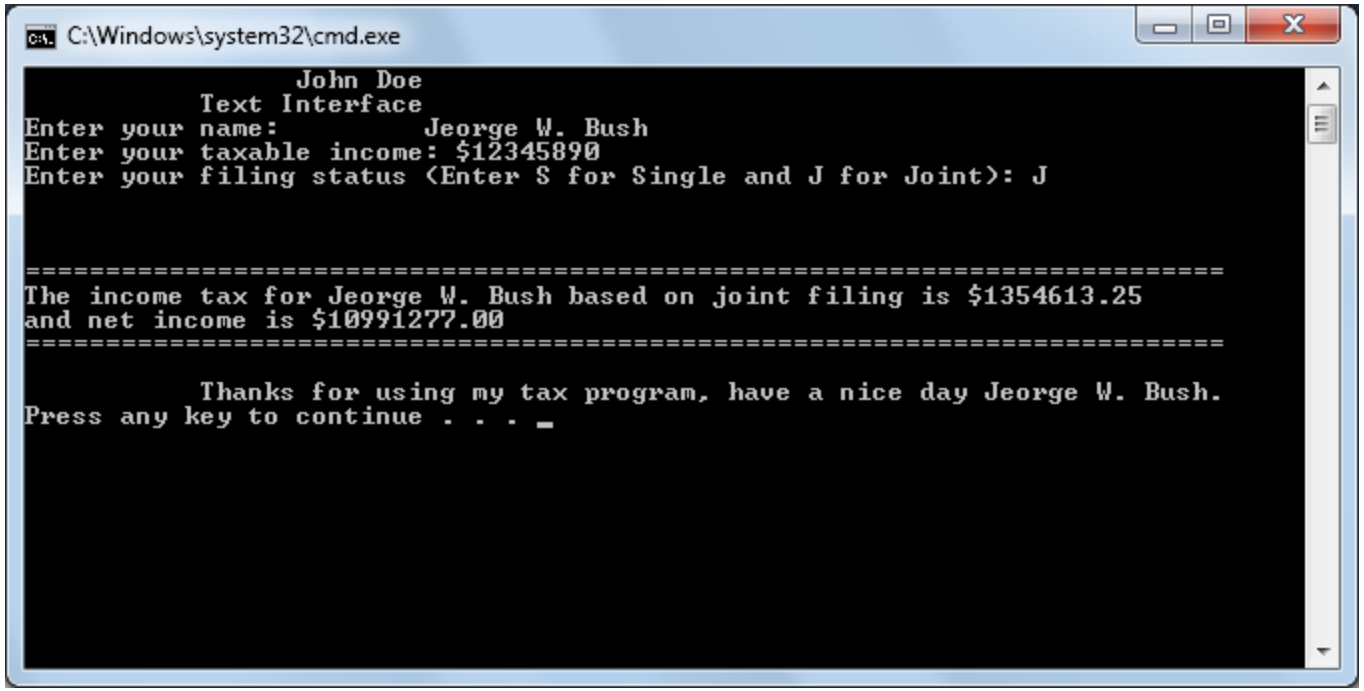
1980s Interfaces (mostly text based)

- Command-line
  - Too many to remember
  - Abbreviated commands
- WIMP(window, icon, menu, pointing device)
  - Limited
  - Primitive
  - Hardware Compatibility
  - Speed

SAMPLES FROM THE NEAR PAST

Mostly Text Based User Interface

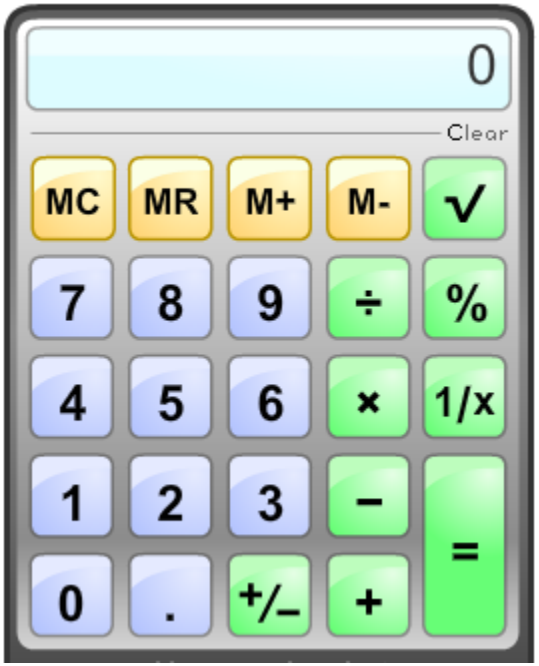
Text Oriented OS: : DOS, UNIX, IBM OS



NEAR PAST

1990s Interfaces (GUI: color, 3D, sound, …)

- Advanced graphical (multimedia, virtual reality, information visualization)
- Internet, WWW
- Natural language interfaces
- Pen, gesture, and touch
- GUI OS: Windows, MAC OS



NOW

2000s Interfaces

- Multi-media
  - BioBLAST (Better Learning through Adventure, Simulation, and Technology) a NASA-funded Multimedia Learning Project
- Mobile
- Multimodal
- Shareable
- Augmented and mixed reality

http://www.youtube.com/watch?v=1yvic9sAg64&feature=g-logo

NOW - FUTURE

http://www.youtube.com/watch?v=NZNTgglPbUA

http://www.youtube.com/watch?v=uug8m0BHzZo&feature=fvsr

http://www.youtube.com/watch?v=KKchgm9Nslk&feature=related

http://www.youtube.com/watch?v=1nKFW-lDNK8&feature=related

http://www.youtube.com/watch?v=z4bJEqoCAuI&feature=related

PARADIGMS

What are Paradigms?

- Refers to a particular approach that has been adopted by a community in terms of shared assumptions, concepts, values and practices
- Mainly theoretical frameworks or scientific world views

Why Study Paradigms

- Concerns
  - how can an interactive system be developed to ensure its usability?
  - how can the usability of an interactive system be demonstrated or measured?
- Understanding HCI history is largely about understanding a series of paradigm shifts

USER INTERFACE (UI)

Usability

- Effective to use
- Efficient to use
- Safe to use
- Have good utilities
- Easy to learn
- Easy to remember how to use

USABILITY REQUIREMENTS

Synonyms for "user-friendly" in Microsoft Word 2002 are:

- easy to use;
- accessible;
- comprehensible;
- intelligible;
- idiot proof;
- available;
- ready

What is missing?

- be helpful
- be valuable.
- not only be understandable, but understands.
- be reliable
- don't hurt
- be pleasant

These measures are subjective and vague, so a systematic process is necessary to develop usable systems for specific users in a specific context

USABILITY REQUIREMENTS (CONT.)

The *U.S. Human Engineering Design Criteria for Military Systems* (1999) states these purposes:

- Achieve required performance by operator, control, and maintenance personnel
- Minimize skill and personnel requirements
- Minimize training time
- Achieve required reliability of personnel-equipment/software combinations
- Foster design standardization within and among systems

Should improving the user's quality of life and the community also be part of objectives?

Usability requires project management and careful attention to requirements analysis and testing for clearly defined objectives

USABILITY MEASURES

5 human factors central to community evaluation:

- ***Time to learn***
  How long does it take for typical members of the community to learn relevant task?
- ***Speed of performance***
  How long does it take to perform relevant benchmarks?
- ***Rate of errors by users***
  How many and what kinds of errors are made during benchmark tasks?
- ***Retention over time***
  Frequency of use and ease of learning help make for better user retention
- ***Subjective satisfaction***
  Allow for user feedback via interviews, free-form comments and satisfaction scales

Define the target user community and class of tasks associated with the interface

Be aware Communities evolve and change

USABILITY MEASURES (CONT.)

Trade-offs in design options frequently occur.

- Changes to the interface in a new version may create consistency problems with the previous version, but the changes may improve the interface in other ways or introduce new needed functionality.

Feedback: Design alternatives can be evaluated by designers and users via mockups or high-fidelity prototypes.

- The basic tradeoff is getting feedback early and perhaps less expensively in the development process versus having a more authentic interface evaluated.

USABILITY MOTIVATIONS

Poorly designed interfaces can be found across domains and should be avoided.

Life-critical systems : Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems, medical equipment

- High costs, reliability and effectiveness are expected
- Length training periods are acceptable despite the financial cost to provide error-free performance and avoid the low frequency but high cost errors
- Subject satisfaction is less an issue due to well motivated users

USABILITY MOTIVATIONS (CONT.)

Industrial and commercial uses : Banking, insurance, order entry, inventory management, reservation, billing, and point-of-sales systems

- Ease of learning is important to reduce training costs
- Speed and error rates are relative to cost
- Speed of performance is important because of the number of transactions
- Subjective satisfaction is fairly important to limit operator burnout

USABILITY MOTIVATIONS (CONT.)

Office, home, and entertainment applications:

Word processing, electronic mail, computer conferencing, and video game systems, educational packages, search engines, mobile device, etc.

- Ease of learning, low error rates, and subjective satisfaction are paramount due to:
  - use is often optional
  - fierce competition
- Infrequent use of some applications means interfaces must be intuitive and easy to use online help is important
- Choosing functionality is difficult because the population has a wide range of both novice and expert users
- Competition cause the need for low cost
- New games and gaming devices!
  - For example, Nintendo Wii

USABILITY MOTIVATIONS (CONT.)

Exploratory, creative, and cooperative systems :

Web browsing, search engines, artist toolkits, architectural design, software development, music composition, and scientific modeling systems

- Collaborative work
- Benchmarks are hard to describe for exploratory tasks and device users
- With these applications, the computer should be transparent so that the user can be absorbed in their task domain

USABILITY MOTIVATIONS (CONT.)

Social-technical systems: Voting, health support, identity verification, crime reporting

- Complex systems that involve many people over long time periods
- Trust, privacy, responsibility, and security are issues
- Verifiable sources and status feedback are important
- Ease of learning for novices and feedback to build trust
- Administrators need tools to detect unusual patterns of usage

UNIVERSAL USABILITY

Physical abilities and physical workplaces

- Basic data about human dimensions comes from research in *anthropometry*
- There is no average user, either compromises must be made or multiple versions of a system must be created
- Physical measurement of human dimensions are not enough, take into account dynamic measures such as reach, strength or speed
- Screen-brightness preferences vary substantially, designers customarily provide a knob to enable user control
- Account for variances of the user population's sense perception
    - Vision: depth, contrast, color blindness, and motion sensitivity
    - Touch: keyboard and touchscreen sensitivity
    - Hearing: audio clues must be distinct
- Workplace design can both help and hinder work performance

UNIVERSAL USABILITY (CONT.)

Cognitive and perceptual abilities

- Humans are able to interpret sensory input rapidly and to initiate complex actions
- The journal *Ergonomics Abstracts* offers this classification of human cognitive processes:
  - Long-term and semantic memory
  - Short-term and working memory
  - Problem solving and reasoning
  - Decision making and risk assessment
  - Language communication and comprehension
  - Search, imagery, and sensory memory
  - Learning, skill development, knowledge acquisition, and concept attainment

UNIVERSAL USABILITY (CONT.)

They also suggest this set of factors affecting perceptual and motor performance:

- Arousal and vigilance
- Fatigue and sleep deprivation
- Perceptual (mental) load
- Knowledge of results and feedback
- Monotony and boredom
- Sensory deprivation
- Nutrition and diet
- Fear, anxiety, mood, and emotion
- Drugs, smoking, and alcohol
- Physiological rhythms

In any application, background, experience and knowledge in the task domain and the interface domain play key roles in learning and performance

UNIVERSAL USABILITY (CONT.)

Personality differences

- There is no set classification for identifying user personality types
- Designers must be aware that populations are subdivided and that these subdivisions have various responses to different stimuli
    - Myers-Briggs Type Indicator (MBTI)
        - extroversion versus introversion
        - sensing versus intuition
        - perceptive versus judging
        - feeling versus thinking

UNIVERSAL USABILITY (CONT.)

Cultural and international diversity

- Characters, numerals, special characters, and diacriticals
- Left-to-right versus right-to-left versus vertical input and reading
- Date and time formats
- Numeric and currency formats
- Weights and measures
- Telephone numbers and addresses
- Names and titles (Mr., Ms., Mme.)
- Social-security, national identification, and passport numbers
- Capitalization and punctuation
- Sorting sequences
- Icons, buttons, colors
- Pluralization, grammar, spelling
- Etiquette, policies, tone, formality, metaphors

UNIVERSAL USABILITY (CONT.)

Users with physical challenges

- Designers must plan early to accommodate users with disabilities
- Early planning is more cost efficient than adding on later
- Businesses must comply with the "Americans With Disabilities" Act for some applications

Older Adult Users

- Including the elderly is fairly easy
  - Designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc. with less distracting animation

UNIVERSAL USABILITY (CONCLUDED)

Younger users

USER INTERFACE (UI)

User Experience must be

- Enjoyable
- Engaging
- Pleasurable
- Entertaining
- Helpful

USER INTERFACE

Individual User Level UI Design

- Routine processes: tax return preparation
- Decision support: a doctor’s diagnosis and treatment
- Education and training: encyclopedias, drill-and-practice exercises, simulations
- Leisure: music and sports information
- User generated content: social networking web sites, photo and video share sites, user communities
- Internet-enabled devices and communication

User Interface

Communities UI Design

- Business use: financial planning, publishing applications
- Industries and professions: web resources for journals, and career opportunities
- Family use: entertainment, games and communication
- Globalization: language and culture

HCI PHASES

Analysis

Design

Prototype/Paper Design

Implementation / Unit testing

System Testing

GOALS FOR REQUIREMENTS ANALYSIS

Ascertain the user's needs

- Determine what tasks and subtasks must be carried out
- Include tasks which are only performed occasionally. Common tasks are easy to identify.
- Functionality must match need or else users will reject or underutilize the product

GOALS FOR REQUIREMENTS ANALYSIS

Ensure reliability

- Actions must function as specified
- Database data displayed must reflect the actual database
- Appease the user's sense of mistrust
- The system should be available as often as possible
- The system must not introduce errors
- Ensure the user's privacy and data security by protecting against unwarranted access, destruction of data, and malicious tampering

GOALS FOR REQUIREMENTS ANALYSIS

Promote standardization, integration, consistency, and portability

- *Standardization*: use pre-existing industry standards where they exist to aid learning and avoid errors (e.g. the W3C and ISO standards)
- *Integration*: the product should be able to run across different software tools and packages (e.g. Unix)
- *Consistency*:
  - compatibility across different product versions
  - compatibility with related paper and other non-computer based systems
  - use common action sequences, terms, units, colors, etc. within the program
- *Portability*: allow for the user to convert data across multiple software and hardware environments

GOALS FOR REQUIREMENTS ANALYSIS

Complete projects on time and within budget

Late or over budget products can create serious pressure within a company and potentially mean dissatisfied customers and loss of business to competitors

HCI DESIGN CONSIDERATIONS

The Interdisciplinary Design Science of Human-Computer Interaction (HCI) combines knowledge and methods associated with professionals including:

- Psychologists (incl. Experimental, Educational, Social and Industrial Psychologists)
- Computer Scientists
- Instructional and Graphic Designers
- Technical Writers
- Human Factors and Ergonomics Experts
- Anthropologists and Sociologists

DESIGN EVALUATION

Prototyping

- Develop a prototype to evaluate
  - Physical appearance (presentation)
  - Friendliness
  - Functionality
  - Interaction

Paper Design

- Show
  - Screenshots
  - Menus
  - Specifications

IMPLEMENTATION

Implement the system

- Interaction with user
- Interaction with sub-system / other systems
- Unit test with live data
- Documentation of all activities and changes

SYSTEM TESTING

Comprehensive system testing

- All sub-systems connected
- Use real data
- Check all exceptions/ special cases
- Test system at the client site

DELIVERY AND MAINTENANCE

Install and hand over the system to client

Train users

Maintain system

- Corrective
- Adaptive
- Expansion

GOALS FOR OUR PROFESSION

Potential research topics

- Reducing anxiety and fear of computer usage
- Graceful evolution
- Specification and implementation of interaction
- Direct manipulation
- Social media participation
- Input devices
- Online assistance
- Information exploration

GOALS FOR OUR PROFESSION (CONT.)

Providing tools, techniques, and knowledge for system implementers

- Rapid prototyping is easy when using contemporary tools
- Use general or self-determined guideline documents written for specific audiences
- To refine systems, use feedback from individual or groups of users

Raising the computer consciousness of the general public

- Many novice users are fearful due to experience with poor product design
- Good designs help novices through these fears by being clear, competent, and nonthreatening