Universal Usability

- The interface designers have to face challenges due to the remarkable diversity of human abilities, backgrounds, motivations, personalities, cultures, and work styles .
- Understanding the physical, intellectual, and personality differences among users is vital for expanding market share, supporting required government services, and enabling creative participation by the broadest possible set of users.
- The ultimate goal: addressing the needs **of all users**

- The huge international consumer market in mobile devices has raised the pressure for designs that are universally usable.
- Rethinking interface designs for differing situations often results in a better product for all users.

we will now study the challenges posed by physical, cognitive, perceptual, personality and cultural differences.

we will cover the considerations for users with disabilities, older adults, and young users, ending with a discussion of hardware and software diversity.

- Variations in Physical Abilities and Physical Workplaces

- *Anthropometry* is the science of Human dimensions.
- Thousands of measures of hundreds of features of people—male and female, young and adult, European and Asian, underweight and overweight, tall and short—provide data to construct 5- to 95-percentile design ranges.
- Head, mouth, nose, neck, shoulder, chest, arm, hand, finger, leg, and foot sizes have been carefully cataloged for a variety of populations.
- The great diversity in these static measures means that there can be no image of an "average" user and that compromises must be made or multiple versions of a system must be constructed

- Cellphone keypad design parameters—placement, size, distance between keys, and so forth have evolved to accommodate differences in users' physical abilities.
- People with especially large or small hands may have difficulty using standard cellphones or keyboards, but a substantial fraction of the population is well served by one design.
- Screen brightness preferences vary substantially, designers often enable users to control this parameter.
- Similarly, controls for chair seat and back heights and for display angles allow individual adjustment.
- **When a single design cannot accommodate a large fraction of the population, multiple versions or adjustment controls are help**

- The physical abilities influence elements of the interactive-system design.
- They also play a prominent role in the design of the workplace or workstation (or playstation). The *Human Factors Engineering of Computer Workstations* standard (**HFES, 2007**) lists these concerns:
    - Worktable and display-support height
    - Clearance under work surface for legs
    - Work-surface width and depth
    - Adjustability of heights and angles for chairs and work surfaces
    - Posture—seating depth and angle, backrest height, and lumbar support
    - Availability of armrests, footrests, and palmrests
    - Use of chair casters

- Workplace design is important in ensuring high job satisfaction, good performance, and low error rates. Incorrect table heights, uncomfortable chairs, or inadequate space to place documents can substantially impede work.
- Other issues are illumination levels (200 to 500 lux); glare reduction (antiglare coatings, baffles, mesh, positioning); luminance balance and flicker; equipment reflectivity; acoustic noise and vibration; air temperature, movement, and humidity; and equipment temperature

- Diverse Cognitive and Perceptual Capabilities

Perception

- Perception is our awareness and understanding of the elements and objects of our environment through the physical sensation of our various senses, including sight, sound, smell, and so forth.
- Perception is influenced, in part, by *experience*. Experience plays a major role in Perception. Comparing the accumulated knowledge of a child with that of an adult in interpreting the world is a vivid example of the role of experience in perception

- **The goal in design, is to utilize our perceptual capabilities so that a design can be structured in the most meaningful and obvious way.**

Perceptual Characteristics

- **1. Proximity.** Our eyes and mind see objects as belonging together if they are near each other in space.
- **2. Similarity.** Our eyes and mind see objects as belonging together if they share a common visual property, such as color, size, shape, brightness, or orientation.
- **3.Matching patterns.** We respond similarly to the same shape in different sizes. The letters of the alphabet, for example, possess the same meaning, regardless of physical size.
- 4. **Succinctness. We** see an object as having some perfect or simple shape because perfection or simplicity is easier to remember.
- **5. Closure.** Our perception is synthetic; it establishes meaningful wholes. If something does not quite close itself, such as a circle, square, triangle, or word, we see it as closed anyway.

6. **Unity.** Objects that form closed shapes are perceived as a group.

7. **Continuity.** Shortened lines may be automatically extended.

8. **Balance.** We desire stabilization or equilibrium in our viewing environment.Vertical, horizontal, and right angles are the most visually satisfying and easiest to look at.

Memory

- Our power of recognition is much greater than our power of recall, and this phenomenon should be utilized in design.
- To do this, one should present, whenever possible, lists of alternatives to remind people of the choices they have.

- General ways to reduce user memory loads, reduce the need for mental integration, aid recall, and expand working memory are :

1. Presenting information in an organized, structured, familiar, and meaningful way.
2. Giving the user control over the pace of information presentation.
3. Placing all required information for task performance in close physical proximity.

- People can remember a few items for only 3 or 4 seconds.
- ■■ Placing important items at the beginning or end of listing, not in the middle. These items will be learned faster and recalled better.
- ■■ Placing information that must be compared in close proximity so memory does not have to be taxed.
- ■■ Making important items unique or distinctive in some manner because the likelihood of their being remembered will be increased. Highlighting key elements is one way to do this.

Sensory Storage

- Sensory storage is the buffer where the automatic processing of information collected from our senses takes place.
- It is an unconscious process, large, attentive to the environment, quick to detect changes, and constantly being replaced by newly gathered stimuli.
- In a sense, it acts like radar, constantly scanning the environment for things that are important to pass on to higher memory.
- Repeated and excessive stimulation can fatigue the sensory storage mechanism, making it less attentive and unable to distinguish what is important (called *habituation*).
- Avoid unnecessarily stressing it.
- **Design the interface so that all aspects and elements serve a definite purpose. Eliminating interface noise will ensure that important things are less likely to be missed.**

Visual Acuity

- The capacity of the eye to resolve details is called *visual acuity*
- . It is the phenomenon that results in an object becoming more distinct as we turn our eyes toward it and rapidly losing distinctness as we turn our eyes away — that is, as the visual angle from the point of fixation increases.
- It has been shown that relative visual acuity is approximately halved at a distance of 2.5 degrees from the point of eye fixation (Bouma, 1970).
- Therefore, a 5-degree diameter circle centered around an eye fixation character on a display has been recommended as the area near that character or the maximum length for a displayed word .

Foveal and Peripheral Vision

- *Foveal vision* is used to focus directly on something;
- *peripheral vision* senses anything in the area surrounding the location we are looking at, but what is there cannot be clearly resolved because of the limitations in visual acuity just described.
- Foveal and peripheral vision maintain, at the same time, a cooperative and a competitive relationship.
- Peripheral vision can aid a visual search, but can also be distracting.
- In its cooperative nature, peripheral vision is thought to provide clues to where the eye should go next in the visual search of a screen.
- Patterns, shapes, and alignments peripherally visible can guide the eye in a systematic way through a screen

Information Processing

- The information that our senses collect that is deemed important enough to do something about has to be processed in some meaningful way.
- There are two levels of information processing going on within us.

    1. One level, the highest level, is identified with consciousness and working memory. It is limited, slow, and sequential, and is used for reading and understanding.

- The second level is a lower level of information processing
- The limit of its capacity is unknown.
- This lower level processes familiar information rapidly, in parallel with the higher level, and without conscious effort.

- Both levels function simultaneously, the higher level performing reasoning and problem solving, the lower level perceiving the physical form of information sensed.
- When a screen is displayed, we usually will want to verify that it is the one you want.
- If you're new to a system, or if a screen is new to you, you rely on its concrete elements to make that determination, its title, the controls and information it contains, and so forth.
- You consciously look at the screen and its components using this higher-level processing.
- As you become experienced and familiar with screens, however, you can identify a newly
- presented screen very quickly with just a momentary glance.
- Just its shape and structure adequately communicate to you that it is the correct screen for the context in which you are working.
- Your reasoning and problem solving continues unhindered; your lower-level information processing does the screen identity task.

Learning

- Learning is the process of encoding in long-term memory information that is contained in short-term memory.
- It is a complex process that requires some effort on our part. Our ability to learn is important — it clearly differentiates people from machines..
- **A design developed to minimize human learning time can greatly accelerate human performance.**
- People prefer to stick with what they know, and they prefer to jump in and get started.
- Unproductive time spent in learning is something frequently avoided.

- people are very sensitive to even minor changes in the user interface, and that such changes may lead to problems in transferring from one system to another.
- The idea of having to learn huge amounts of information is enough to keep some people from even using a system.
- Learning can be enhanced if it
- ■■ Allows skills acquired in one situation to be used in another somewhat like it. Design consistency accomplishes this.
- ■■ Provides complete and prompt feedback.
- ■■ Is phased; that is, it requires a person to know only the information needed at that stage of the learning process.

- A significant by-product of learning is that it enables users to anticipate the location of common screen or page elements before they are displayed .
- Experienced users often begin moving a mouse pointer to the area of an expected target before the target appears on the screen.

Skill

- The goal of human performance is to perform skillfully.
- To do so requires linking inputs and responses into a sequence of actions.
- The essence of skill is performance of actions or movements in the correct time sequence with adequate precision.
- It is characterized by consistency and economy of effort.
- Economy of effort is achieved by establishing a work pace that represents optimum efficiency.
- It is accomplished by increasing mastery of the system through such things as progressive learning of shortcuts, increased speed, and easier access to information or data.
- Skills are hierarchical in nature, and many basic skills may be integrated to form increasingly complex ones.
- Lower-order skills tend to become routine and may drop out of consciousness.
- **System and screen design must permit development of increasingly skillful performance**.

Personality Differences

- A clear understanding of personality and cognitive styles is helpful in designing interfaces for diverse communities of users.

- Some people are eager to use computers and mobile devices, while others find them frustrating.
- Even people who enjoy using these technologies may have very different preferences for interaction styles, pace of interaction, graphics versus tabular presentations, dense versus sparse data presentation, and so on

- A popular technique is the Big Five Test for determining the user personality types , based on the OCEAN model (**Wiggins, 1996**):
    - **Openness to Experience/Intellect (closed/open),**
    - **Conscientiousness (disorganized/organized),**
    - **Extraversion (introverted/extraverted),**
    - **Agreeableness (disagreeable/agreeable), and**
    - **Neuroticism(calm/nervous).**

- There are hundreds of other psychological scales, including risk taking versus risk avoidance; internal versus external locus of control; reflective versus impulsive behavior; convergent versus divergent thinking; high versus low anxiety; tolerance for stress; tolerance for ambiguity, motivation, or compulsiveness; field dependence versus independence; assertive versus passive personality; and left- versus right-brain orientation

- Cultural and International Diversity

- Another perspective on individual differences has to do with cultural, ethnic, racial, or linguistic background.
- Users who were raised learning to read Japanese or Chinese will scan a screen differently from users who were raised learning to read English or French.
- Users from reflective or traditional cultures may prefer interfaces with stable displays from which they select a single item, while users from action oriented or novelty-based cultures may prefer animated screens and multiple clicks.

- Preferred content of webpages also varies
- University home pages in some cultures emphasize their impressive buildings and respected professors lecturing to students, while others highlight student team projects and a lively social life.
- Mobile device preferences also vary across cultures that lead to rapidly changing styles in successful apps, which may include playful designs, music, and game-like features.

- The role of information technology in international development is steadily growing, but much needs to be done to accommodate the diverse needs of users with vastly different language skills and technology access.

- **User-interface design concerns for internationalization include the following:**
    - 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., M., Dr.*)
    - Social Security, national identification, and passport numbers
    - Capitalization and punctuation
    - Sorting sequences
    - Icons, buttons, and colors
    - Pluralization, grammar, and spelling
    - Etiquette, policies, tone, formality, and metaphors

Users with Disabilities

- When digital content and services can be flexibly presented in different formats, all users benefit

- **Flexibility is most appreciated by users with disabilities who can access content and services using diverse input and output devices.**

- Blind users may utilize screen readers (speech output such as JAWS or Apple's VoiceOver) or refreshable braille displays.
- Low-vision users may use magnification.
- Users with hearing impairments may need captioning on videos and transcripts of audio
- People with limited dexterity or other motor impairments may utilize speech recognition, eye-tracking, or alternative keyboards or pointing devices.
- **On Apple products, these alternate forms of input or output are integrated into technology .**
- **Other laptops, tablets, and smartphones have add-on screen reader and magnification capability, and a small number of laptops have built-in eye tracking**

- Designing for accessibility helps everyone.
- The same captioning on video that can be utilized by users with hearing impairments ican also used by users watching video in noisy locations, such as gyms, bars, and airports.

Older Adult Users

- Understanding the human factors of aging can help designers to create user interfaces that facilitate access by older adult users .
- The benefits include improved chances for productive employment and opportunities to use writing, e-mail, and other computer tools plus the satisfactions of education, entertainment, social interaction, and challenge

- Designers in many fields are adapting their work to serve older adults, which can benefit all users.

- Desktop, web, and mobile devices can be improved for all users including older adults by providing users with control over font sizes, display contrast, and audio levels.
- Interfaces can also be designed with easier-to-use pointing devices, clearer navigation paths, and consistent layouts to improve access for older adults and every user

- Considering older and disabled users during the design process often produces novel designs such as ballpoint pens (for people with impaired dexterity), cassette tape recorders (for blind users to listen to audiobooks), and auto-completion software (to reduce keystrokes).
- Texting interfaces that suggest words or webaddress completion were originally designed to ease data input for older and disabled users but have become expected conveniences or all users of mobile devices and web browsers.
- **These conveniences reduce cognitive load, perceptual difficulty, and motor control demands, become vital in difficult environments, such as while traveling, injured, stressedor under pressure for rapid correct completion**.
- Similarly, subtitles (closed captioning) and user-controlled font sizes were designed for users with hearing and visual difficulties, but they benefit many users.

- In summary, making computing more attractive and accessible to older adults enables them to take advantage of technology, enables others to benefit from their participation, and can make technology easier for everyone

Children

- Designer goals for children’s software include educational acceleration, facilitating socialization with peers, and fostering the self- confidence that comes from skill mastery
- . Advocates of educational games promote intrinsic motivation and constructive activities as goals,

- Designing for younger children requires attention to their following limitations.
  - Their evolving dexterity means that mouse dragging, double-clicking, and small targets cannot always be used;
  - Their emerging literacy means that written instructions and error messages are not effective;
  - Their low capacity for abstraction means that complex sequences must be avoided unless an adult is involved.
  - Other concerns are short attention spansand limited capacity to work with multiple concepts simultaneously.
- Designers of children's software also have a responsibility to attend to dangers, especially in web-based environments, where parental control over access to violent, racist, or pornographic materials is necessary.
- Appropriate information for the education of children about privacy issues and threats from strangers is also a requirement

Accommodating Hardware and Software Diversity

- In addition to accommodating different classes of users and skill levels, designers need to support a wide range of hardware and software platforms.
- The rapid progress of technology means that newer systems may have a hundred or a thousand times greater storage capacity, faster processors, and higher-bandwidth networks.
- **However, designers need to accommodate older devices and deal with newer mobile devices that may have low-bandwidth connections and small screens**

Technical Challenges for Interface designers

Producing satisfying and effective Internet interaction on high-speed (broadband) and slower (dial-up and some wireless) connections

- Compression algorithms to reduce file sizes for images, music, animations, and even video, but more are needed.
- New technologies are needed to enable pre-fetching or scheduled downloads.
- User control of the amount of material downloaded for each request could also prove beneficial (for example, allowing users to specify that a large image should be reduced to a smaller size, sent with fewer colors, converted to a simplified line drawing, replaced with just a text description, or downloaded at night when Internet charges are perhaps lower).

- Responsive design enabling access to web services from large displays (3200 × 2400 pixels or larger) and smaller mobile devices (1024 × 768 pixels and smaller

- Rewriting each webpage for different display sizes may produce the best quality, but this approach is probably too costly and time-consuming for most web providers.

- Software tools such as Cascading Style Sheets (CSS) allow designers to specify their content in a way that enables automatic conversions for an increasing range of display sizes.

Supporting easy maintenance of or automatic conversion to multiple languages

- Commercial operators recognize that they can expand their markets if they can provide access in multiple languages and across multiple countries.

- This means isolating text to allow easy substitution, choosing appropriate metaphors and colors, and addressing the needs of diverse cultures