CPT-208

1. Design I

a) Interaction Design

   i.   **Definition:** Designing interactive products to support the way people communicate and interact in their everyday and working lives.

   ii.   **Goal**:

      1. Develop usable products, Usability means easy to learn, effective to use, and provides an enjoyable experience.

      2. Involve users in the design process.

   iii.   **Core characteristics** of interaction design

      1. **Users should be involved** throughout the development of the project.

      2. **Specific usability** and **user experience goals** need to be **identified**, clearly documented, and agreed to at the beginning of the project

      3. **Iteration** is needed through the core activities

b) User Experience

   i.   Definition: How a product behaves and is used by people in the real world. We cannot **design** a user experience – only can design **for** a user experience.

   ii.   **Designers should understand users:**

      1. Understand how to design interactive products that fit with what people want, need, and may desire.

      2. Appreciate that one size does not fit all.

3. Identify any incorrect assumptions they may have about particular user groups.

4. Be aware of both people's sensitivities and their capabilities.

c) Accessibility and inclusiveness

   i. **Accessibility:** the extent to which an interactive product is **accessible** by as many people as possible. Focus is on people with disabilities; for instance, those using android OS or apple voiceover

   ii. **Inclusiveness:** making products and services that **accommodate** the widest possible number of people. For example, smartphones designed for all and made available to everyone regardless of their disability, education, age, or income.

d) Disability:

   i. Disabilities can be classified as:

      1. **Sensory impairmen**t such as loss of vision or hearing.

      2. **Physical impairmen**t having loss of functions to one or more parts of the body.

      3. **Cognitive** including learning impairment or loss of memory/cognitive function.

      4. Further definition: **Permanent/Temporary/Situational**

   ii. Being cool about disabilities.

e) Usability goals:

   i. Effective to use (**effectiveness**) – how good it is

ii.   Efficient to use (**efficiency**) – how easy / fast it is

iii.   Safe to use (**safety**)

iv.   Have good utility (**utility**)

v.   Easy to learn (**learnability**)

vi.   Easy to remember how to use (**memorability**)

f) User experience goals:

→ Desirable aspects
  → Satisfying   Helpful   Fun
  → Enjoyable   Motivating   Provocative
  → Engaging   Challenging   Surprising
  → Pleasurable   Enhancing sociability   Rewarding
  → Exciting   Supporting creativity   Emotionally fulfilling
  → Entertaining   Cognitively stimulating Experiencing flow
→ Undesirable aspects
  → Boring   Unpleasant
  → Frustrating   Patronizing
  → Making one feel guilty   Making one feel stupid
  → Annoying   Cutesy
  → Childish   Gimmicky

i.

ii.   **Difference between them:**

1. There is no clear cut between them.

2. Usability is more **objective**: how useful or productive a system is from its

    own perspective.

3. User experience is more **subjective**: how users experience an interactive

    product from their own perspective.

4. Trade-offs between the two kinds of goals: Can a product be both fun

    and safe?

5. Historically HCI was concerned primarily with **usability**, but it has since

    become concerned with understanding, designing for, and evaluating a

    wider range of **user experience aspects**.

g) **Design to persuade:** Tricks used in webs and apps that make you do things that you did not mean to.

h) **Key points:**

i. Interaction design is concerned with designing interactive products to support how people communicate and interact in their everyday and working lives

ii. It is concerned with how to create quality user experiences for services, devices, and interactive products

iii. It is multidisciplinary, involving many inputs from wide-reaching disciplines and fields

iv. Optimizing the interaction between users and interactive products requires consideration of a number of interdependent factors, including context of use, types of activity, UX goals, accessibility, cultural differences, and user groups.

v. Design principles, such as feedback and simplicity, are useful heuristics for informing, analyzing, and evaluating aspects of an interactive product

i) **Design Principles**

i. **Principles:**

1. **Visibility**

2. **Feedback**

3. **Constraints**

4. **Consistency**
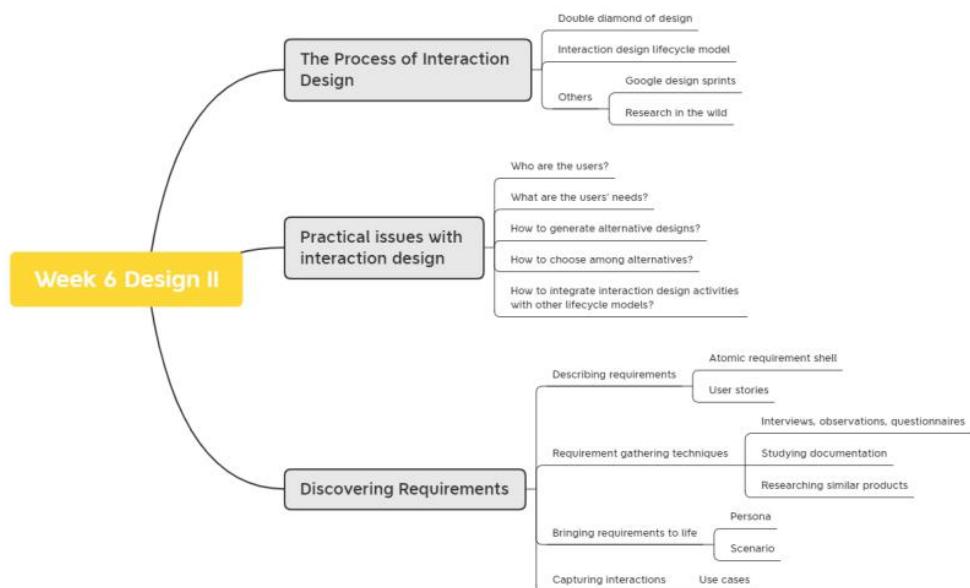
5. **Affordance**

ii. **Shneiderman' s Eight Golden Rules of Interface Design:**
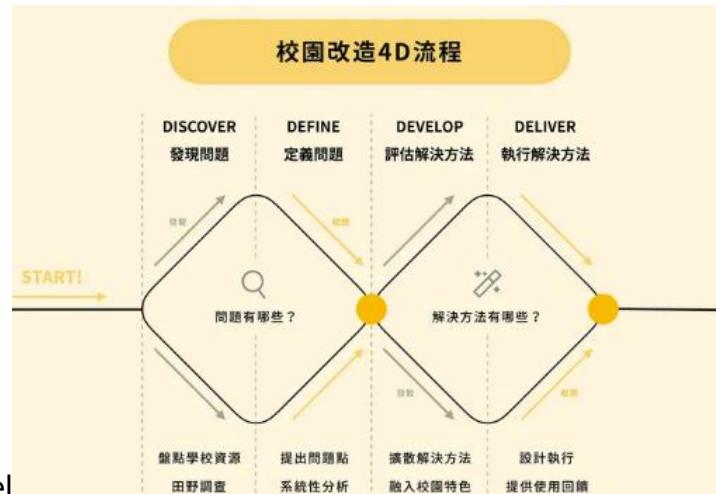
1. **Strive for consistency**

2. **Enable frequent users to use shortcuts**

3. **Offer informative feedback**

4. **Design dialog to yield closure**

5. **Offer simple error handling**

6. **Permit easy traversal of actions**

7. **Support internal locus of control**

8. **Reduce short-term memory load**

2. Design II

a) Mind map:

b) The Process of Interaction Design

i. Double Diamond Model

ii. Understanding the problem space:

1. **Explore**

   a) What is the current user experience?

   b) Why is a change needed?

   c) How will this change improve the situation?

2. **Articulating the problem space**

   a) Should be a team effort

   b) Explore different perspectives

   c) Avoid incorrect assumptions and unsupported claims

iii. Importance of **involving users**

   1. Understanding of users' goals leading to better products

   2. Expectation management

      i. Realistic expectations

      ii. No surprises, no disappointments

      iii. Timely training

      iv. Communication, but no hype

3. Ownership

    i. Make the users active stakeholders

    ii. More likely to forgive or accept problems

    iii. Can make a big difference in acceptance and success of product

iv. Degrees of user involvement

1. Member of the design team:

    a) **Full-time**: constant input, but lose touch with users

    b) **Part-time**: patchy input, and very stressful

    c) **Participatory design**: involve all stakeholders in the early stages of design

2. Face-to-face group or individual activities

3. Online contributions from thousands of users:

    a) Online Feedback Exchange (OFE) systems

    b) Crowdsourcing design ideas

    c) Citizen science

4. User involvement **after product release**: Customer review analysis

v. User-centered approach: **3 principles**

1. **Early focus on users and tasks**: directly studying **cognitive, behavioral, anthropomorphic, and attitudinal** characteristics

2. **Empirical measurement:** users' reactions and performance to scenarios, manuals, simulations, and prototypes are observed, recorded, and analyzed

3. **Iterative design**: when problems are found in user testing, fix them and carry out more tests

   vi. **4 basic activities of interaction design [Lifecycle model]**

      1. **Discovering requirements** for the interactive product.

      2. **Designing alternatives** that meet those requirements.

      3. **Prototyping** the alternative designs so that they can be communicated and assessed.

      4. **Evaluating the product** and the user experience it offers throughout the process.

   vii. **Early focus** on users and tasks

      1. **Users' tasks and goals** are the driving force behind the development.

      2. **Users' behavior and context of use** are studied, and the system is designed to support them.

      3. **Users' characteristics** are captured and designed for.

      4. Users are **consulted** throughout development from earliest phases to the latest.

      5. All design decisions are taken within the context of the **users**, their **activities**, and their **environment**.

c) **Practical issues with interaction design**

   i. **Questions should be clarified:**

      1. Who are the **users/stakeholders**?

      2. What are the **users' needs**?

a) Focus on peoples' goals, usability, and user experience goals, rather than expect stakeholders to articulate requirements

3. How to generate **alternative designs**?

   a) 'Flair and creativity': research and synthesis

   b) Cross-fertilization of ideas from different perspectives

   c) Users can generate different designs

   d) Product evolution based on changing use

   e) Seek inspiration: similar products and domain, or different products and domain

   f) Balancing constraints and trade-offs

4. How to choose **among alternatives**?

   a) Interaction design focuses on externally-visible and measurable behavior

   b) Considering technical feasibility

   c) Evaluation with users and stakeholders with demo instead of doc

   d) 所谓 AB test，就是测试用户对某个产品同一个元素A和B两个版本（只有这个元素不同）的反应差异，从而进行后续取舍判断。

   e) Quality threshold

5. How to **integrate interaction design** activities with other lifecycle models?

   a) Integrating with **agile software development** is promising because: It incorporates tight iteration.

   b) It champions early and regular feedback.

c) It handles emergent requirements.

d) It aims to strike a balance between flexibility and structure.

d) Discovering Requirements

   i. **The purpose:**

     1. Explore the problem space to gain insights

     2. Establish a description of what will be developed

   ii. **How to capture requirements:**

     1. Through **structured or rigorous notations**

     2. Good to be **explicit** to keep record of key requirements

     3. Different capturing mechanisms **emphasize and de-emphasize** different

       aspects

   iii. **Why?** Requirements activity is the stage where **miscommunication occurs**

     most commonly

   iv. **What are the requirements?**

     1. A **statement** about an intended product that specifies **what it is expected**

       to do or how it will perform

     2. Different forms and different **levels of abstraction** → **Atomic requirement**

       shell → **User stories**

Atomic requirement shell

Requirement #: **75**   Requirement Type: **9**   Event/use case #: **6**

Description: The product shall issue an alert if a weather station fails to transmit readings.

Rationale: Failure to transmit readings might indicate that the weather station is faulty and needs maintenance, and that the data used to predict freezing roads may be incomplete.

Source: Road Engineers
Fit Criterion: For each weather station the product shall communicate to the user when the recorded number of each type of reading per hour is not within the manufacturer's specified range of the expected number of readings per hour.

Customer Satisfaction: **3**   Customer Dissatisfaction: **5**
Dependencies: **None**   Conflicts: **None**
Supporting Materials: **Specification of Rosa Weather Station**
History: **Raised by GBS, 28 July**

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3.

Group C3

→ As a user, I want to have an improved **social community feature** on the sports app, similar to Keep app, so that I can connect with other fitness enthusiasts, share my progress and receive motivation from the community.
  → As a user, I want to have **a profile page** on the app, so that I can customize my personal information and view my fitness progress.
  → As a user, I want to **join fitness groups or communities**, so that I can connect with other fitness enthusiasts and receive motivation from them.
  → As a user, I want to have **a leaderboard function**, so that I can compete with other users and motivate myself to achieve my fitness goals.
  → As a user, I want to have **a chat function**, so that I can communicate with other users in real-time and receive motivation and support from them.
  → As a user, I want to have **a feature that allows me to share my fitness progress on social media**, so that I can inspire my friends and receive encouragement from them.

4.

v.   Different kinds of requirements

1. Functional requirements: As a video game, it will be challenging for a range of user abilities

2. Non-Functional requirements: As a video game, it can run on a variety of platforms, such as the Microsoft Xbox, Sony PlayStation, and Nintendo Switch game systems.

   a) Data requirements: What kind of/How will they be stored

   b) Environment requirements

   c) Users characteristics

   d) Usability goals

   e) User experience goals

The seven product dimensions

User	Interface	Action	Data	Control	Environment	Quality Attribute
Users interact with the product	The product connects to users, systems, and devices	The product provides capabilities for users	The product includes a repository of data and useful information	The product enforces constraints	The product conforms to physical properties and technology platforms	The product has certain properties that qualify its operation and development

vi.

vii. **Data gathering methods:**

1. Observation (direct and indirect)

2. Interviews (individual and group)

3. Diaries

4. **Surveys**

5. Think-aloud evaluation

6. Working prototype evaluation

7. Studying documentation

8. Evaluating other systems

9. Ethnographic study

10. Usability tests

viii. Contextual study(4 main topic): for UX study

1. **Context:** Going to the user, wherever they are, and seeing what they do as they do it

2. **Partnership:** User and interviewer explore user's life together

3. **Interpretation:** Observations interpreted by user and interviewer together

4. **Focus:** Project focus to understand to what should be paid attention

5. **Interview guided by 7 concepts:**

   a) **Joy of life concepts** (How products make our lives richer and more fulfilling) → Accomplish (empower users) → Connection (enhance real relationships) → Identity (support users' sense of self) → Sensation (pleasurable moments)

   b) **Joy of use concepts** (Describe impact of using the product) → Direct in action (provide fulfillment of intent) → The hassle factor (remove all glitches and inconveniences) → The learning delta (reduce the time to learn)
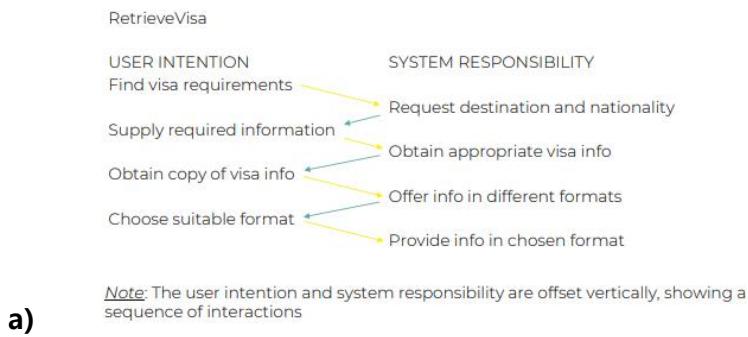
ix. Brainstorming for innovation

   1. Include participants from a wide range of disciplines, with a broad range of experience

   2. Don't ban silly stuff

   3. Use catalysts for further inspiration

   4. Keep records. Capture every idea, without censoring

   5. Sharpen the focus

   6. Use warm-up exercises and make the session fun

x. Augmenting the basic requirements expressed as **user stories/personas/scenarios**

xi. **User cases:** Use cases are step-by-step descriptions of interactions, user stories focuses on outcomes and user goals

1. **Essential use cases:** division of tasks, no implementation detail

a)

RetrieveVisa

USER INTENTION ... SYSTEM RESPONSIBILITY
Find visa requirements → Request destination and nationality
Supply required information → Obtain appropriate visa info
Obtain copy of visa info → Offer info in different formats
Choose suitable format → Provide info in chosen format

Note: The user intention and system responsibility are offset vertically, showing a sequence of interactions

2. **Use case with normal and alternative courses:** more detail

a)

1. The product asks for the name of the destination country
2. The user provides the country's name
3. The product checks that the country is valid
4. The product asks the user for their nationality
5. The user provides their nationality
6. The product checks the visa requirements of that country for a passport holder of the user's nationality
7. The product provides the visa requirements
8. The product asks whether the user wants to share the visa requirements on social media
9. The user provides appropriate social media information

Some alternative courses:
→ 4. If the country name is invalid:
   → 4.1: The product provides an error message
   → 4.2: The product returns to step 1
→ 6. If the nationality is invalid:
   → 6.1: The product provides an error message
   → 6.2: The product returns to step 4
→ 7. If no information about visa requirements is found:
   → 7.1: The product provides a suitable message
   → 7.2: The product returns to step 1

e) **Key points:**

i. **Four basic activities in interaction design process** → Discovering requirements → Designing alternatives → Prototyping → Evaluating

ii. **User-centered design** rests on **three principles** → Early focus on users and tasks → Empirical measurement using quantifiable and measurable usability criteria → Iterative design

iii. A requirement is a statement about an intended product that specifies what it is expected to do or how it will perform.

iv. Articulating requirements **avoids miscommunication** and supports technical developers and users to contribute.

v. Different **kinds of requirements**: functional, data, environmental (context of use), user characteristics, usability goals, and user experience goals.

vi. Requirements **data gathering** methods: questionnaires, interviews, observation,

studying documentation, and similar products

    vii.   **Scenarios** are a story-based narrative to explore existing behavior, potential of new products, and futuristic visions of use.

   viii.   **Personas** capture characteristics of typical users that are relevant to the product under development. Scenarios and personas together bring requirements to life.

     ix.   **Use cases** capture details about an existing or imagined interaction between users and the product

3. Design III

a)   **Visualization:** Computer-based visualization systems provide visual representations of datasets intended to help people carry out some tasks more effectively.

    i.   **Representation** of objects users pay attention to.

    ii.   **Interactions** which are operations users can apply.

   iii.   Visual marks: Points/Lines/Areas

   iv.   Visual variables: Shape/Size/Value/Orientation/Color/Texture

b)   **Interaction type: Instructing / Conversing / Manipulating / Exploring / Responding**

Interaction types

- Instructing
  - issuing commands and selecting options
- Conversing
  - interacting with a system as if having a conversation
- Manipulating
  - interacting with objects in a virtual or physical space by manipulating them
- Exploring
  - moving through a virtual environment or a physical space

i. **Touch / Pen-based Interaction**

1. Pros:

   a) fast, precise, direct

   b) increase the user's impression they are making direct manipulations

2. Cons:

   a) limited: used as a discrete interaction mechanism

   b) limiting: many complex tasks (in particular for 3D manipulations)

      require input/control with more than three degrees of freedom

ii. **Tangible Interaction**

1. Pros:

   a) allow users to achieve complex 3D manipulations with simple

      real-world style gestures

   b) more flexible than other interaction paradigms

   c) Manipulations with these devices can be programmed to feel realistic,

      as they would in the real world

2. Cons

a) Need extra devices

b) Sometimes, difficult to manipulate

iii. Mid-air gestural interaction

1. Pros:

   a) touchless interaction

   b) mimics the physical actions we make in the real world

2. Cons:

   a) Not precise

   b) Sometimes, difficult to control

iv. Hybrid interaction

1. combine multiple interaction paradigms together

2. overcome the inherent limitations of a device

   a) augmenting the number of DOF that can be manipulated

   b) reduce the occlusion limitation with tactile interaction

3. combine the benefits of two interaction(触觉、无触觉) paradigms

4. simply tackle complicated tasks

c) Input and output devices of spatial user interface with 3D data

i. Input:

1. Tactile and pen-based

2. Tangible and haptic

3. Mid-air gestural

4. Hybrid

     5. Voice

  ii.   Output:

    1. 2D projection

    2. Mobile device

    3. Augmented Reality

    4. Virtual Reality

d) 20 interface types

20 Interface types covered

1. Command	11. Gesture
2. Graphical	12. Haptic
3. Multimedia	13. Multimodal
4. Virtual reality	14. Shareable
5. Web	15. Tangible
6. Mobile	16. Augmented reality
7. Appliance	17. Wearables
8. Voice	18. Robots and drones
9. Pen	19. Brain–computer interaction
10. Touch	20. Smart

4.Prototyping I

a) Introduction of prototyping

  i.   What is a prototype

    1. Instead of an object, it is more a way of thinking.

    2. It could be: a series of **screen sketches** ➔ a **storyboard**, i.e., a cartoon-like series of scenes ➔ a **PowerPoint slide** show ➔ a **video simulating the use of a system** ➔ a **lump of wood** (e.g., PalmPilot) ➔ a **cardboard mock-up** ➔ **a piece of software with limited functionality written in**

the target language or in another language

ii.   Why should prototype

    1.   Evaluation and feedback are central to interaction design

    2.   **Stakeholders** can see, hold, interact with a prototype more easily than a

        document or a drawing

    3.   **Team members** can communicate effectively

    4.   **You can test** out ideas for yourself

    5.   It **encourages reflection**: very important aspect of design

    6.   Support designers in **choosing between alternatives**

iii.   Prototype could help you to **understand**:

    1.   Design alternatives: Design more to know if it possible

    2.   Strategy: Make your design from intangible to tangible, know their pros and

        cons.

    3.   User-centered processes: Prototype could build **empathy** between

        designers and users with concrete ideas.

        a)   **Empathy map** and **User journey map (Based on persona)**

iv.   Prototype could help you to **communication**:

    1.   Same "language"

    2.   Different stakeholder

    3.   No "maybe"

v.   Prototype could help you to **Test and reflection**:
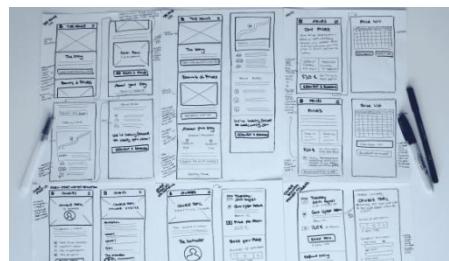
    1.   Hypotheses and assumptions

a) When we begin the design, we have to make assumptions no matter how hard we try to understand users. **The only way to find the answer is to let them play with a mock system, like you need to practice before the presentation**.

2. Other's comments

a) The prototype is an opportunity for you to present and promote the idea to peers.

b) Fidelity in prototyping

  i. What is fidelity

    1. The fidelity of a prototype refers to how it conveys the **look-and-feel of the final product** (basically, its level of **detail and realism**). Select the right level of fidelity in prototyping is **the key to the success** of design process.

    2. **Low-fidelity Prototyping** Is **quick, cheap and easily changed like:**

      a) sketches of screens

      b) task sequences:

      c) 'Post-it' notes:

d) Storyboards: Early stage

e) 'Wizard-of-Oz': The user thinks they are interacting with a computer, but a developer is responding to output rather than the system.
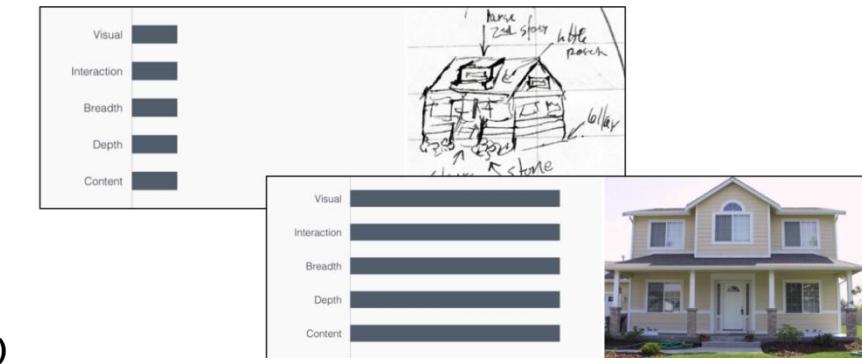
3. **High-fidelity prototyping** Uses materials that you would expect to be in the final product.

4. **Compromises in prototypes**

   a) **Horizontal:** wide range of functions with little detail

   b) **Vertical:** lot of detail for only a few functions

5. **There is no clear separations between low- or high- fidelity, so we use a spectrum(频谱)**

      a)

ii.   **Key points:**

    1. Features of prototyping

    2. Prototyping is important in

        a) Understanding

        b) Communication

        c) Test and reflection

    3. Low- vs. High-fidelity prototyping

        a) Examples of prototyping

    4. No "low fidelity" versus "high fidelity" in a generic way. Instead, refer to the primary dimensions and why they matter for your prototype.

5. Prototyping II

a) **Dimensions** in prototyping

    i.   **Visual:** How real does it look?

        1. It is the most direct dimension that user feels about the prototype

        2. Refers to the devotion and granularity put into the design for visual interfaces and physical objects

        3. Actions/procedures/concepts for **early stage**

4. Accessibility/touch/visual details for **later stage**

5. The **big, obvious problem** involves jumping to high visual fidelity too early in the process

6. Designers should sometimes intentionally **keep visual fidelity low** to encourage the kind of communication and feedback they want

ii. **Interaction:** How real does it feel?

1. Refers to the objective degree of exactness with which real-world interactions can be reproduced

2. Users can click, tap, and swipe through screens and get the feel.

3. It allowed the team to quickly and cheaply test hundreds of variations.

iii. **Breadth:** To what degree is this the whole or just a part?

1. Choosing where to draw the lines of your prototype's edges sets up its breadth

iv. **Depth:** At a given level of breadth, to what degree is the user constrained?

v. **Content:** How real is the stuff and is it contextual to the user?

b) **Physical design**

i. **Concrete Design** vs Conceptual design

1. Considers more concrete, **detailed issues of designing the interface**

a) Guidelines for physical design:

i. Nielsen's heuristics

ii. Shneiderman's eight golden rules

iii. Styles guides: commercial, corporate decide 'look and feel' for your widgets prescribed, e.g., icons, toolbar

b) Widgets:

i. menu design

ii. icon design: Meaning of icons is cultural and context sensitive

1. always draw on existing traditions or standards

2. concrete objects or things are easier to represent than actions

iii. screen design:

1. How to split across screens

a) Frustration if too many simple screens

b) multiple screens open at once

2. Individual screen design

a) **Draw user attention to salient** point. Animation is very powerful but can be distracting. Have good organization.

b) **Trade off between sparse population and overcrowdin**g

iv. Information display

1. Relevant information available at all times

2. Different types of information imply different kinds of display

3. Consistency between paper display and screen data entry

c) **Tips for prototyping**

i. The type of prototyping:

1. **Throw-away**

a) prototype only serves to elicit user reaction

b) creating prototype must be rapid, otherwise too expensive

2. **Incremental**

a) product built as separate components (modules)

b) each component prototyped and tested, then added to the final system

3. **Evolutionary**

a) prototype altered to incorporate design changes

b) eventually becomes the final product

Ideation	Low fidelity paper sketches
Conceptual design	Low fidelity paper sketches, storyboards
Intermediate design	Low to medium fidelity wireframes
Detailed design	High fidelity wireframes, programmed prototypes

4.

ii. Cautions:

1. Rationalize cost-value trade-offs

2. Do not oversell

3. Do not overbuild

4. Decide early on exploratory or evolutionary prototypes

d) **Summary:**

i. No "low fidelity" versus "high fidelity" in a generic way. Instead, refer to the primary dimensions and why they matter for your prototype.

ii. Ask yourself if you are controlling the less obvious dimensions. Will any of them create an unintended distraction or hindrance during your tests?

iii. The levels of each dimension.

iv.   Articulate how your prototype connects to your key research questions.

v.   Ask if you're picking the right fidelity to answer those questions fairly and

efficiently

vi.   Different kinds of prototyping are used for different purposes and at different

stages

vii.   Prototypes answer questions, so prototype appropriately

viii.   Physical design: e.g., menus, icons, screen design, information display

ix.   Prototypes and scenarios are used throughout design

6.Prototyping III

a)   **Processes**

i.   **Start -> The minimum viable product(最小可行产品)(MVP): A product with**

enough features to attract early   adopter customers and validate a product

idea early in the product development cycle.

1.   **MVP 的 steps，如何根据 needs 来设计原型?**

→ Understand your users and **identify the problem**

→ Write down the user flow

→ Use the prototype to optimize the user flow

→ Test, refine, iterate

ii.   **Generate lots of different solutions for a problem -> Exploration**

→ Find the right issue to solve

→ Find solutions

→ Identify where we are now

流程：

1. Brainstorming about issues/solutions

2. Clustering and categorization

3. Priority check

iii. **Communicate or advocate for a certain direction -> Specific audience：**

Focusing on specific audience makes you maintain a smooth

communication with different stakeholder.

→ Identify your audience, purpose, and fidelity

→ Tools for different stakeholders: designer/sponsor/developer

→ Present

iv. **Have a question or assumption to test -> Assumptions**

→ **Understand your audience, issues, and assumptions**

→ **Fidelity**

→ **Purpose of the testing**

→ **Make and test**
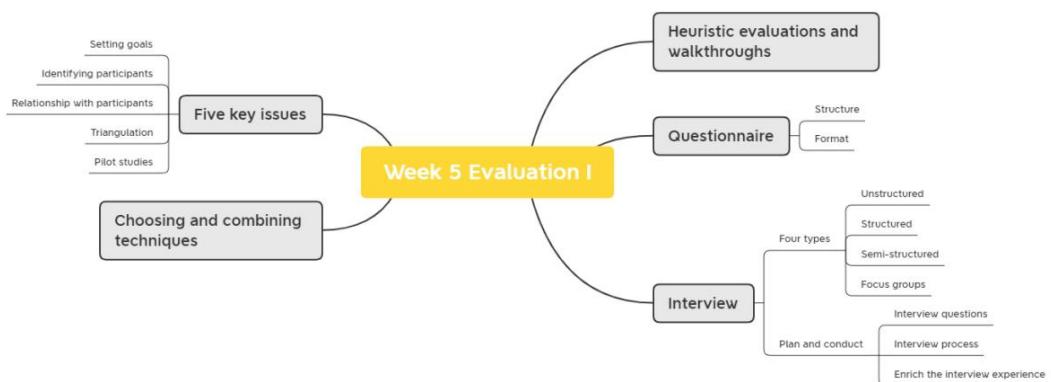
b) **Digital prototyping**

i. ➔ **Screen**

ii. ➔ **Responsive design mobile/desktop**

iii. ➔ **Interaction types** 见 design 3 部分

iv. ➔ **Accessibility**

v. ➔ **Animation:** Design as earlier as possible to create space for designers to

implement

c) **Physical prototyping**

   i. ➔ **Electronic technology**

   ii. ➔ **Compatibility**

      1. ➔ You need to make the coding between different devices compatible

      2. ➔ Reliability and consistency

      3. ➔ Robust and free from errors (connection lost, signal errors)

   iii. ➔ **Material and tactility**

      1. ➔ Where? The context of the device

      2. ➔ How? How users interact with the device

      3. ➔ When? How frequently or time range

      4. ➔ Who? Who will use it

      5. ➔ Sustainability? Disposable or not

7. Evaluation I

a)

b) **Heuristic Evaluation**

i. Developed by Jacob Nielsen in the early 1990s. Based on heuristics distilled from an empirical analysis of 249 usability problems

ii. **Nielsen's heuristics:**

1. **Visibility of system status**

2. **Match between system and real world**

3. **User control and freedom -> unwanted action**

4. **Consistency and standards**

5. **Error prevention -> prevent problems**

6. **Recognition rather than recall -> Memory load**

7. **Flexibility and efficiency of use -> Frequent actions**

8. **Aesthetic and minimalist design**

9. **Help users recognize, diagnose, recover from errors**

10. **Help and documentation**

iii. **Shneiderman's Eight Golden Rules**

1. **Strive for consistency.**

2. **Seek universal usability.**

3. **Offer informative feedback.**

4. **Design dialogs to yield closure.**

5. **Prevent errors.**

6. **Permit easy reversal of actions.**

7. **Keep users in control.**

8. **Reduce short-term memory load.**

iv. Number of evaluators and problems

1. Nielsen suggests that on average **five evaluator**s identify **75-80 percent** of usability problems

2. Cockton and Woolrych (2001) point out that the number of users **needed to find 75-80 percent of usability problems** depends on the context and nature of the task problems

v. **The process of heuristic evaluation**

1. Briefing session to tell experts what to do

2. Evaluation period of 1-2 hours in which:

    a) Each expert works separately

    b) Take one pass to get a feel for the product

    c) Take a second pass to focus on specific features

3. Debriefing session in which experts work together to prioritize problems

4. A **more detailed** process:

    a) **Know what to test and how** – Whether it's the entire product or one procedure, clearly define the parameters of what to test and the objective.

    b) **Know your users and have clear definition**s of the target audience's goals, contexts, etc. User personas can help evaluators see things from the users' perspectives.

    c) **Select 3–5 evaluators**, ensuring their expertise in usability and

the relevant industry.

d) **Define the heuristics** (around 5–10) – This will depend on the nature of the system/product/design. Consider adopting/adapting the Nielsen-Molich heuristics and/or using/defining others.

e) **Brief evaluators on what to cover** in a selection of tasks, suggesting a scale of severity codes (e.g., critical) to flag issues.

f) **1st Walkthrough** – Have evaluators use the product **freely** so they can identify elements to analyze.

g) **2nd Walkthrough** – Evaluators scrutinize individual elements **according to the heuristics**. They also examine how these fit into the overall design, clearly recording all issues encountered.

h) **Debrief evaluators** in a session so they can collate results for analysis and suggest fixes.

vi. Advantages

1. Few ethical and practical issues to consider because users are not involved

vii. Problems

1. Can be difficult and expensive to find experts

2. Best experts have knowledge of application domain and users

3. Important problems may get missed

4. Many trivial problems are often identified, such as false alarms

5. Experts have biases

viii. Cognitive walkthroughs:

1. Simulating how users go about problem-solving at each step in a human-computer interaction. Focus on ease of learning.

2. **Preparations**

   a) Identify and document the **characteristics of typical users.**

   b) Develop **sample tasks**, focusing on the aspects of the design.

   c) Produce a **description, mock-up, or prototype** of the interface to be developed, along with a clear sequence of the actions needed for the users to complete the task.

3. A designer and one or more researchers come together to do the analysis.

4. The researchers walk through the **action sequences** for each task, placing it within the context of a typical scenario. As they do this, they try to answer three questions.

5. Compile a record of critical information – assumptions, notes of issues and design changes, etc.

6. (Check with real users and) Revise the design to fix the problems presented.

7. **Three questions to ask of each action sequences:**

a) Will the **correct action** be sufficiently evident to the user? → Users know what to do

b) Will the user notice that **the correct action is available**? → Users know how to do it

c) Will the user **associate and interpret** the response from the action correctly? → Users understand the feedback

c) **Questionnaire:**

i. **Pros**

1. Can collect data from a large number of people, at a relatively low cost

2. Can get an overview of a population of users in a short amount of time

3. Surveys do not require any special equipment

4. Surveys are generally approved by institutional review boards because they are typically non-intrusive

ii. **Cons**

1. Surveys are good at getting shallow data from a large number of people, but are not good at getting "deep" data

2. Since surveys are usually self-administered, it is usually not possible to ask follow-up questions

3. Surveys can lead to biased data when the questions are related to patterns of usage, or feelings about a previous experience, rather

than clear factual phenomena → Example recall question: how many times did you use this software application over 6 months?

iii. How to deploy?

1. Plan the timeline

2. Design the questionnaire offline

3. Program/complete online survey

4. Test the survey to make sure that it behaves as you would expect

5. Test it with a group that will not be part of the survey to check that the questions are clear

6. Recruit participants

d) Interview:

i. **Types:**

1. **Unstructured:** Not directed by a script. Rich but not replicable.

2. **Structured**: Tightly scripted, often like a questionnaire. Replicable but may lack richness.

3. **Semi-structured:** Guided by a script, but interesting issues can be explored in more depth. Can provide a good balance between richness and replicability.

4. **Focus groups:** A group interview

5. **Question types:**

a) Closed questions

b) Open questions

6. **Cautions: Avoid**

   a) Long questions

   b) Compound sentences

   c) Jargon and language that may not be understood

   d) Leading questions

   e) Unconscious biases

7. **Interview process**:

   a) Introduction: Introduce yourself, **explain the goals of the interview**, reassure about the ethical issues, ask to record, and present the informed consent form.

   b) **Warm-up**: Make **first questions easy and non-threatening.** Build **rapport.**

   c) Main body: Present questions in **a logical order**

   d) A cool-off period: Include **a few easy questions** to defuse tension at the end

   e) Closure: Thank interviewee, signal the end, for example, **switch recorder off**.

8. Pros and Cons

   a) Pros

      i. **Go deep:** encourage reflection and consideration

      ii. **Flexible:** open-ended and exploratory

   b) Cons

i. **Skill** to manage

ii. **Time and resource** intensive

iii. **Data analysis**

iv. **Recall** problems

e) **Five key issues of data collection:**
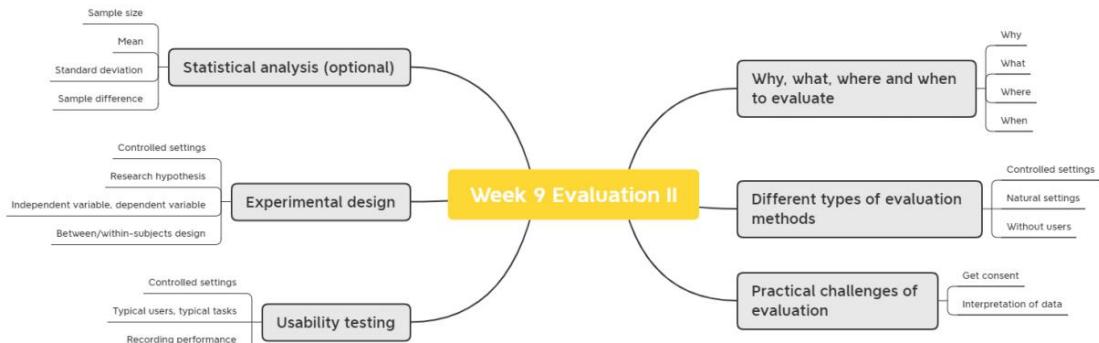
1. **Setting goals**

   a) → What information to collect

   b) → How to analyze data once collected

2. **Identifying participants**

   a) → Decide from whom to gather data and how many

3. **Relationship** with participants

   a) → Clear and professional

   b) → Informed consent when appropriate

4. **Triangulation**

   a) → Look at data from **more than one perspective**

   b) → Collect **more than one type of data**, for instance, quantitative

      data from experiments and qualitative data from interviews

5. **Pilot studies!!!!!!**

f) **Summary：**

1. ➜ **Questionnaires may be on paper, online, or telephone**

2. ➜ **Interviews may be structured, semi-structured, or unstructured**

3. ➜ **Focus groups are group interviews**

4. ➔ **Observation may be direct or indirect, in the field, or in controlled settings**

5. ➔ **Techniques can be combined depending on the study focus, participants, nature of technique, and available resources and time**

6. ➔ **Data may be recorded using handwritten notes, audio or video recording, a camera, or any combination of these**

7. ➔ **Data gathering sessions should have clear goals**

8. ➔ **An informed consent may be needed**

9. ➔ **Five key issues of data gathering are: goals, choosing participants, participant relationship, triangulation, pilot**

8.Evaluation II

a)

b) **Why, what, where, and when to evaluate**

 i. **Why:** To check users' requirements and confirm that users can utilize the product and that they like it

 ii. **What:** A conceptual model, early and subsequent prototypes of a new system, more complete prototypes, and a prototype to compare with

competitors' products

    iii.   **Where:** In natural, in-the-wild, and laboratory settings

    iv.   **When:** Throughout design; finished products can be evaluated to collect information to inform new products

c) Difference between **Micro-HCI** and **Macro-HCI**

→ Time performance	→ Motivation
→ Task correctness / accuracy	→ Collaboration
	→ Social participation
→ Error rate	→ Trust
→ Time to learn	→ Empathy
→ Retention over time	→ …
→ User satisfaction	
→ …	

d) **Different types of evaluation method**

    i.   **Controlled settings that directly involve users** → For example, usability and research labs

    ii.   **Natural settings involving users** → For instance, online communities and products that are used in public places→ Often there is **little or no control over what users do**, especially in in-the-wild settings

    iii.   Setting that does not directly involve users → consultants and researchers critique the prototypes, and may predict and model how successful they will be when used by users

e) **Practical challenges of evaluation**

    i.   Participants need to be told why the evaluation is being done, what

they will be asked to do and informed about their rights

    ii.   Informed consent forms provide this information and act as a contract between participants and researchers

f) Interpreting data

    i.   **Reliability:** Does the method produce the same results on separate occasions?

    ii.   **Validity:** Does the method measure what it is intended to measure?

    iii.   **Ecological validity:** Does the environment of the evaluation distort the results?

    iv.   **Biases:** Are there biases that distort the results?

    v.   **Scope:** How generalizable are the results?

g) Usability test

    i.   **Procedure:**

        1. Test on controlled settings

        2. Users are observed and timed

        3. Data is recorded on video, and key presses are logged

        4. The data is used to calculate performance times and to identify and explain errors

        5. User satisfaction is evaluated using questionnaires and interviews

        6. Field observations may be used to provide contextual understanding

        7. Involves recording performance of typical users doing typical tasks

    ii.   Test conditions

        1. Usability lab or other controlled space

        2. Selecting representative users

        3. Developing representative tasks

        4. 5-10 users typically selected

        5. Task around 30 minutes

    iii.   The experiments

        1. Usability testing is applied experimentation

        2. Developers **check that the system is usable by the intended user population** by collecting data about participants` performance on prescribed tasks

        3. Experiments test **hypotheses** to discover new knowledge by **investigating the relationship between two or more variables**

        4. **The difference between Usability test and experiments**

Usability Testing	Experiments for Research
→ Improve products	→ Discover knowledge
→ Few participants	→ Many participants
→ Results inform design	→ Results validated statistically
→ Usually not completely replicable	→ Must be replicable
→ Conditions controlled as much as possible	→ Strongly controlled conditions
→ Procedure planned	→ Experimental design
→ Results reported to developers	→ Scientific report to scientific community

h) Quantitative performance measures

    i.   Number of users successfully completing the task

    ii.   Time to complete task

    iii. Time to complete task after time away from task

    iv.   Number and type of errors per task

    v.   Number of errors per unit of time

    vi.   Number of navigations to online help or manuals

    vii.   Number of users making a particular type of error

    viii.   Count and calculate data

i) Experimental design

    i.   Definitions:

      1. Test **hypothesis**

        a) a hypothesis is a **precise problem statement** that can be **directly tested through an empirical investigation**

Types of Hypotheses

→ Null hypothesis: typically states that there is no difference between experimental treatments
→ Alternative hypothesis: a statement that is mutually exclusive with the null hypothesis
→ The goal of an experiment is to find statistical evidence to reject the null hypothesis in order to support the alternative hypothesis

        b)

      2. Predict the **relationship** between two or more variables

      3. **Independent variable** is manipulated by the researcher

      4. **Dependent variable** influenced by the independent variable

      5. Typical experimental designs have **one or two independent variables**

      6. Validated **statistically and replicable**

    ii.   Type of experiment design:

1. **Between subjects** design

   a) **Different participants**

   b) **Single group of participants is allocated randomly to the experimental conditions**

   c) **Advantage:** No order effects

   d) **Disadvantage:** Individual differences

2. **Within subjects** design

   a) **Same participants**

   b) **All participants appear in both conditions**

   c) **Advantage:** Few individuals, no individual differences

   d) **Disadvantage:** Counter-balancing needed because of order

iii. **Process:**

   1. Identify a research hypothesis

   2. Specify the design of the study

   3. Run a pilot study to test the design, the system, and the study instruments

   4. Recruit participants

   5. Run the actual data collection sessions:

      a) Preparation

      b) Greet participants

      c) Introduce the purpose of the study and the procedures

      d) Get consent

e) Assign participants to a specific experiment condition

f) Training task(s)

g) Actual task(s)

h) Participants answer questionnaires (if any)

i) Debriefing session

j) Payment (if any)

6. Analyze the data

7. Report the results

j) Data analysis: 学会在 excel 上做数据分析

9.Evaluation III

a) Recap:

    i. Controlled settings:

      1. Usability testing

      2. Experimental design

    ii. Natural settings:

      1. Field study

    iii. Without users: heuristic evaluation

b) **Observation:**

    i. Direct observation:

      1. In the field

        a) how involved you will be

        b) How to gain acceptance

       c) How to handle sensitive topics, for example, culture, private spaces, and so on

       d) How to collect the data

   2. In controlled environments

       a) Think aloud techniques

       b) Tracking users' activities

       c) Video, audio, photos, and notes are used to capture data in both direct and indirect observations

  ii. Indirect observation:

   1. Tracking users' activities

       a) Diaries

       b) Interaction logging

       c) Video and photographs collected remotely by drones or other equipment

c) Natural settings (in the wild):

  i. Field study:

   1. Used to:

       a) Identify opportunities for new technology

       b) Determine design requirements

       c) Decide how best to introduce new technology

       d) Evaluate technology in use

   2. 流程:

- a) 确定 goal
- b) Data collection and participants
- c) Data analysis and presentation

d) Without users:

 i. Heuristic evaluations and walkthroughs 见 evaluation I 和 II

 ii. Analytics 应用自动记录数据 / 网页分析

 iii. A/B testing

  1. A **large-scale** experiment (thousands of participants or more)

  2. **Offers another way to evaluate a website**, application of app running on a mobile device

  3. Often **used for evaluating changes in design** on **social media** applications

  4. Compares **how two groups of users perform on two versions of a design**

  5. May create ethical dilemmas if users don't know they are part of the test

 iv. Predictive models

  1. ➔ **Provide a way of evaluating products or designs without directly involving users, less expensive than user testing**

  2. ➔ **Use formulas to derive various measures of user performance**

  3. ➔ **Usefulness limited to systems with predictable tasks, for example, voicemail systems, smartphones, and dedicated mobile**

devices