BAIT2203 Introduction to Human Computer Interaction

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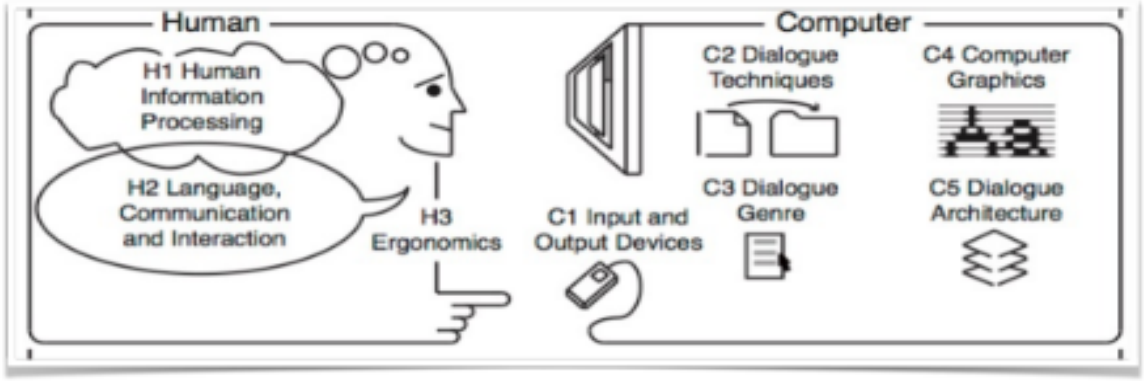
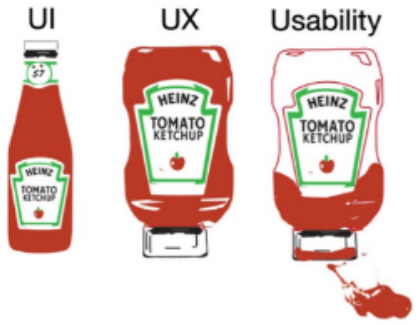
Chapter 1: Introduction to Human Computer Interaction (HCI)

HCI

Definition	HCI is the study of how people interact with computers and the design of computer systems to make them more user-friendly and effective. - **Usability** is the main concept in HCI (Evolution from man-machine interaction (MMI) to HCI)
The Goals	• Increasing individual & organizational productivity • Improving safety and reducing health hazards • Reducing user interface development costs

The concept of Human + Computer + Interaction

Human	Computer	Interaction
		
• The user (human) is the one whom computer systems are designed to assist. • So , we need to know user (human) capabilities and limitations. • Humans are limited in their capacity to process information. This has important implications for design. • More details on the coming chapter.	Historical Development of Computing • 1950s/60s: Expensive computing resources and highly trained professionals • 1970s: Personal computers and Command Line Interface (CLI) • 1980s: Graphical User Interface (GUI) and Xerox Star • 1984: Macintosh and GUI • 1987: Windows 1.0 and 2.0 • 1990s/2000s: Cheap computing resources and non-expert users • Present-future: Ubiquitous/Pervasive Computing	

...Interaction:

User Interface (UI)	The User Interface is the space where interactions between users and a system, including the design and layout of screens, buttons, and other interactive elements. Example components: • Standard PC UI components (SCREEN, KEYBOARD, MOUSE, SPEAKERS) • Other UI components (MICROPHONE, BUTTONS, LIGHTS, HAND-TRACKING GLOVE, EYE TRACKER)
Usability	Usability refers to the ease with which users interact with a system 交互的难易程度, focusing on effectiveness, efficiency, and satisfaction in achieving their goals. Usability Defined by ISO 9241-11:2018: **Effectiveness, Efficiency, and Satisfaction**
User Experience (UX)	User Experience encompasses all aspects of how a user feels about using a system, including their perceptions, emotions, and practical interactions throughout the duration of use.

Components of Usability and User Experience(UX)

Effectiveness	**Efficiency**	**Satisfaction**
measures how accurately and completely users achieve their goals. It checks if user goals are met and if the actual output matches the desired output "Can users use the system to do the work they need to do?"	evaluates the resources (time, effort, costs) used relative to results. It focuses on task completion speed and user productivity “Can experienced users be productive using the system?” “Once users have learned the design, how quickly can they perform tasks?”	assesses the user's physical, cognitive, and emotional responses. It looks at the comfort and acceptability of the system: "How pleasant is it to use?"

User Experience

encompasses a person's perceptions and responses from using or anticipating the use of a product, system, or service (ISO 9241-210:2010). It includes being: Enjoyable, Motivating, Fun...

❤️Examples + Pros and cons + Effects of GOOD/ BAD Usability Design to Developers and Users

	For users	For developers
GOOD • A simple xxx process • Clear instruction within system • Well-designed help center that provide efficient support	• quickly access without any obstacles • successfully complete tasks without seeking external help • minimizes downtime	• minimizes user learning curve • positive user feedback and referrals • higher user retention
	increase productivity - increases satisfaction reduce frustration - creates loyalty improve confidence - become a stable user base	save training resources - projects have faster adoption rates. gain more users with less marketing effort. benefit from a stable user base and reduced churn.
BAD • A complex xxx process • Unclear instruction • Inconsistent navigation/ design	• increases user errors • causes unnecessary anxiety • hard to use	• requires frequent updates to fix usability issues • higher user support volume due to confusion • negative reviews or low ratings
	lose patience - leave cause frustration - abandonment confuse users - negative perception of the brand	prolong development cycles. This can delay the release of new features or products. face increased service costs and resource allocation issues. may struggle to attract new users and retain existing ones.

How to Design Good UI with Good Usability

Design, construct and test ui to make a system/software/product that is easy to use, which means HIGH level of USABILITY

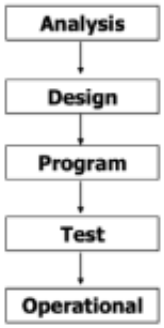
So, to make a good UI:

• focus on users and their tasks (be user centered)

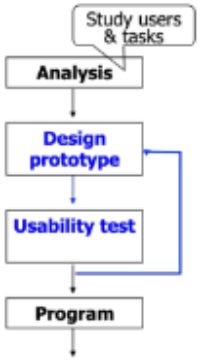
• build a little(prototype), test a little (usability test)

• iterate until a good design is achieved

Traditional Waterfall Model vs. HCI Framework



Waterfall



HCI Framework

Traditional Waterfall Model: Clear structure, manageable for static requirements.

HCI Framework: Enhanced user satisfaction, reduced risk of unnecessary features, encourages innovation.

Process: Waterfall is linear and sequential; HCI is iterative and flexible.

User Involvement: Waterfall involves users less frequently; HCI maintains continuous user engagement.

Adaptability: Waterfall is less adaptable; HCI is more open to changes.

Focus: Waterfall is functionally driven; HCI is user-needs centered.

❤️Disciplines Contributing to HCI

Computer Science❤️ Focuses on creating software and understanding technology's capabilities and limitations. It builds the technical foundation for interactive systems.	• Develop algorithms for efficient search functions on websites. • Ensure **software compatibility** across various devices by understanding technical limitations. (Google doc, support IOS, Android, Linux, window, phone, tablet, pc) • Implement **security features** to protect user data. (login, biometric authentication)
Cognitive Psychology❤️ Studies how people think, learn, and remember. It aids HCI by understanding user information processing and system interaction.	• Design intuitive **user onboarding** processes aligned with how users learn and retain information. (Simple setup guide for first start the smartphone) • Place frequently used **functions in accessible areas** based on cognitive habits and memory processes. (home screen place commonly used apps) • Create **easily understandable error messages** considering attention and interpretation. (When incorrect password, provide guide or suggestion how to reset)
Ergonomics/Human Factors Examines interactions between people and their environments to design tools and spaces that match user abilities and needs, ensuring comfort and efficiency.	• Design keyboard layouts to reduce physical strain by considering hand and finger movements. (keyboard design in split and a slight curve to reduce strain of finger) • **Adjust display brightness and contrast** to prevent eye fatigue based on visual capabilities. • Create adjustable workstations to accommodate users of different heights, ensuring comfort and reducing injury risk. (**adjustable desk and chair**)
Social and Organizational Psychology Investigates behavior in social and work settings. This helps design	• Develop collaborative tools that **support team dynamics and organizational workflows**. (shared task list, video conferencing.)

systems that support teamwork, communication, and social dynamics.	• Design systems that **respect cultural differences** in communication and interaction styles. (choose preferred language, adjust setting to suits different culture norms) • Create user interfaces that **promote social interaction and shared experiences**. (team member profile)

People, Activities, Contexts, Technologies (PACT) Analysis

Designing a Train Ticket Machine Example

Understanding the Users (**People**)	Physical: Consider the age, height, and weight of the users to ensure the machine accommodates a diverse population. Psychology: Account for users' memory and mental models to create an intuitive interface. Usage: Differentiate between expert and novice users in terms of their familiarity and frequency of use.
Analyzing User **Activities**	Time: Evaluate when and how often the ticket machine is utilized. Complexity: Assess the simplicity or complexity of the ticket purchasing process. Safety Critical: Ensure the interaction with the machine is safe for users. Content: Determine the type of information or media that the machine needs to display or process.
Considering the **Context**	Physical Environment: The machine should be designed to function effectively in various physical settings. Social Context: The design should be sensitive to cultural and language differences that may influence user interaction.
Selecting Appropriate **Technology**	Input Methods: Incorporate user-friendly input technologies such as touch screens and mice. Output Methods: Use clear output devices like monitors and speakers to communicate with users.

Chapter 2: User Analysis & Task Analysis

User Analysis

about who the user is, what is the environment that system will operate, what are the tasks to design an efficient system.

User Types (3)

	Novice users Users who are new to a system and may not be familiar with its operations but understand the goals they want to achieve.	**Knowledgeable Intermittent users** Users who use multiple systems irregularly and have stable knowledge of tasks but may struggle to remember system operations.	**Expert users** Users who are very familiar with systems and tasks, often using technical jargon and advanced features.
Design for Them:	Clear instructions and guidance. Simple and brief input requirements. No assumption of prior knowledge. Clear and unambiguous system messages. A limited set of options for decisions. Sufficient feedback and help.	Consistency across systems to aid memory. Good help facilities and documentation to assist users.	Simplified command prompts and shortcuts. Advanced features accessible without affecting the interface for novices.
NOT Design for Them:	Complex interfaces or jargon行话. Multi-step processes without guidance. Overwhelming options or information.	Frequent changes to interface elements. Lack of support or documentation.	Overly simplified interfaces that hide advanced features. Lack of customization options.
Examples (vending machine, public transportation, productivity, banking)	✅have a tutorial for first-time users ✅touch screen with user friendly interface ✅step-by-step guide for setup new account ❌tiny buttons that no clear labeling ❌without clear guidance for first-time user ❌complex process (requires users to navigate through multiple, non-intuitive steps)	✅consistent layouts and features ✅retains user data for future sessions ✅Rechargeable TNG cards with simple, consistent mechanisms ❌frequently changed interface ❌without clear help sections for infrequent user ❌lack of search functionality	✅keyboard shortcuts for formatting and navigation ✅developer options for power users ✅customizable dashboard settings ❌forces expert users to click through multiple menus to access common tasks. ❌without customizable shortcuts for frequent actions ❌lack advanced settings or power-user features

Understanding Users: Requirements

Functional Requirements	Non-functional Requirements
What the system should do	how the system works

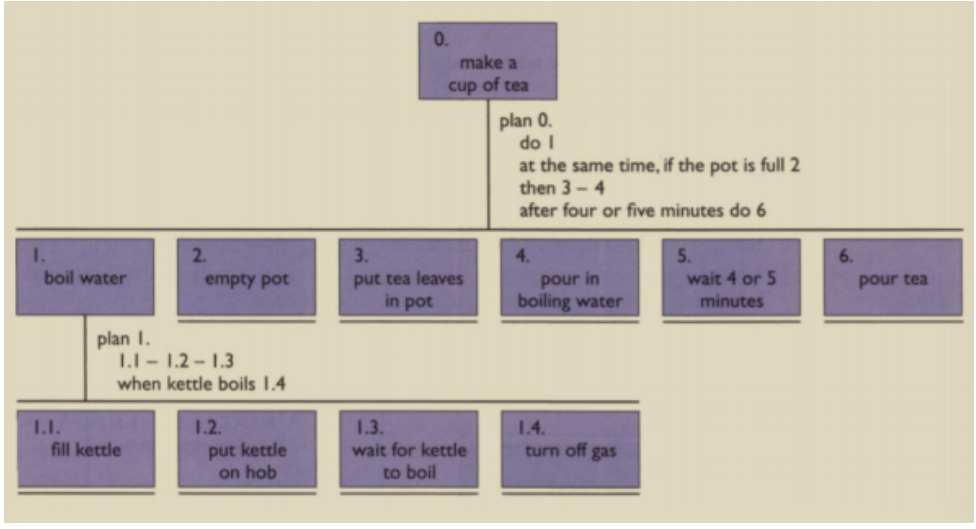
💙How? - Data Gathering (5)

Interviews Personal discussions with users to explore their experiences.	• Engage in one-on-one or group interviews. • Purpose: Gain detailed insights into user behavior and feelings. • Pros: Offers depth; reveals goals, motivations. • Cons: Time-consuming; subject to interviewer influence.
Focus Groups Moderated group discussions aimed at gathering feedback.	• Organized discussions with a demographically representative group of users. • Purpose: Obtain collective feedback and insights into user perspectives. • Pros: Offers a range of viewpoints and can uncover shared user experiences. • Cons: May be influenced by group dynamics or dominant personalities.
Card Sorting Users categorize information on cards to reflect organization preferences.	• Ask users to sort cards representing different features or content areas of a product. • Purpose: Uncover users' mental models and their natural organization of information. • Pros: Provides insights into user categorization and navigation preferences. • Cons: May be limited in scope and requires careful analysis to be useful.
Questionnaires Systematic surveys to gather user feedback through structured questions.	• Design and distribute questionnaires with a mix of open-ended and scaled questions. • Purpose: Gather quantitative and qualitative data from a large user population. • Pros: Reliable if designed well, can reach a wide audience. • Cons: Requires effort to ensure reliability and may lack personal context.

Observation
Watching users interact with a product or system in their natural environment.
	• Conduct direct observations in-person or indirect observations via video recordings.
	• Purpose: Study real user behaviors and tasks as they occur.
	• Pros: Provides unfiltered data on user actions and processes.
	• Cons: Can be obtrusive, potentially altering user behavior.
	  ○ Direct Observation: Investigator is present during the task, observing and taking notes.
	  ○ Indirect Observation: Task is viewed remotely, such as through video recordings or web traffic analytics.

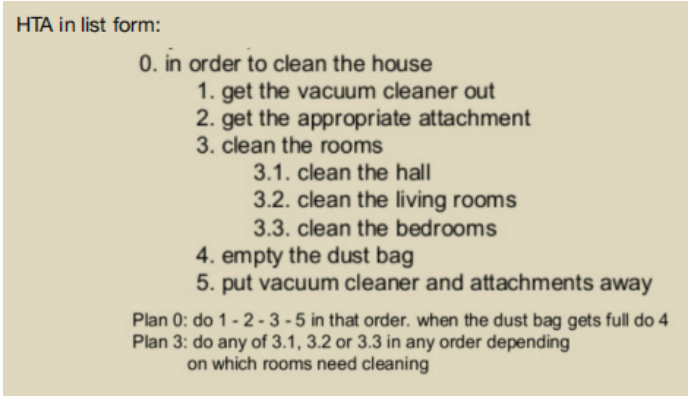
💚User needs Analysis

The process of understanding and identifying the needs and preferences of users to inform product design and development.

Persona	user models that represent a typical user based on real-world observation and real data (characteristics, behaviors, motivations, and goals...). • Marketing personas focus on demographic and buying behaviors. • Proto-personas (no money to do true research) are based on assumptions when detailed research is not possible. • Design personas focus on user goals, behaviors, and pain points.	Helps designers and developers empathize with users and make design decisions that align with user needs. Example: A persona for a fitness app might be a 30-year-old who wants to track daily activities but struggles with motivation.
Scenario	description about how user complete tasks in a specific situation and environment	Facilitates the understanding of user behavior and goals in real-world contexts. Example: A scenario could describe an office worker using a quick meal delivery service during a busy workday.
Environment	the setting and context where the product or service will be used. (Need to consider physical, social, cultural, and technological aspects that influence user interaction.)	Critical to designing products that are suitable for their intended environment.
Task	specific goals or activities users aim to accomplish with a product or service. (Involves understanding the steps users take to complete their objectives.) **Use of TA** By analyzing the user's current workflow, the new system can be designed to align with their familiar habits, making it easier for them to adapt. Advantages: • Skills learned from the old system can be transferred to the new one. • Users don't need to change their approach much when using the new system. • Task analysis can also help create documentation and training materials.	Key to designing interfaces that support user efficiency and effectiveness. 

💙HTA (Hierarchical Task Analysis)

A method for breaking down complex tasks into simpler, hierarchical subtasks.
- Starts with a high-level goal and breaks it down into detailed steps and substeps.



Other analysis tools

- Empathy Mapping: Helps understand what users think, feel, say, and do.
- Customer Journey Mapping: Visualizes the steps users take when interacting with a product or service.
- Experience Mapping: Looks at the entire user experience, including emotions and behaviors, over time.
- Service Blueprinting: Maps out the entire service process, including the frontstage (user-facing) and backstage (behind-the-scenes) activities.
- Job-To-Be-Done: Focuses on what the user is trying to achieve with the product or service.

Chapter 3: Users: Physical Capabilities

Computer systems are designed to assist user(human), we need to know user capabilities & limitations as humans have limited information processing capabilities.

	Limitations	Examples
Vision	Peripheral Vision: Less effective in detecting color and fine details but highly sensitive to motion. Color Blindness: Affects a small percentage of the population, limiting the ability to distinguish between certain colors. Visual Overload: The human brain can only process a limited amount of visual information at once, leading to cognitive overload if too much is presented simultaneously.	✅Google's interface: Clean layout, high contrast, easy to read. ✅Apple's accessibility features: High-contrast mode and voice-over support. ✅Traffic signs: Large, high-contrast text for quick recognition. ❌Low-contrast web pages: Hard to read text on low-contrast backgrounds. ❌Colour-coded interfaces: Difficult for color-blind users. ❌Cluttered control panels: Too much information, overwhelming the user.
Hearing	Hearing Range: Limited to frequencies between 20Hz and 15kHz, with a gradual loss of sensitivity to higher frequencies as age progresses. Auditory Overload: Difficulty in distinguishing sounds in noisy environments. Selective Attention: Can lead to missed auditory cues in the presence of competing sounds. -McGurk effect?	✅Customisable phone alerts: Different sounds for different alerts. ✅Fire alarms with lights: Loud sound plus flashing lights for increased awareness. ✅Voice navigation systems: Audio directions with visual support. ❌Loud public announcements: Uncomfortably loud and distracting. ❌Hospital alarms: Constant noise leading to alarm fatigue. ❌Quiet car indicators: Difficult to hear over road noise.
Haptic (touch)	Sensitivity Variability: Some body parts, like fingers, are highly sensitive, while others are less so. Tactile Feedback: May be insufficient or absent in digital interfaces, leading to uncertainty in interactions. Reduced Sensitivity: In certain populations, such as the elderly, who may not feel subtle haptic feedback.	✅Gaming controllers: Vibrations provide immersive feedback. ✅Braille盲文 keyboards: Tactile input for visually impaired users. ✅Phone haptic feedback: Simulates touchscreen button presses. ❌Cheap remote controls: Buttons without tactile feedback. ❌Flat car touchscreens: Require visual attention, no tactile feedback. ❌Unresponsive ATM touchscreens: Frustrating and unreliable interaction.
Movement	Reaction Time: Varies depending on the stimulus, generally slower for visual compared to auditory stimuli. Fatigue: Repetitive motions can lead to fatigue, - accuracy and + errors. 💙**Fitts' Law** Predicts movement time based on distance to target (D) and target size (W). Used to optimize interface design, such as button placement and menu navigation.	✅Voice-controlled assistants: No physical movement required. ✅Ergonomic keyboards: Reduce strain during prolonged use. ✅Large in-car touchscreens: Large targets, easy to tap on while driving. ❌Small smartphone keyboards: Difficult for users with limited dexterity. ❌Tiny remote control buttons: Require precise, difficult movements. ❌Non-responsive touchscreens: Require repeated taps, leading to frustration.

Chapter 4: Users: Cognitive Capabilities

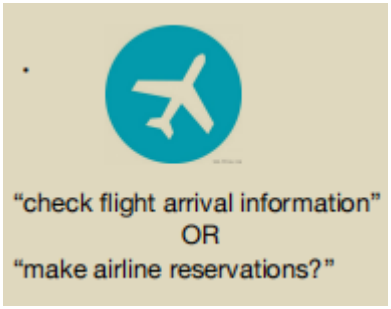
Cognition

involves the interpretation of information received through senses, planning actions, and executing them.
Key cognitive aspects relevant to interaction design: Attention, Perception, Recognition, and Memory.
Aim: Design better products by understanding cognitive processes and limitations.

Core Cognitive Aspects

1-Attention 注意	Focus on relevant information using auditory and visual senses.	Visual Focus: In an email app, a **red dot** on the icon and bold text in the inbox highlight new emails, drawing immediate attention. Auditory Focus: A **cooking timer beeps when time is up**, instantly grabbing attention without needing to look at the timer.
2-Perception 感知	❤️**Gestalt law of perception (4)** Proximity: Objects close together are perceived as related. Continuity: Smooth, continuous patterns are seen as unified统一. Similarity: Similar elements are perceived as a group. Figure-Ground 背景: Separates visual field into foreground and background.	Proximity: On a webpage, buttons for "Submit" and "Cancel" are placed close together. Users naturally perceive these buttons as related actions, encouraging them to consider them as options to confirm or cancel their input. Continuity: In a navigation bar, a breadcrumb trail shows a continuous path of links (e.g., Home > Products > Electronics > Mobile Phones). The user perceives this as a smooth, continuous flow, making it easier to understand their location within the site and navigate back if needed. Similarity: In an online form, all required fields might be marked with a red asterisk, while optional fields are left unmarked. Users perceive the fields with the red asterisks as a group of related elements, recognizing that they need to be filled out. Figure-Ground: On a website, a pop-up window appears in front of a darken background. The user perceives the pop-up as the figure (foreground) and the dimmed page behind it as the ground (background), focusing their attention on the pop-up content.
3-Memory	**Types of Human Memory (3)** **Sensory Memory (SM):** Brief retention of sensory input.	Sensory Memory (SM): When you hover over a button on a website, it changes color briefly. This quick visual change is processed by sensory memory, helping users notice interactive elements.

	💚**Short-Term Memory (STM):** Holds limited information (7±2 chunks) temporarily. **Long-Term Memory (LTM):** Unlimited capacity, long-term storage. **Recognition & Recall** 识别和回忆 Recognition involves identifying familiar elements, while recall requires retrieving information from memory. **Chunking** Grouping information into manageable units to enhance memory retention.	Short-Term Memory (STM): While entering a one-time password (OTP) from your phone into a website, you remember the 6-digit code just long enough to type it in, relying on short-term memory. Long-Term Memory (LTM): A user who frequently uses keyboard shortcuts, like "Ctrl + C" for copy, relies on long-term memory to perform these actions without needing to think about them each time. Recognition & Recall: • Recognition: When logging into a website, you recognize your email address from a dropdown list, making it easier to select without typing. • Recall: To log in to an account, you need to recall your password from memory without any prompts. Chunking: A credit card number is displayed as four groups of four digits (e.g., 1234 5678 9012 3456), making it easier to remember and input correctly, thanks to chunking.
4-Mental Model	Users create mental models based on their understanding of how systems work, which influences their interactions with technology. 💙**Metaphors (Transfer Effect)** to describe unfamiliar concepts or systems, like a computer, in terms of familiar elements, like files and folders Limitation: - metaphors don't scale very well. A metaphor that works well for a simple process in a simple program will often fail to work well as that process grows in size or complexity. - Sometimes it is misleading.If the user doesn't have the same cultural background as the designer, it is easy for metaphors to fail.	When using a smartphone, users expect the "swipe left" gesture to show the next item, like moving to the next photo in a gallery. When using a desktop computer, users often expect that clicking the "X" button in the top corner of a window will close the application. This expectation is based on their mental model of how most software interfaces function, guiding their behavior across different programs.

	 Cultural Association • Example : red = danger, green = good to go But these differences in different places: • Light switches : America: down is off , Britain: down is on • White Colour: China: funeral, America: Wedding • Color indications in stock market: China: up(red), green(down), America: up(green), green(up)	

Chapter 5: UI Design Guidelines & Principles

Interaction Model

helps us understand the communication between the user and the system. It's a conceptual tool for identifying the problem space in design, such as understanding user difficulties, functionalities desired, and whether all users have the same requirements.

Donald Norman's Model

outlines the interactive cycle, divided into two phases: **execution** and **evaluation**. It consists of seven stages, starting from the user establishing a goal to evaluating the system's state with respect to that goal. This model helps in identifying the gulfs of execution and evaluation, which are the distances between user expectations and system capabilities.

UI Design Guidelines & Principles	Norman's Design Principle
These are used to guide and evaluate the design of user interfaces. They ensure that interfaces are user-friendly, efficient, and meet user needs.	Norman's principles focus on aspects like visibility, feedback, constraints, mapping, consistency, and affordance. They emphasize making functions and controls obvious, providing clear feedback for user actions, and designing interfaces that are intuitive and easy to learn.

❤️Shneiderman's Eight Golden Rules (8)

These rules provide a framework for creating effective and user-friendly interfaces.

Rules	Examples	Importance
Strive for consistency. 保持一致性	Google Search: The search bar is always at the top of the page across all devices. Microsoft Word: The "Save" function is consistently found in the File menu. Facebook: The "Like" button looks and behaves the same across posts. Restaurant Website: The "Menu" button changes position on different pages. Mobile App: The "Back" button sometimes takes the user back, and other times it closes the app. E-commerce Site: Product filtering options change drastically between desktop and mobile views. All buttons across a website, like "Submit" and "Cancel," have the same color and style, making it easy for users to recognize and understand their function.	reduces the learning curve and helps users develop muscle memory for common actions.
Enable frequent users to use shortcuts. 允许快捷键	Good: Photoshop: Offers keyboard shortcuts for almost every function.	increase efficiency for experienced users, saving time and reducing effort

	Gmail: Allows users to use shortcuts like "C" to compose a new email. Excel: Autofill feature speeds up data entry for power users. Bad: Basic Calculator App: No shortcut keys, forcing users to click every button. Online Form: Requires users to manually enter repetitive information without autofill options. Streaming Service: No shortcut to skip the intro; users must manually do it each time.	
Offer informative feedback. 提供信息反馈	ATM Machine: Displays "Processing" when a transaction is in progress. File Download: Shows a progress bar with percentage completed. Uber App: Notifies users when their ride is arriving. Mobile App: Freezes without any indication of loading or processing. Online Payment: No confirmation message after submitting payment, leaving the user uncertain. Website Form: Submits with no acknowledgment, leaving users unsure if the form was successfully sent.	reassures users that their actions have been successfully received and processed
Design dialogs to yield closure. 对话框实现关闭	Online Shopping: After checkout, shows a "Thank you for your purchase" page with order details. Banking App: After a transaction, it shows a confirmation message with the transaction ID. Customer Support Chat: Ends with "Is there anything else I can help with?" and a summary of the conversation. Email Subscription: No confirmation message after signing up, leaving users uncertain. Social Media Post: No notification that a post has been successfully shared. Survey Submission: No message confirming the survey was received after submission.	helps users feel a sense of completion and satisfaction after completing a task
Offer simple error handling. 提供简单的错误管理	Google Search: Suggests the correct spelling when a user misspells a word. Undo Button: In text editors like Word, it allows users to easily correct mistakes. Email Client: Warns users if they mention an attachment in the email body but forget to attach a file. Website Form: Deletes all entered data if an error is found upon submission. Mobile App: Crashes without explaining the cause or suggesting a solution. Online Payment: Automatically cancels the transaction if a mistake is made, forcing the user to start over.	prevents user frustration and guides them toward a resolution
Permit easy reversal of	Google Docs: Allows undoing an action with Ctrl+Z.	reduces anxiety and allows users to correct

actions. 允许轻松撤销操作	Photo Editing Software: Provides a history panel to revert to previous steps. Shopping Cart: Users can easily remove items from their cart before checkout. Mobile App: No undo option after deleting an item or piece of data. Online Form: No option to go back to the previous page without losing all entered data. Photo Gallery: Deleting a photo gives no chance to recover it if done by mistake.	mistakes without consequence
Support internal locus of control. 允许内部控制	Video Game: Provides players with clear control over character movements and actions. Customization Features: Apps like Spotify allow users to create and manage their playlists. Website Navigation: Users can freely browse through categories and pages without restrictions. Auto-playing Ads: Users have no control over stopping them. Pop-up Messages: Constantly interrupts users without giving them an option to disable them. Software Installation: Forces the installation of additional software without the user's consent.	empowers users, making them feel in charge of their actions and decisions
Reduce short-term memory load. 减少短期记忆的负担	Navigation Menu: Clearly labeled categories reduce the need to remember complex site structures. Password Managers: Save passwords so users don't have to remember them. Wizard Interfaces: Break down tasks into simple steps with clear instructions. Bad: Complex Multi-step Forms: Requires users to remember previous steps to complete the process. ATM Machine: Asks users to input information that was already entered earlier in the process. Overloaded Dashboard: Too much information on one screen, overwhelming the user.	prevents users from becoming overwhelmed and enhances the overall user experience

Techniques to draw user attention (5)

1. Blinking/Flashing:
    - A **blinking cursor in a text field** indicates where the user should start typing, drawing their attention to the input area.
2. Bold:
    - **Important instructions on a webpage**, such as "Please read before continuing," are often **displayed in bold text** to make them stand out.
3. Underlining:
    - **Links** on a webpage are typically **underlined to distinguish them from regular text**, signaling that they are clickable.
4. Sound:
    - When receiving a new message, a **notification sound alerts** the user, drawing their attention to the message.

5. Using Color:
    - Error messages, such as **"Invalid password,"** are often **displayed in red** to immediately catch the user's attention and indicate a problem.

These techniques are methods used in interface design to highlight important elements of information and ensure they capture the user's attention.

Errors

Main Types (2)

💙**Slip**

- is an **execution error** where the user's action does not match their intention意图, often due to **poor interface design**.
- Example: A user accidentally **deleted** an important email because they clicked the "**Delete" button instead of "Archive"** due to poor button placement or similar button designs.

💙**Mistake**

- is a **planning error** where the user's intention is incorrect, often due to a **misunderstanding** of the system.
- Example: user attempts to **save a file in a format** that is **not supported** by the application (e.g., trying to **save an image as a text file**) because they misunderstood the file format requirements.

Error Message Design (5)

1. EXPLICIT 不含糊
    a. Clearly indicating that an error has occurred.
    b. When a user enters an incorrect password, a **clear message** like **"Error: Incorrect password"** appears, explicitly indicating that an error has occurred.
2. HUMAN-READABLE
    a. Using plain language familiar to the user.
    b. A form might display an error message saying, **"Please enter your email address in the format: example@domain.com,"** using plain language familiar to the user.
3. POLITE 客气，有礼貌的
    a. Not blaming the user for the error.
    b. When a file upload fails, the error message might say, **"Oops! We couldn't upload your file. Please try again,"** instead of implying user fault.
4. PRECISE 精密
    a. Describing the exact problem.
    b. An error message might read, **"The file size exceeds the 5MB limit,"** precisely describing the exact issue with the file upload.
5. CONSTRUCTIVE 建设性建议
    a. Offering advice on how to fix the problem.
    b. After an unsuccessful search query, a message like **"No results found. Try using different keywords or check your spelling"** provides advice on how to improve the search.

Good error messages are crucial for maintaining a positive user experience and guiding users to resolve issues effectively.

Chapter 6: The Computer & Interaction Style

Input Devices: Keyboard, Stylus, Microphone, Mouse, Trackball, Touchpad, Touch screen, Camera, Scanner
Output Devices: Computer Screens, Speakers, Braille Display(for blind), Printers

❤️Interaction Types (4)

Instructing- Issuing commands and selecting options.	Instructing involves users giving direct commands or selecting options to control a system. It's efficient for completing tasks quickly. Example: In a banking app, users can transfer money by selecting the transfer option, entering details, and pressing "Send," allowing them to control the process efficiently.
Conversing - Interacting with a system like having a conversation.	Conversing allows users to interact with a system using natural language, like speaking to another person. This interaction feels like a conversation, making a system intuitive and easy to use. Example: Using Siri, users ask "What's the weather today?" then Siri responds verbally about the weather today.
Manipulating - Interacting with objects in a virtual or physical space.	Manipulating involves interacting directly with objects in a system, often through gestures or tools, giving users a sense of control and immediate feedback. Example: In Instagram, users can pinch to zoom, rotate, and adjust filters directly on their photos by using touch gestures before posting a story or post.
Exploring - Moving through a virtual environment	Exploring lets users navigate through a virtual environment to discover information or content. It's commonly used in games and virtual tours. Example: In Google Earth VR, users explore 3D cities and landscapes by moving through the virtual environment, discovering new areas as they go.

Interface Types (4)

Command Line Interface, Menu, Fill-in Form
Direct Manipulation: directly manipulate objects at the interface using a pointing device such as a mouse, stylus or fingers.

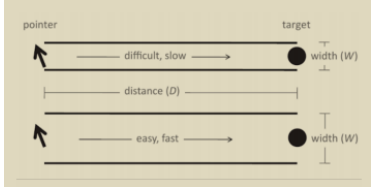
Menu Design Guidelines (2)

Ordering menu items

- Alphabetical: choices are simply listed in alphabetical order
- Categorical: choices are grouped according to semantic property
- Conventional: choices are neither in alphabetical order nor categorical order but can have a temporal order – such as months of the year, days of the week, numbers, sizes
- Frequency of use: choices are listed in order of expected frequency of use

Accot-Zhai Steering Law(An extension to Fitts's Law.)

A narrow and long path increases selection time.
Conversely, a wider and short path reduces selection time.



Fill-in Form Design Guidelines (5)

Organization & Layout

- Match online form layouts to their paper versions for consistency (e.g., credit card forms).
- Use spaces, lines, or color to separate sections logically and create balance.
- Minimize gaps between labels and input fields for clarity.

Caption & Field Design

- Place labels above input fields for better readability.
- Clearly indicate mandatory or optional fields (e.g., "*").
- Avoid using all-uppercase text, as mixed case is easier to read.
- Align numeric fields, especially with decimal points, for accuracy.

Input Formats

- Ensure that the input formats are clear, and provide examples or placeholders where necessary to guide users in entering the correct information.

Error Handling

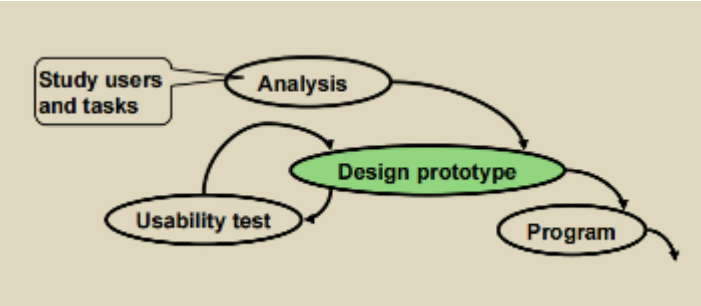
- Provide specific error messages and highlight mistakes for easy correction.

Completion Signal

- Make the form's completion action (e.g., "Submit") clear to users.

Chapter 7: Prototyping

Prototyping & Iterative Design



Iterative design addresses incomplete requirements

Prototyping & Iterative Design (3)

1. **Throw-away**: is built and tested but actual prototype is discarded, knowledge gained from prototype is used to build the final product
2. **Incrementa**l: is build as separated component, one at a time overall design is partitioned into independent & smaller components
   Final product is then released as a series of products
3. **Evolutionary**: is not discarded and serve as a basis for next iteration of design actual system is evolve from a limited initial version to its final release

Prototype in HCI

Purpose: Evaluation, feedback, communication, idea testing

Examples: Hand-drawn, tool-drawn, screen, functional prototypes

❤️Lo-Fi & Hi-Fi Prototypes

Low Fidelity Prototypes	High Fidelity Prototypes
• Used during early stages of development • quicker to create. • helpful in enabling early visualization of alternative design Paper-based, quick to create, early visualization of design solutions Examples: Sketching, storyboards, wireframes, index cards, 'Wizard of Oz'	• Close representation of the user interface appearance • assumed to be much more effective in collecting true human performance data (e.g., time to complete a task) Development environments: Adobe XD, Visual Basic, Photoshop, Xcode/Swift

Chapter 8: Evaluation

Evaluation is about assessing the usability of a system.

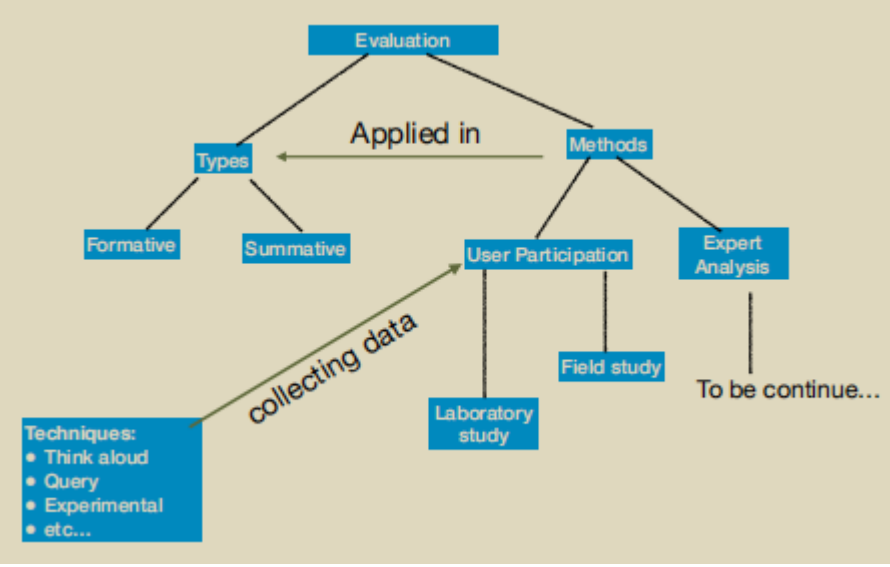
Importance of Evaluation	Goals of Evaluation
Ensuring usability, identifying features, informing design, fixing problems	Assessing functionality, usability impact, specific problems

💚Types of Evaluation(2)

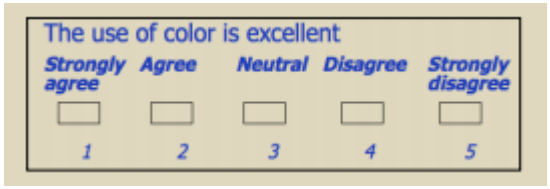
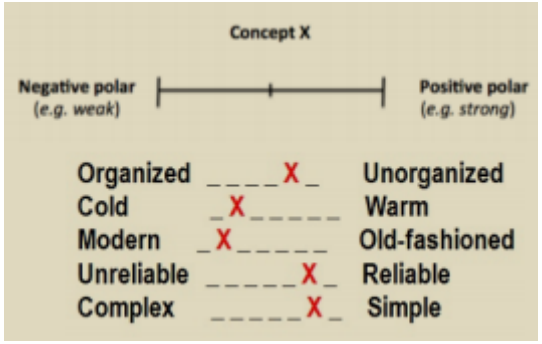
Formative (during design)	Summative (finished product)
done during the design phase. It can be done by the design team or by involving real users.	Evaluation performed with the finished product. It is mostly done by external users

Evaluation Methods broad headings(2)

Expert analysis and user participation



Styles of Evaluation	Laboratory studies and field studies
Observation + Think Aloud	Combining observation with user verbalization
Query Techniques for feedback collection	Interviews

	Questionnaires • Open / closed question • Checklist / multiple- choice question • Scalar question: range of values ○ Likert scales  • Semantic differential scales: measure meaning of things and concepts. 
Experimental Technique	Controlled experiments and A/B testing
Physiological Methods	Eye tracking and physiological measurements

Data Analysis

Quantitative: Statistical methods — e.g., counting, t-tests, analysis of variance, time series analysis
Qualitative: Interpretations, comparative analysis

Chapter 9: Evaluation (Expert Analysis)

Expert Analysis Techniques: Cognitive walkthrough and heuristic evaluation

❤️Nielsen’s Ten Heuristics (10)

1. Visibility of system status
   Keep users informed with feedback like progress bars or confirmation messages.

2. Match between system and real world
   Use language familiar to users, following real-world conventions for clarity and ease.

3. User control and freedom
   Provide options to undo or exit unwanted actions, like "Back" or "Undo" buttons.

4. Consistency and standards
   Ensure consistency in language and design. Follow platform conventions for clarity (e.g., "Search" vs. "Find").

5. Error prevention
   Design to prevent errors, such as validating form fields and requiring confirmation before actions.

6. Recognition rather than recall
   Make objects and options visible to reduce memory load; users shouldn't need to remember information.

7. Flexibility and efficiency of use
   Accommodate both new and experienced users with options like shortcuts for frequent actions.

8. Aesthetic and minimalist design
   Avoid irrelevant or excessive information. Keep designs simple and focused.

9. Help users recognize and recover from errors
   Use plain language for error messages, clearly explaining the issue and offering solutions.

10. Help and documentation
    Provide easy-to-search, task-focused help and documentation with clear, actionable steps.

Conducting a Heuristic Evaluation: Briefing, evaluation, and debriefing stages

Chapter 10: Usability Measurements

Usability (rev)

ISO 9241-11 standard definition: “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.

Importance of Usability Metrics

- Track progress between releases. (prototype ver.)
- Assess your competitive position.

Measuring Usability

- Task Time:
  - Record how long it takes users to complete a task. This measures efficiency and productivity. Start timing after users read the task and end when all actions are completed.
- Errors:
  - Track unintended actions or mistakes users make during tasks. Review and categorize errors (e.g., navigation error, selection error). Errors can help diagnose UI problems.
- Completion Rates/Task Success:
  - Measure task success by tracking whether users can achieve their goals. This is a binary metric (1 = success, 0 = failure), and it provides a simple way to assess usability.
- Page Views/Clicks:
  - Use tracking metrics like page views and clicks to see how users interact with websites or apps. This provides insight into navigation and interaction patterns.
- Conversion Rate:
  - Track the percentage of users who complete a specific action, like signing up or purchasing a product. Conversion rates reflect the system's ability to guide users toward their goals.
- Test Level Satisfaction:
  - Measure satisfaction through interviews, questionnaires (like SUS or SUPR-Q), or Net Promoter Score (NPS). These subjective measures capture users' feelings about the system.

❤️Example of Measuring Usability

Efficiency	Efficiency refers to the amount of effort (mental/cognitive or physical) users need to put in to achieve their goals: • Time taken on first attempt • Time to perform a particular task • Number of actions or steps taken by participants (more actions = more effort) Efficiency measures can be used to compare: • Two or more similar products or versions of a product, used by the same user groups for the same tasks in the same environments. • Two or more types of users using the same product for the same tasks in the same environment.

	• Two or more tasks performed by the same users on the same product in the same environment.
Effectiveness	Effectiveness refers to the accuracy and completeness with which users can achieve their goals: • Accuracy: Number of errors per unit of time. • Completeness Rate: Percent of users able to successfully complete the task (1 = complete, 0 = failed). Example: • Goal: Transcribe a 2-page written document into a PDF format with your new system. • Accuracy could be measured by the number of spelling mistakes. • Completeness could be measured by the number of words transcribed divided by the number of words in the source document.
Satisfaction	Satisfaction encompasses comfort and acceptability of use: • Comfort: Overall physiological or emotional responses to using the system (users feel good, warm, pleased, uncomfortable, etc.). • Acceptability: Overall attitude towards the system, such as: • Whether users feel that the system supports their tasks. • Do they feel in command of the system? • Is the system helpful and easy to learn? Measured by: • Percentage of customers who would recommend it to a friend after two hours of use **(Net Promoter Score, NPS**). • Percentage of customers rating the product as "more satisfying" than a previous product. • **Software Usability Measurement Inventory (SUMI) Questionnaire**: an internationally standardized 50-item questionnaire providing an overall assessment in 5 sub-scales: Affect, Efficiency, Helpfulness, Control, and Learnability.

How Many Users?

According to Nielsen:

💚qualitative testing 5 users are typically enough to gain insights.	💚quantitative testing (measuring time, errors), testing 20 users per design gives a high confidence interval.

Chapter 11: Ergonomics, Health & Safety

Ergonomics is the study of human beings in relation to their working environment and the engineering of that environment for comfort, efficiency, and safety.

The Goals of Ergonomics

To make work more comfortable

To improve worker productivity

To enhance both health and safety

When working environments are well designed (ergonomically correct), employees will be:

- Happier and healthier
- More productive
- Less likely to quit their jobs

Conversely, poorly designed (ergonomically incorrect) working environments, particularly when using a computer for extended periods, can lead to various illnesses and injuries, such as:

- Repetitive Strain Injury (RSI) is a type of injury caused by repeated movements. For example, a worker performing the same tasks repeatedly over long periods, such as keyboard operators (over 167 keystrokes per minute), may be at risk.
    - Some preventive measures include:
        - Keeping typing speed at a reasonable level
        - Taking regular breaks from repetitive tasks (to allow your body to rest)
        - Considering job redesign
- Eye Disorders: Sore eyes, Blurred vision, Red and watering eyes
    - Causes of eye disorders include:
        - Poor contrast
        - Very small font size
        - Inadequate lighting (too bright or too dull)
        - Screen flicker
        - Sitting too close to the screen
        - Focusing on something at a fixed distance for an extended time
- Back and Shoulder Pain

❤️Environment Factors (5)

Lighting:	Adequate lighting should be provided to allow users to perform tasks without discomfort or eyestrain. The more detail the user needs to see, the more important proper lighting becomes.
Noise Level:	Noise should be maintained at a comfortable level.

	Excessive noise can cause stress, higher blood pressure, and poor concentration.
Temperature:	Office temperature should be kept within a comfortable range. Performance can be negatively impacted by extremely high or low temperatures.
Workspaces:	The top of the screen should be positioned at eye level and 18” – 24” from the face. The keyboard should be kept at elbow height and easily movable around the desk to find the most comfortable position, preventing stress on the wrists.
Tables & Chairs:	The seat should be padded for comfort but firm enough to maintain good posture. There should be sufficient space under the desk. The edges of tables should be smooth and rounded.