Construction of User Interfaces (SE/ComS 319)

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DESIGNING THE USER INTERFACES

Outline

- User interfaces
  - UI vs. UX
- UI Design process
- UX Design
- Case Study: Mobile Web UX Design
- User interface development process

User interface

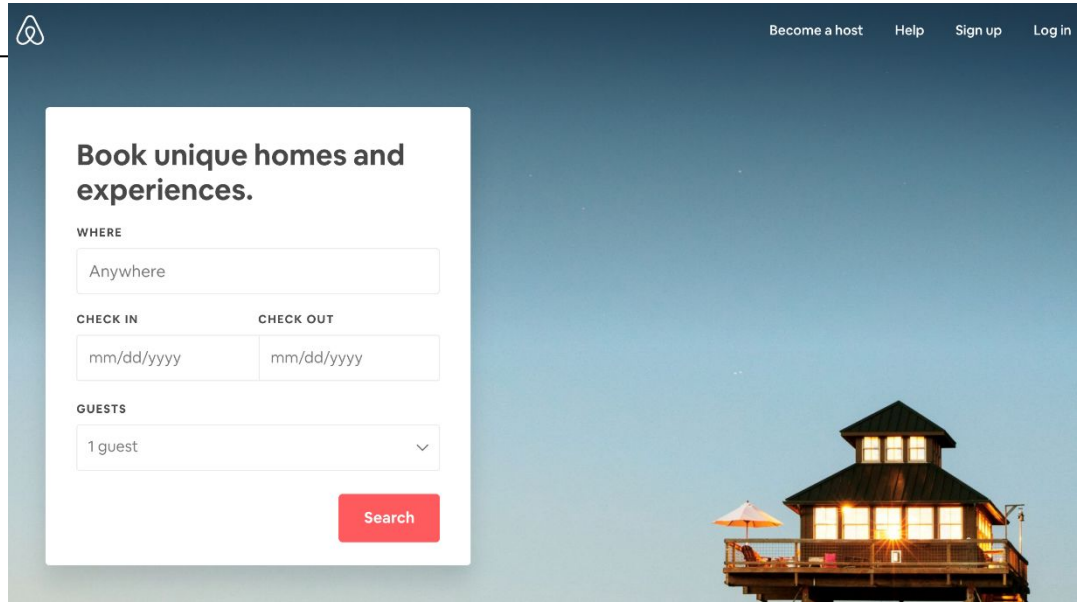
- User interface: Way by which end-users will interact with your software
- Should take into consideration users' expectations, experience and skills
- Bad interface low usability

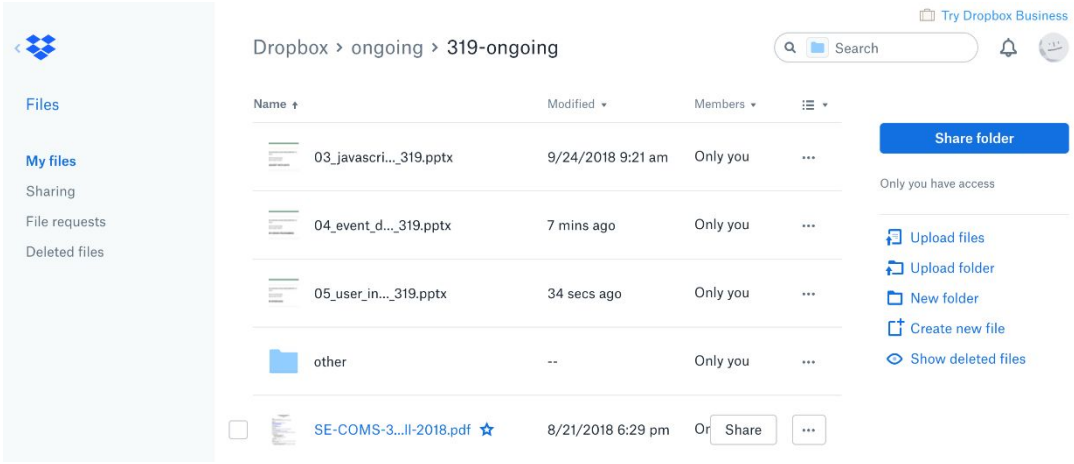
User interface

- Human errors have been correlated to the usability of user interface (J. Galliers and et al, ACM TCHI).
  - Confirmation dialog box:

User interface

- Examples of excellent UI:
  - AirBnB, DropBox, …





User interface

- Examples of poor UI
  - IBM Lotus Notes
  - Windows 8,…

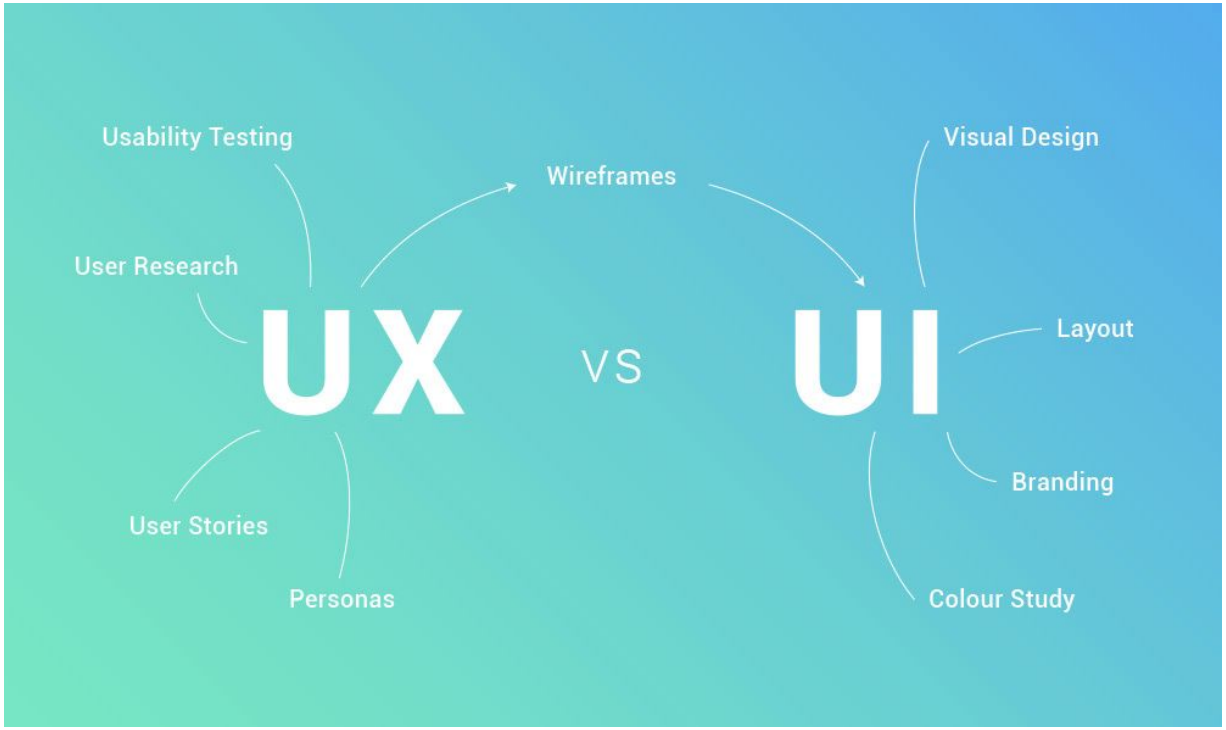
User Interface (UI) vs. User Experience (UX)

- **UI** design is all about how the product's interfaces look and function
  - The look and feel, the presentation and interactivity of a product
  - Process of **making interfaces in software** or computerized devices with a **focus on looks or style**
- **UX** design is all about the overall feel of the experience
  - Focused on the optimization of a product for **effective and enjoyable use**
  - Used to create products that provide meaningful and relevant experiences to users
  - UX design is **NOT** about visuals; it focuses on the overall feel of the experience
- Both are essential for the product's success!

UI vs. UX

- Focus of UI lies in the **visual part** of what you see on screen
- Focus of UX is on designing the **navigation experience** of the user and the product **logical flow** from one step to the next

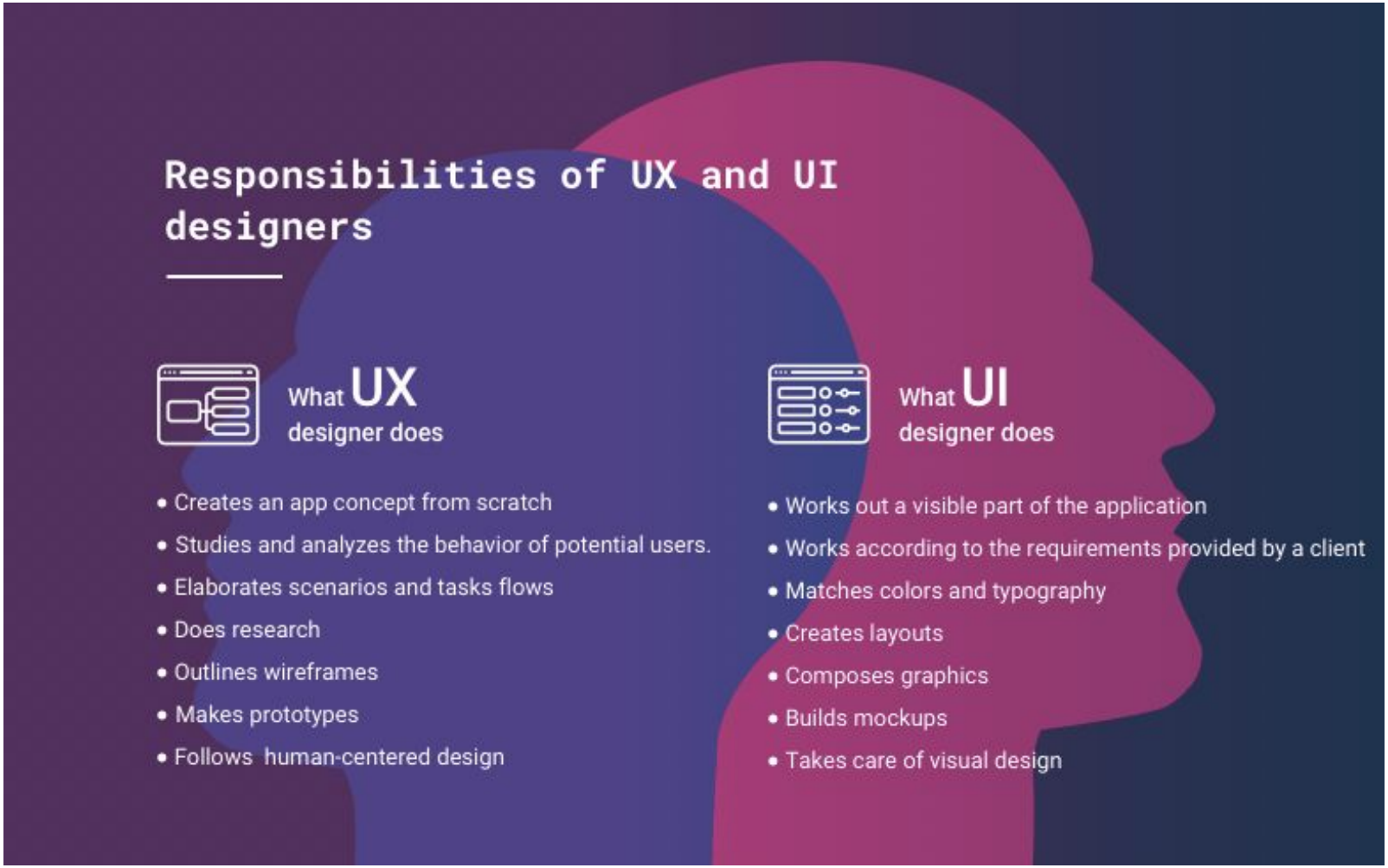
Wireframe is a layout of a web page/app that demonstrates what interface elements will exist on key pages.



Personas are fictional but represent a selection of real users and their behaviors.

https://wecreate.com.hk/blog/what-is-difference-ux-design-ui-design

UI vs. UX (2)



UI designers work very closely with UX designers!

https://www.cleveroad.com/blog/debunking-stereotypes-about-the-identity-of-ui-and-ux-design

USER INTERFACE (UI) DESIGN

Designing User Interface (UI)

UI designers:

- **Create** and design interfaces using different tools such as Sketch, Figma, Pencil, Photoshop, etc.
- Conduct user **interface testing** to ensure the product meets its specifications
- Should consider these questions:
  - Do the **colors** work well together?
  - How is **typography** used to convey meaning and hierarchy?
  - Is the app **well-designed?**
  - How can I improve the UI design of the app?
  - Would flat UI design (flat design) work here?

Visible language

- **Visible language: graphical techniques** used to communicate the message or context:
  - **Layout**: formats, proportions, grids and 2-D/3-D organization
  - **Typography**: selection of typefaces (fonts) and typesetting, including variable width and fixed width
    - Monospaced fonts are same width, opposed to variable-width fonts, where the ‘w’ and ‘m’ are wider than most letters, and the ‘i’ is narrower!
  - **Color and Texture**: color, texture and light that convey complex information and pictorial reality
  - **Imagery**: signs, icons and symbols, from the photographically real to the abstract

Visible language (2)

- **Visible language: graphical techniques** used to communicate the message or context:
  - **Sequencing**: the overall approach to visual storytelling
  - **Sound**: abstract, vocal, concrete, or musical cues
  - **Visual identity**: the additional, unique rules that lend overall consistency to a user interface
    - The overall decisions as to how the corporation or the product line expresses itself in visible language
    - E.g. ISU web Red & gold

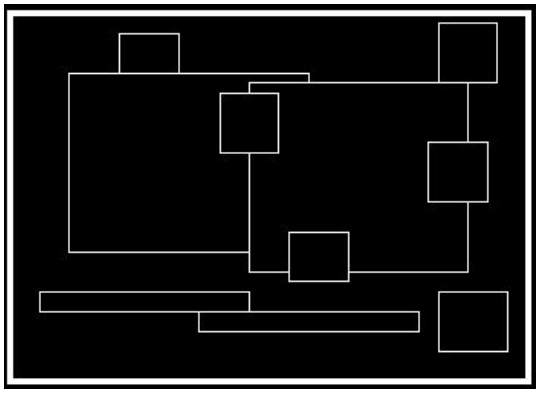
Use of a visible language – Fundamental principles

1. **Organize**: provide the user with a clear and consistent conceptual structure
   - Consistency, screen layout, relationships and navigability
2. **Economize**: do the most with the least amount of cues
   - Simplicity, clarity, distinctiveness, and emphasis
     - **Emphasis**: The most important elements should be easily perceived.
     - Non-critical elements should be de-emphasized.
3. **Communicate**: match the presentation to the capabilities of the user
   - In order to communicate successfully keep in balance legibility, readability, typography, symbolism, multiple views, and color/texture

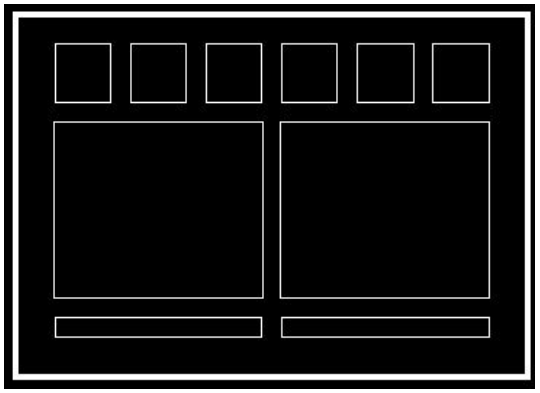
Use of a visible language – Fundamental principles (2)

1. **Organize**: provide the user with a clear and consistent conceptual structure (consistency, screen layout, relationships and navigability)

   - **Layout**

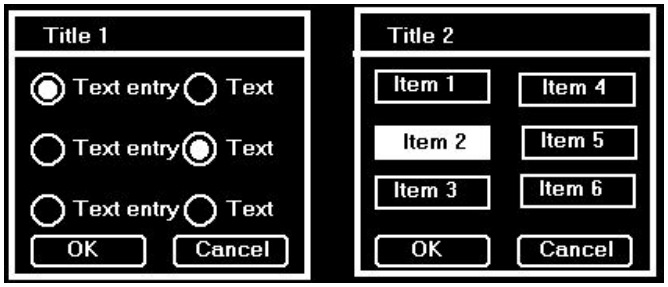


Chaotic Screen



Ordered Screen

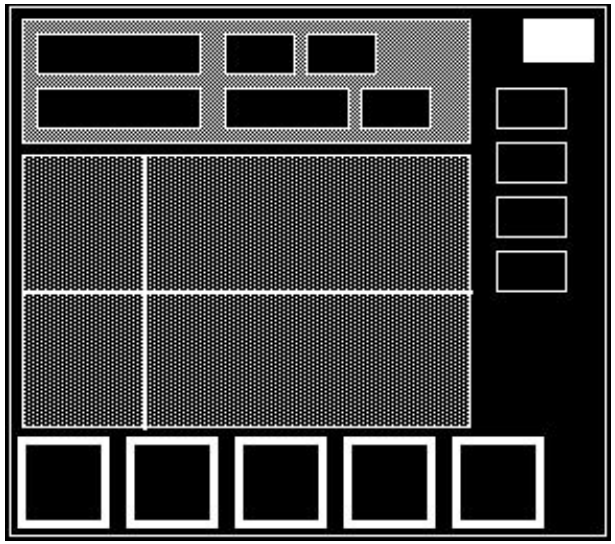
   - **Consistency**: Same kinds of elements are shown in the same places

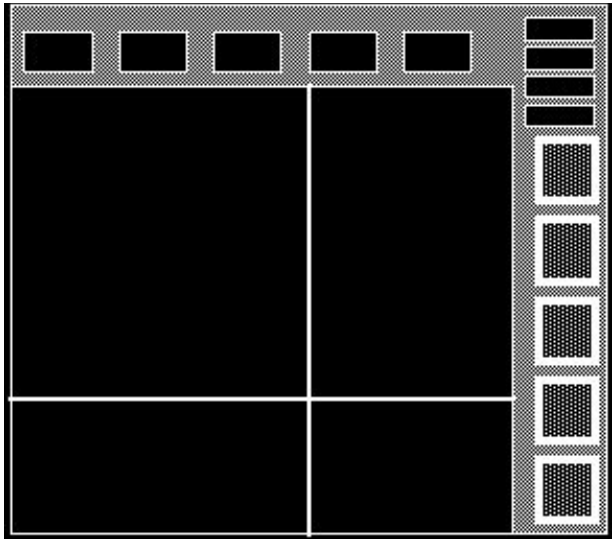


http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html

Use of a visible language – Fundamental principles (3)

1. **Organize**: provide the user with a clear and consistent conceptual structure (consistency, screen layout, relationships and navigability)
   - **Relationships**: Linking related items and disassociating unrelated items can help achieve visual organization





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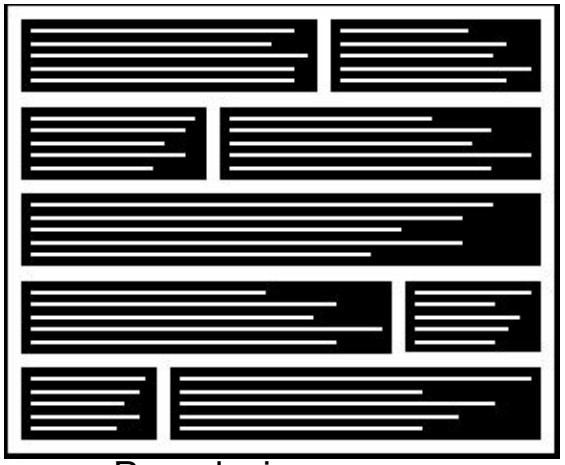
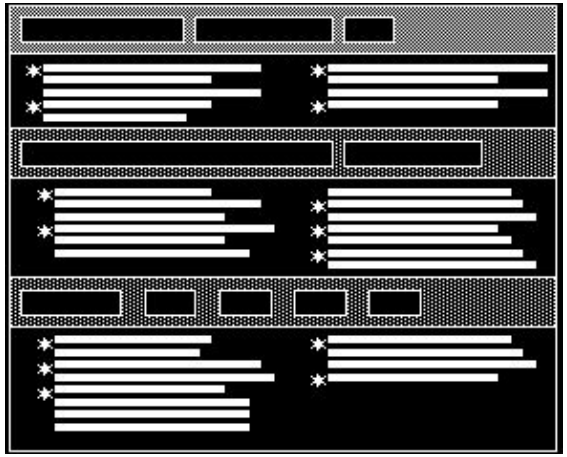
Use of a visible language – Fundamental principles (4)

1. **Organize**: provide the user with a clear and consistent conceptual structure (consistency, screen layout, relationships and navigability)
   - **Navigability**



Poor design

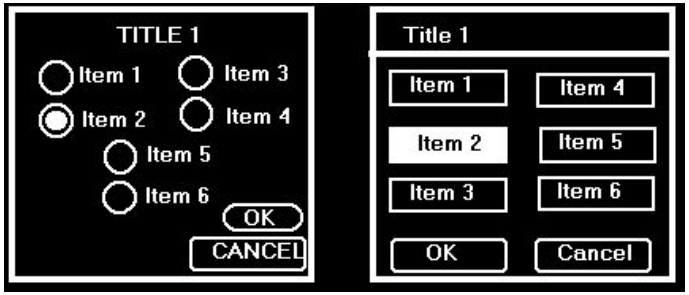


Improved design
- Spatial layout and color help focus viewer's attention to most important areas
- Bulleted items guide the viewer through the secondary contents

http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html

Use of a visible language – Fundamental principles (5)

2. **Economize**: do the most with the least amount of cues
   - Simplicity, clarity, distinctiveness, and emphasis
   - **Simplicity**
     - Includes only the elements that are most important for communication
     - It should also be as unobtrusive as possible

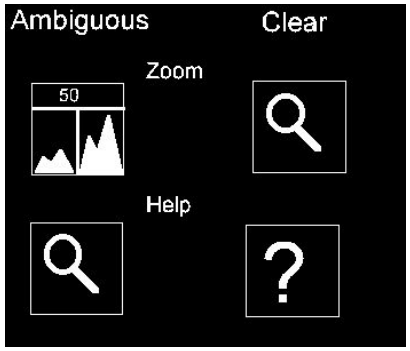


Complicated and Simpler Designs

   - **Emphasis**: The most important elements should be easily perceived. Non-critical elements should be de-emphasized.

Use of a visible language – Fundamental principles (5)

2. **Economize**: do the most with the least amount of cues
   - Simplicity, clarity, distinctiveness, and emphasis
   - **Clarity:** All components should be designed so their meaning is not ambiguous



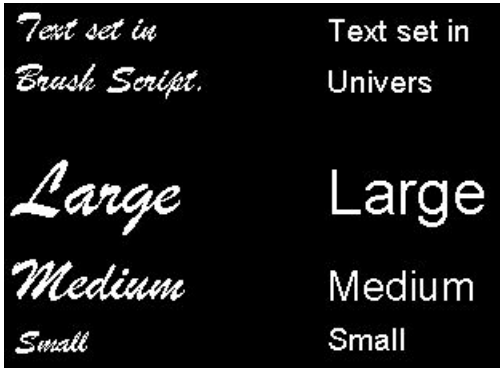
Ambiguous and Clear Icons

   - **Distinctiveness:** The important properties of the necessary elements should be distinguishable

Use of a visible language – Fundamental principles (6)

3. **Communicate**: match the presentation to the capabilities of the user

- In order to communicate successfully keep in balance legibility, readability, typography, symbolism, multiple views, and color/texture



Illegible and Legible Texts

- Developing better visual (color or black-and-white) communication is an important part of making UI that communicate effectively and efficiently through graphic design

Use of a visible language – Fundamental principles (6)

3. **Communicate**: match the presentation to the capabilities of the user

- In order to communicate successfully keep in balance legibility, readability, typography, symbolism, multiple views, and color/texture
- **Readability:** display must be easy to identify and interpret, should also be appealing and attractive
  - **Example:**

Unreadable and Readable Texts:

Unreadable: Design components to be easy to interpret and understand. Design components to be inviting and attractive.

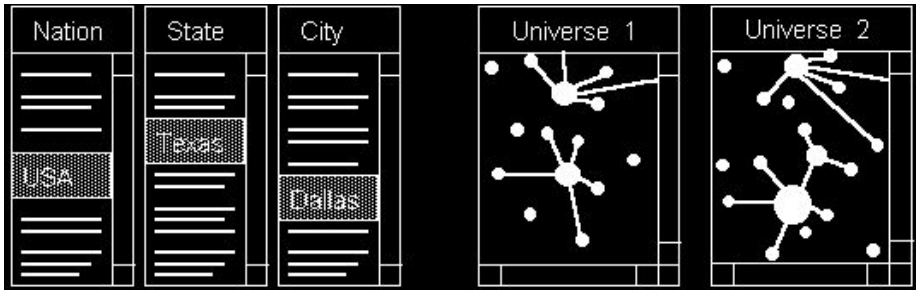
Readable

Design components to be easy to interpret and understand.

Design components to be inviting and attractive.

Use of a visible language – Fundamental principles (6)

3. **Communicate**: match the presentation to the capabilities of the user
   - In order to communicate successfully keep in balance legibility, readability, typography, symbolism, multiple views, and color/texture
   - **Multiple Views**: provide multiple perspectives on the display of complex structures and processes (multiple levels of abstraction)
     - Example:



Verbal and Visual Multiple Views

Design principles for user interfaces

- UI Design Issues
- UI Design Process
- UI Evaluation

UI Design Issues

- UI design issues depend on
  1. Human factors
  2. Interaction styles (to/from the user)
     - Visualization
     - Error/warnings
     - Color (visible language)
     - . . .

Human Factors

- Limited short-term memory
  - How many items of information can one remember instantaneously?
- Familiarity
  - Use terms and concepts from the domain of the application
- Consistency
  - Similar/comparable operations should be activated in the same way
- Error recovery & guidance
  - Provide meaningful, unambiguous feedback when errors occur

Interaction styles

1. Obtaining information from the user
2. Presenting information to the user

3. Obtaining information from the user
    a. Direct Manipulation
    b. Menu-based
    c. Form-based
    d. Natural language
    e. Command language

Interaction styles – Input

a. Direct manipulation

- Advantage: Intuitive interaction
- Disadvantage: Hard to implement, requires visual metaphor
- Applications: Games, CAD

b. Menu-based

- Advantage: Avoids user error
- Disadvantage: Can be slow and/or complex
- Applications: Most systems

Interaction styles – Input

c. Form-based

- Advantage: Simple and Checkable
- Disadvantage: Can be long
- Applications: e-Commerce

d. Natural Language

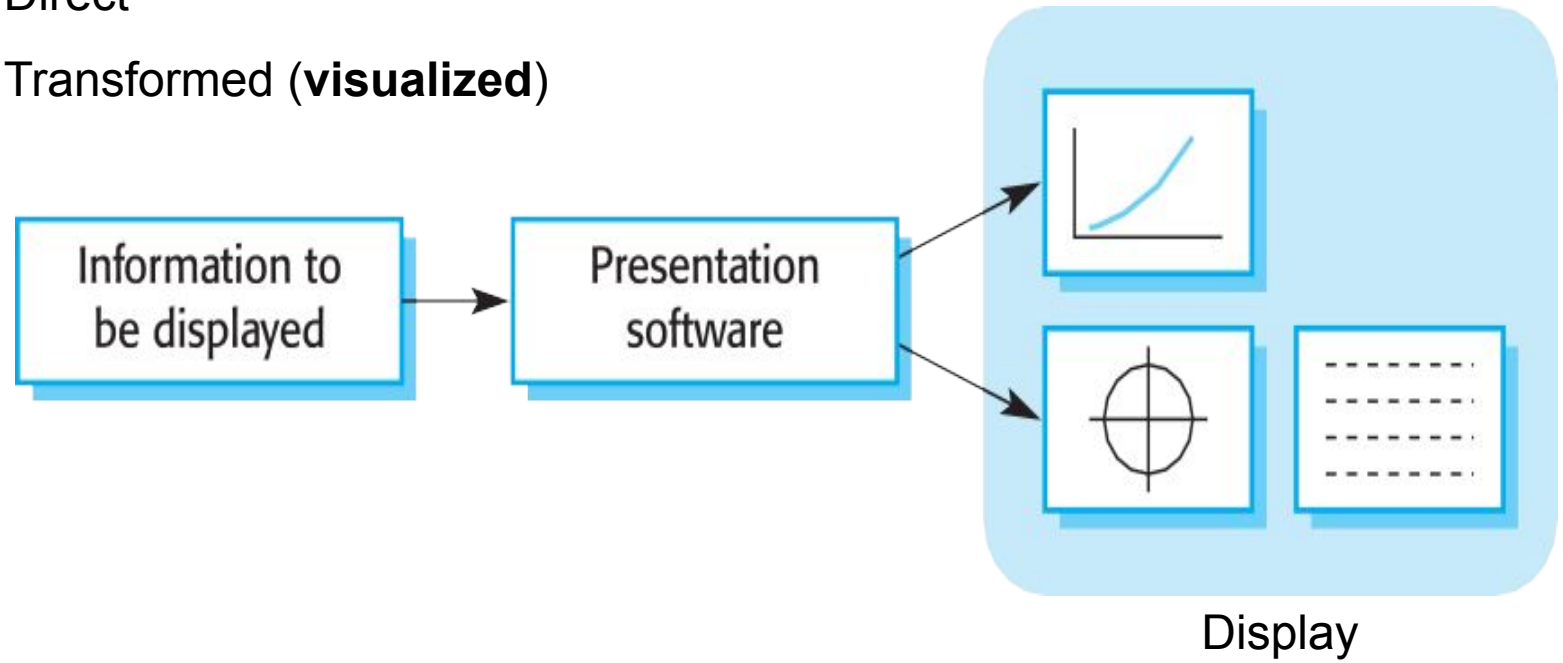
- Advantage: easy and natural
- Disadvantage: Natural language processing (AI – NLP)
- Applications: Information retrieval systems, apps

e. Command-Line Language

- Advantage: : Easy to implement
- Disadvantage: Hard to understand/remember all commands

Interaction styles – output

2. Presenting information to the user
   - Direct
   - Transformed (**visualized**)



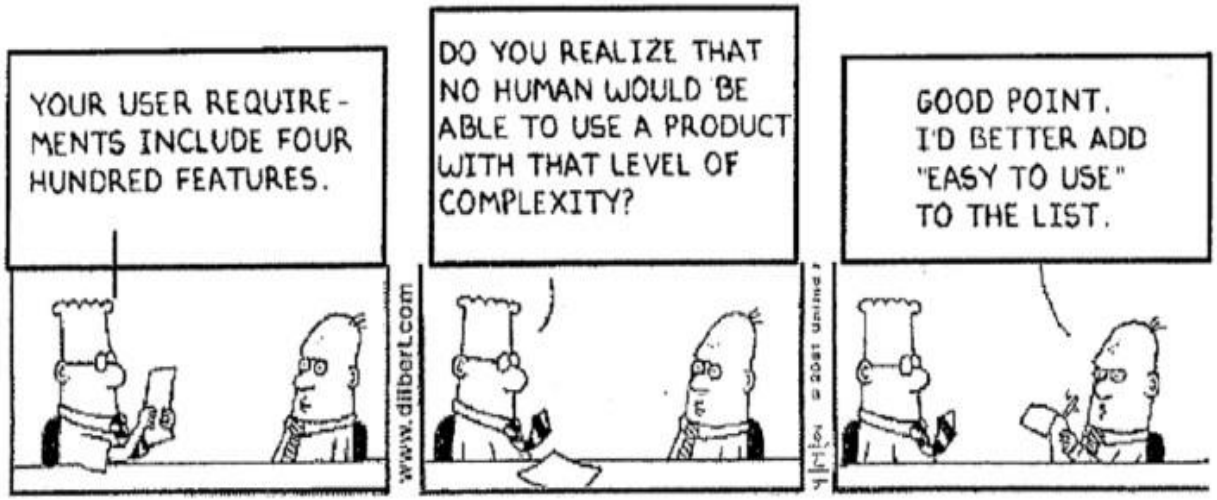
Designing the user interfaces

UI DESIGN PROCESS

Design process of UI

- User Analysis
  - Understand what users will do with the system
- Prototyping
  - Develop (many) prototypes
- Evaluation
  - Experiment with the prototypes

User Analysis – Humor



User Analysis

- Ask questions, show examples, explain what can (more importantly cannot) be done, . . .
  - Requirements solicitation
  - Ethnography (Observe the user at work)

- **Tangible** information (feedback) from user:
  - I want to control my computing device using voice commands
  - I want to control my computing device using voice commands and it must only follow my voice commands
  - I want to mind-control my computing device

Prototyping

- Provide users a direct experience with the interface
- Helps in getting users' judgment
- Simple prototypes
  - Paper + pencil
    - Story-boards, scenarios, use-cases, etc.
  - Digital with dummy buttons
    - e.g., Sketch, Pencil Project http://pencil.evolus.vn
      - Pencil is free and open-source GUI prototyping tool
  - Digital with some functionality
    - e.g., scripting, visual language, etc.

Evaluation – Usability

- Conformance to domain-specific vocabulary
- Recognition of options
- Consistency
- Visibility of system status
- Error prevention
- Error information
- Easy recovery methods
- Precise and concise information
- Help and manuals
- Flexibility for experts

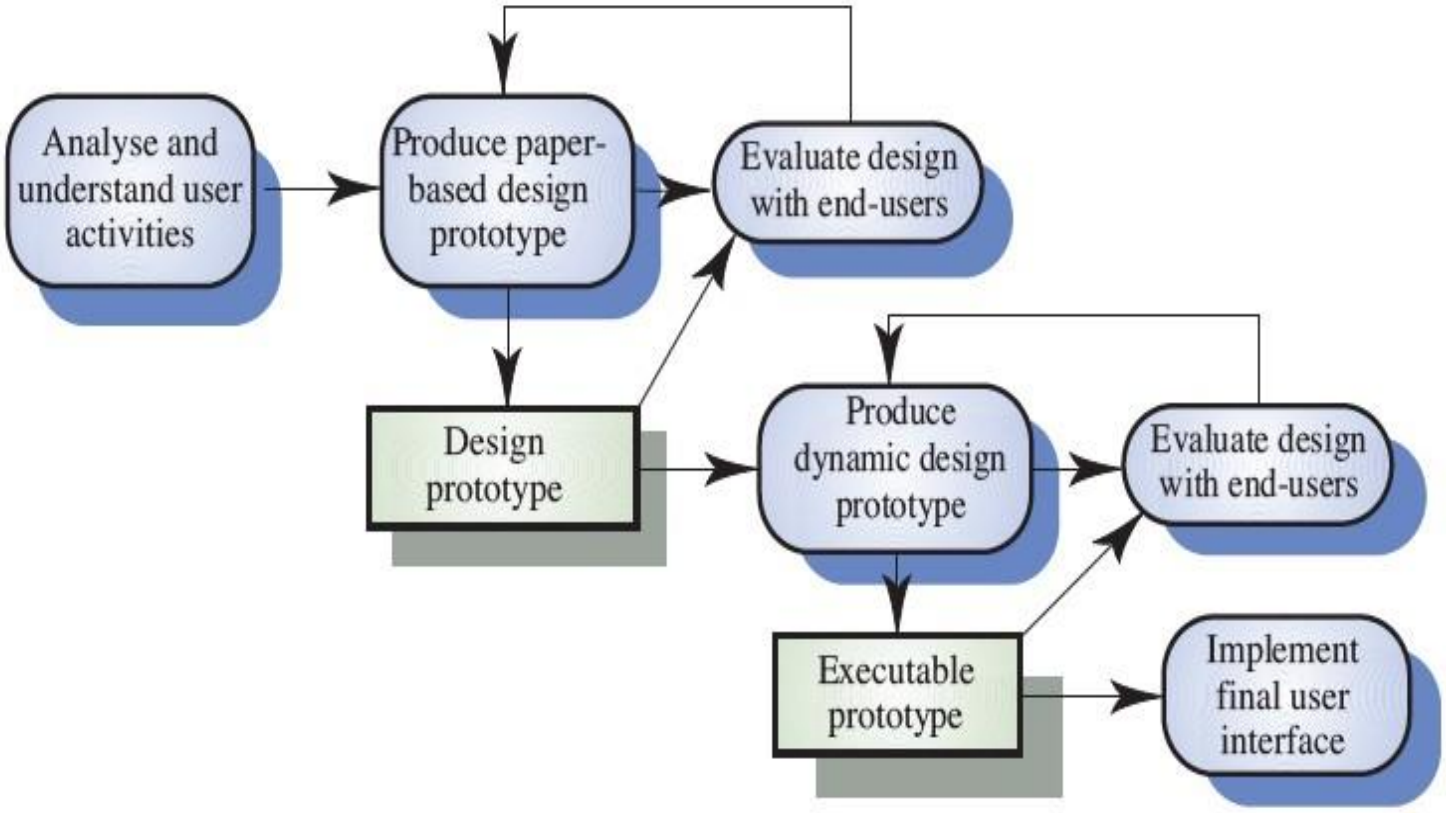
Evaluation – Usability

Designing the User Interface (Ben Shneiderman criteria):

1. Strive for consistency.
2. Give shortcuts to the user.
3. Offer informative feedback.
4. Make each interaction with the user yield a result.
5. Offer simple error handling.
6. Permit easy undo of actions.
7. Let the user be in control.
8. Reduce short-term memory load on the user.

Typical UI Design – UI Development cycle

- Iterative design offers a way to manage the inherent risk in user interface design:



UI designer tasks

- **Collaboration – Design – Prototyping**
- **Collaboration:** Collaborating with others (client, UX designer and developers)
  - Communication is key at every stage of UI design
- **Design:** Using tools to design screens and create visual touch points, as well as the interactivity behind them
  - Ensuring consistency - so creating a style guide, or visual language, to be used across the board
- **Prototyping:** Enabling to showcase visual designs in action, helping to quickly identify flaws and smooth

User interface (UI) principles – Recap

- Keep the users in mind
- Get feedback often!
- Prepare multiple (progressively advanced) prototypes

UI:
Digital practice that considers all the visual, interactive elements of a product interface including buttons, icons, spacing, typography, color schemes, and responsive design!

Construction of UI

- UI allows users interact with the data
  - Manage
  - View
  - Modify
- Location of data & type of interaction
  - Stand-alone applications: data hosted on the client
  - Client-server applications
    - Data hosted on the server, user-interface and computations on the client
    - Data hosted on the server, computations on the server, user-interface on the client
    - Data hosted on the server, computations partitioned between client and server (data requested when needed or pre-fetched), user-interface on the client.

UX DESIGN

User Experience (UX)

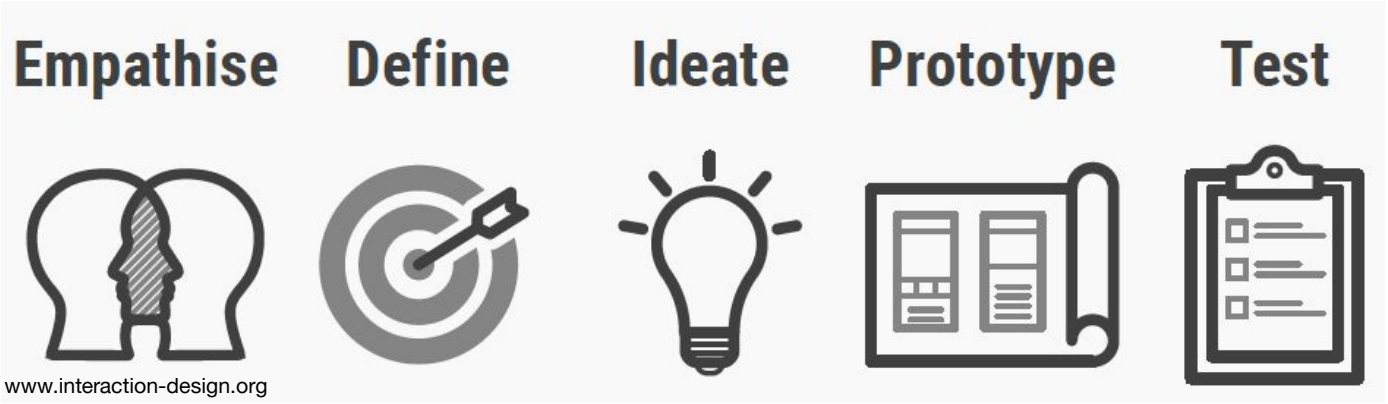
- Refers to the interaction between the user and a product/service
- Considers all the different elements that shape this experience
- UX designer:
  - How the experience makes the user feel?
  - How easy it is for the user to accomplish their desired tasks?
    - E.g. How easy is the checkout process when shopping online? Or How easy is to manage your money using your online banking app?

 Creating easy, efficient, relevant, and all-round pleasant experiences for the user!

 Developing and improving the quality of interaction between a user and all facets of a company!

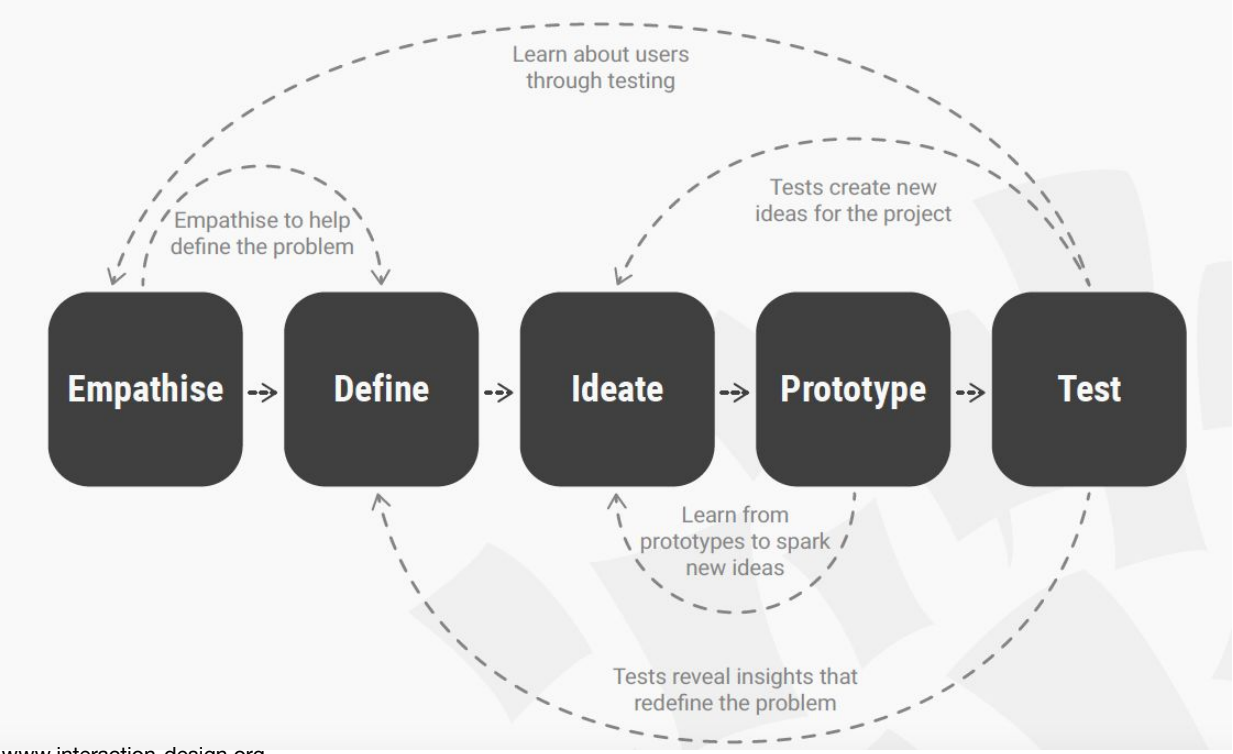
Design thinking approach

- **Empathize** – with your users
- **Define** – your users' needs, their problem, and your insights
- **Ideate** – by challenging assumptions and creating ideas for innovative solutions
- **Prototype** – to start creating solutions
- **Test** – solutions



Design thinking – An iterative process

- Design team continuously use their results to review, question, and improve their initial assumptions, understandings and results.



www.interaction-design.org

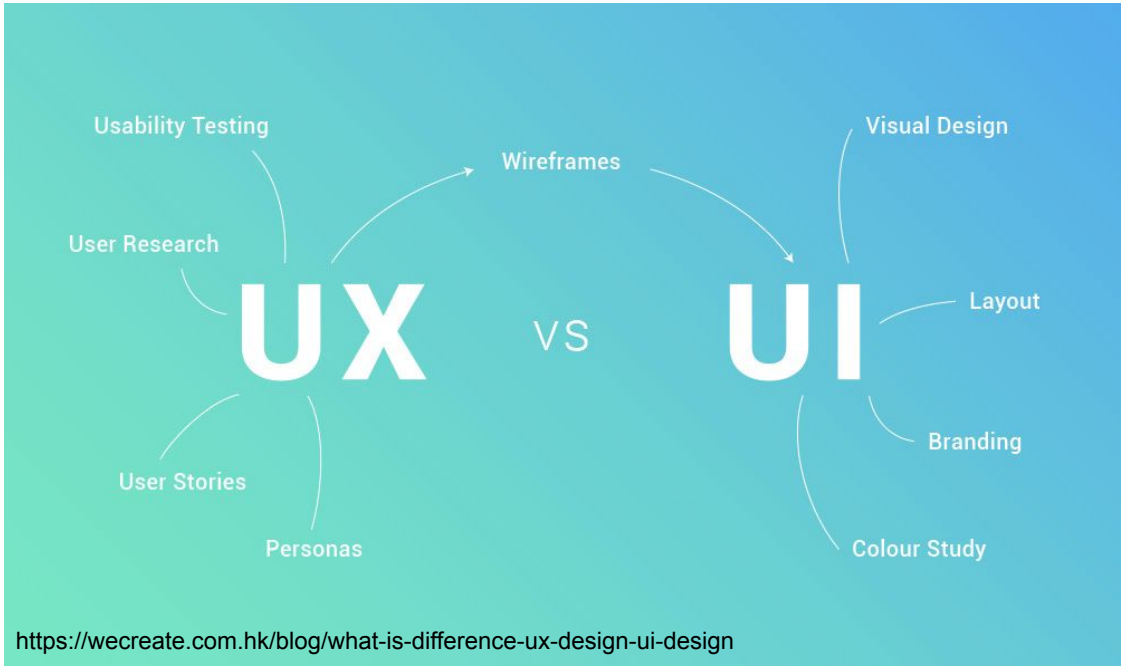
User Experience (UX) influencing factors

UX is critical to the success of a product:

1. **Useful**: has purpose and able to compete for attention alongside a market full of purposeful and useful products
2. **Usable**: users can easily use a product and achieve their end objective
3. **Findable**: the content within them must be easy to find
4. **Credible**: users trust in the product that you've provided
5. **Desirable:** through branding, image, identity, aesthetics, and emotional design
6. **Accessible:** users with a full range of abilities
7. **Valuable:** delivers value to the business which creates it and to the users who uses

UX vs. UI

- Focus of UX is on designing the **navigation experience** of the user and the product **logical flow** from one step to the next



https://wecreate.com.hk/blog/what-is-difference-ux-design-ui-design

UX
involves **user research** (finding out who the users are in the first place), creating user **personas** (why, and under what conditions, would they use the product), performing user testing and **usability testing**.

UX – Usability

Five characteristics of usable products:

1. **Effectiveness**: users can complete their goals with a high degree of accuracy
2. **Efficiency**: How fast can the user get the job done (speed)
3. **Engagement**: users find the product pleasant and gratifying to use (looking nice but also about looking right)
4. **Error Tolerance**: users can easily recover from an error and get back to what they are doing
5. **Ease of Learning**: users are able to learn their way around that product easily

UX research techniques

- **Card sorting**: a way of assessing what are users' priorities
- **Expert review:** an 'expert' walking through a product via the User Interface (UI) and looking for issues with the design, accessibility, and usability of the product
- **Eye movement tracking**: Knowing where your users are looking when they're using your system
- **Field studies**: Observing users in the field and measure behavior in the context where users actually use a product
- **Usability testing:** observation of users trying to carry out tasks with a product

UX research techniques (2)

- **Remote usability testing:** without the need to drag users into your laboratory environment
- **User personas**: fictional representation of the ideal user

Dimensions of interaction design

Interaction design is all about the interface between users and a product/service and involves **five dimensions**:

- **Words**: e.g. button labels used in interactions should be meaningful and simple to understand
- **Visual representations**: images, typography and icons that users interact with
- **Physical objects or space**: laptop, with a mouse or touchpad, or smartphone
- **Time**: amount of time a user spends interacting with the product

Dimensions of interaction design (2)

- **Behavior**: reactions – for instance, emotional responses or feedback – of users and the product
- Creating a world-class interaction design requires **matching the five dimensions of interactions** to the psychology of your users.
  - **Example**:
    - When you tune the timing of your animations to the cognitive capabilities of our brains, you'll produce an effective design.
    - Off by a few milliseconds? Your design might instead induce friction and frustration.

CASE STUDY: MOBILE WEB UX DESIGN

Case Study: Mobile Web UX Design

- **Space and occasion**: the places (context) in which users interact with their mobile devices are virtually limitless
  - How to reduce distractions and make it easy for the user to focus on the task in hand?
- Mobile web access:
  - **Micro-tasking**: When users interact with their devices for brief but frenzied periods of activity
  - **Local**: When the users want to know what's going on around them
  - **Bored**: When the users have nothing better to do and are looking to be entertained or otherwise diverted

If your business isn't mobile friendly, your business is dead."
— Jonathan Stark, Best-selling mobile technology author

Mobile-specific design considerations

- Small Screens
  - Responsive design or adaptive design?
- **Responsive design**
  - Single static page which loads the same on all devices or a single page **which reorders and resizes content responsively** based on the device/screen size/browser of the user (the device handles the changes in display)
- **Adaptive design**
  - Promotes creation of **multiple versions** of a web page to better fit the user's device (your servers handle the changes)

Mobile-specific design considerations (2)

- Keep Navigation Simple
  - Prioritize navigation based on the way users work with functionality—the most popular go at the top
- Keep Content to a Minimum
  - Don’t overwhelm your users—respect the small screen space
- Reduce the Inputs Required from Users
  - The less the users have to fiddle with their phones, the more they’re going to enjoy using your mobile web offering
  - Offering alternative input mechanisms (video, voice, etc.)

Mobile-specific design considerations (3)

- Remember Mobile Connections Are Not Stable
  - Retaining data so that it's not lost in a connection break
  - Minimizing page size for rapid loading
  - Reducing the numbers of embedded images to a minimum (speeding up load times)

Mobile-specific design considerations (4)

- Continuous Integrated Experiences
  - Maintain **continuity:** If they log into your webstore on mobile, they should be able to track orders and make purchases just like they would on the desktop
  - Maintain **consistency:** Offer the option to switch between mobile and desktop offerings at will
  - Maintain **brand**. The look and feel of each version should be similar

Software Engineering & User Interface Design

USER INTERFACE DEVELOPMENT PROCESS

Software development process – Recap

- **System analysis & requirements elicitation:** What are the functional and non-functional requirements of the desired system?
  - Domain model: Relationship of the software with the real-world
  - Application model: Description of application functionality
- **System design**: High-level architecture of the application
  - Relationships: UML and modularization
  - Class diagrams: Organize the data (information hiding, interface specification)
  - Interface design (interactions between software modules)
- **Implementation & Testing**
- **Deployment**

System design – Software development process (1)

- System design considers domain & data, modularization and interface
- Distinction between **data**, **components** and **interface** during system design
  - Data design
    - data structures
  - Component (package) design
    - separation of functionalities
      - Decomposability
      - Composability
      - Understandability (Individuality)
      - Continuity (Extensibility)
      - Protection (Security)

System design – Software development process (2)

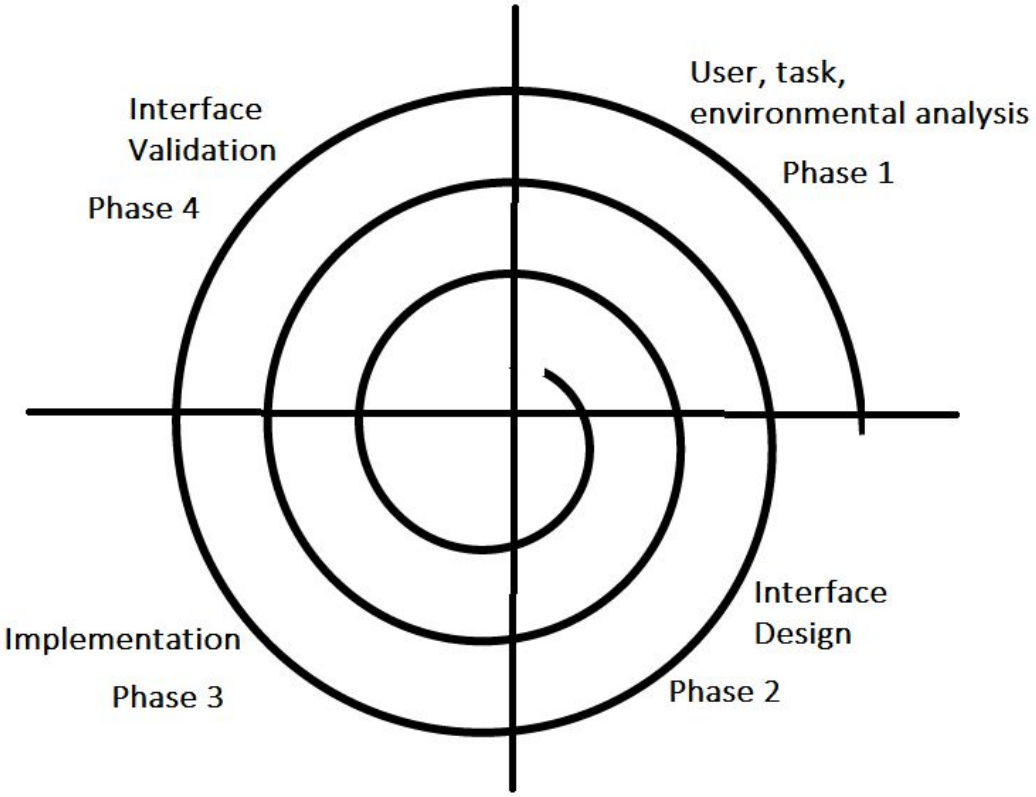
- Distinction between **data**, **components** and **interface** during system design
  - Interface design (not necessarily user interface (GUI) design only)

  reduction of communication complexity

    - Example of interfaces in Java:
      - Runnable – The Runnable interface should be implemented by any class whose instances are intended to be executed by a thread.

User interface development process

- User interface development is an iterative process and follows the iterative manner of the software development process (similar for other softwa



User interface development process (2)

1. **User, task, environmental analysis, and modeling**
   - Understanding, skill and knowledge, type of user
2. **Interface (UI) design**
   - Define the set of interface objects and actions i.e. control mechanisms that enable the user to perform desired tasks
4. **Interface (UI) construction and implementation**
   - creation of prototype (model) that enables usage scenarios to be evaluated
5. **Interface (UI) validation**
   - This phase focuses on testing the interface

Summary

- User interfaces
  - UI vs UX
- Data visualization
- UI Design process
- UX Design
- Case Study: Mobile Web UX Design
- User interface development process

Literature – User Interfaces

- https://www.interaction-design.org/literature/topics/ui-design
- https://blog.teamtreehouse.com/10-user-interface-design-fundamentals
- http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html
- www.interaction-design.org
- Marcus, A. SIGGRAPH 93 tutorial notes: Graphic Design for User Interfaces. August 1993.
- Designing the User Interface (6th Edition) by Ben Shneiderman and Catherine Plaisant