Subject Revision

SPRING 2020

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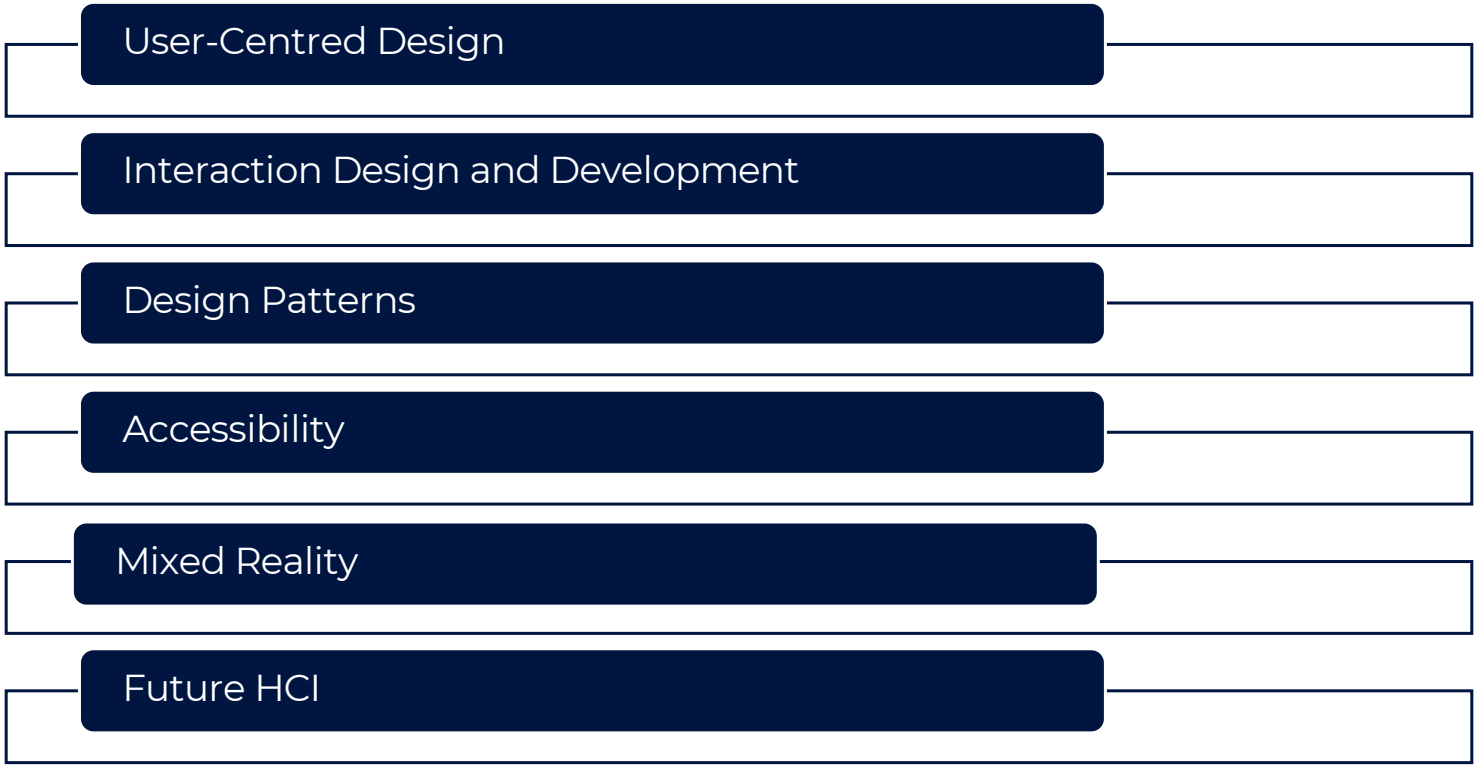
Week	Topic	Reading
1	Introduction to HCI; Design Principles	Chapter 1
2	User-Centred Design Process	Chapter 2 & 3 / Gould et al. (1987)
3	User Interaction and Interfaces	Chapters 4, 5 & 6 / Shin et al. (2017)
4	Interaction Design and Development I	Chapters 7 & 8
5	Interaction Design and Development II	Chapters 9 & 10
6	Interaction Design and Development III	Chapters 11 & 12
7	Information Presentation and Design Patterns	
8	Usability Evaluation Methods I	Chapters 13 / Borsci et al. (2015)
9	Usability Evaluation Methods II	Chapter 14, 15 & 16
10	Accessibility and Special Issues in HCI	Online: WCAG2.0
11	Models, Theories and Risks	MacKenzie (1992)
12	Mixed Reality and Future HCI	
13	Subject Revision	

This Week


User-Centred Design
Interaction Design and Development
Design Patterns
Accessibility
Mixed Reality
Future HCI

Subject Description

- The subject provides students with an understanding of Human Computer Interaction (HCI) principles and practices, and how to apply them in the context of developing usable interactive computer applications and systems. The subject also emphasises the importance of taking into account contextual, organisational, and social factors in the design of computer systems. Students will be taken through the analysis, design, development, and evaluation of user interfaces. They will acquire hands-on design skills through an interaction design project. The subject will cover topics including user-centred design, the development process, prototyping, usability testing, measuring and evaluating the user experience and accessibility.

Subject Learning Outcomes (SLOs)

- On successful completion of this subject, students will be able to:
  1. Identify and describe HCI principles and design issues.
  2. Discuss and justify HCI solutions based on design principles.
  3. Demonstrate an understanding of the HCI design process.
  4. Acquire skills to design and implement user-centred design.
  5. Select and use suitable methods of measuring and evaluating the user experience.

Exam Details – 2020

2 different exams:

- CSIT226
- CSIT826

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Structure

- 3 hours in length
- 50% of your final mark for ISIT226/826
- Open Book
- Exam delivered via Moodle

CSIT226 – Exam

Question 1 (40 marks) – Short Answer Questions

- Key concepts from the subject
- Make sure you answer the complete question

Question 2 (60 marks) – Interface Development and UEMs

- Interaction Styles
- Development of a basic system
- Usability Evaluation Methods

CSIT826 – Exam

Question 1 (50 marks) – Short Answer Questions

- Key concepts from the subject
- Make sure you answer the complete question

Question 2 (50 marks) – Usability Report

- Case Study
- Usability Evaluation Methods

Subject Revision

THIS SHOULD NOT BE THE ONLY MATERIAL USED IN YOUR REVISION

THIS IS A STARTING POINT TO USE TO REFRESH WHAT WE HAVE COVERED OVER THE SESSION!

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Definitions

- “Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.” (Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank 1992)
- Usability: “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.” ISO 9241-11
- “User experience (UX) is an approach to product development that incorporates direct user feedback throughout the development cycle (human-centered design) in order to reduce costs and create products and tools that meet user needs and have a high level of usability (are easy to use).” (UXPA 2013)

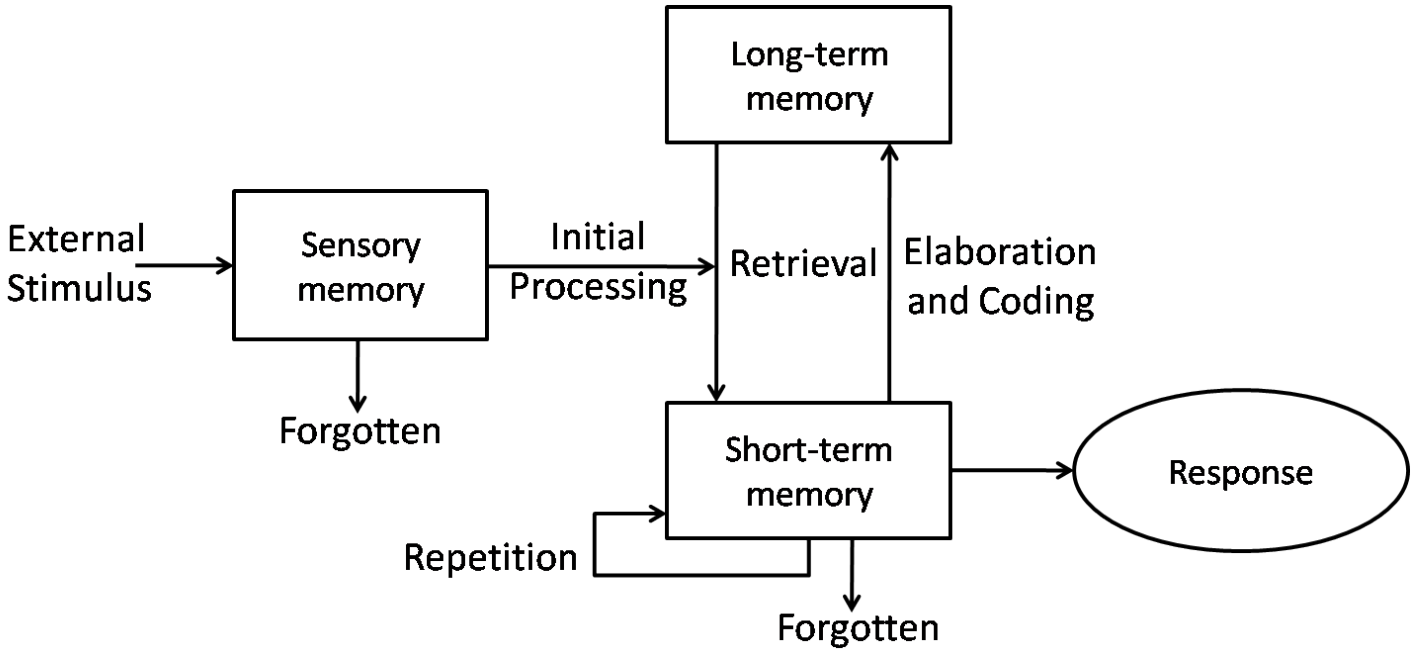
Definitions

- “Human-centered design is characterised by: the active involvement of users and a clear understanding of user and task requirements; an appropriate allocation of function between users and technology; the iteration of design solutions; multi-disciplinary design.”- ISO 13407
- Interaction Design: “Designing interactive products to support the way people communicate and interact in their everyday and working lives.” (Preece, Sharp and Rogers 2015)

The ‘Human’ (Dix et al., 2004)

- Consider…
  - Information input/output (i/o)
    - Visual
    - Haptic
    - Auditory
    - Movement
  - Information storage (human memory)
    - Sensory
    - Short-term (working)
    - Long-term
  - Information processing
    - Reasoning
    - Skill level
    - Problem Solving
- Everyone is different

Human Cognitive Architecture



International Standard ISO 9241-210

- Ergonomics of human–system interaction —
  Part 210: Human-centred design for interactive systems

- *“Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance.”*

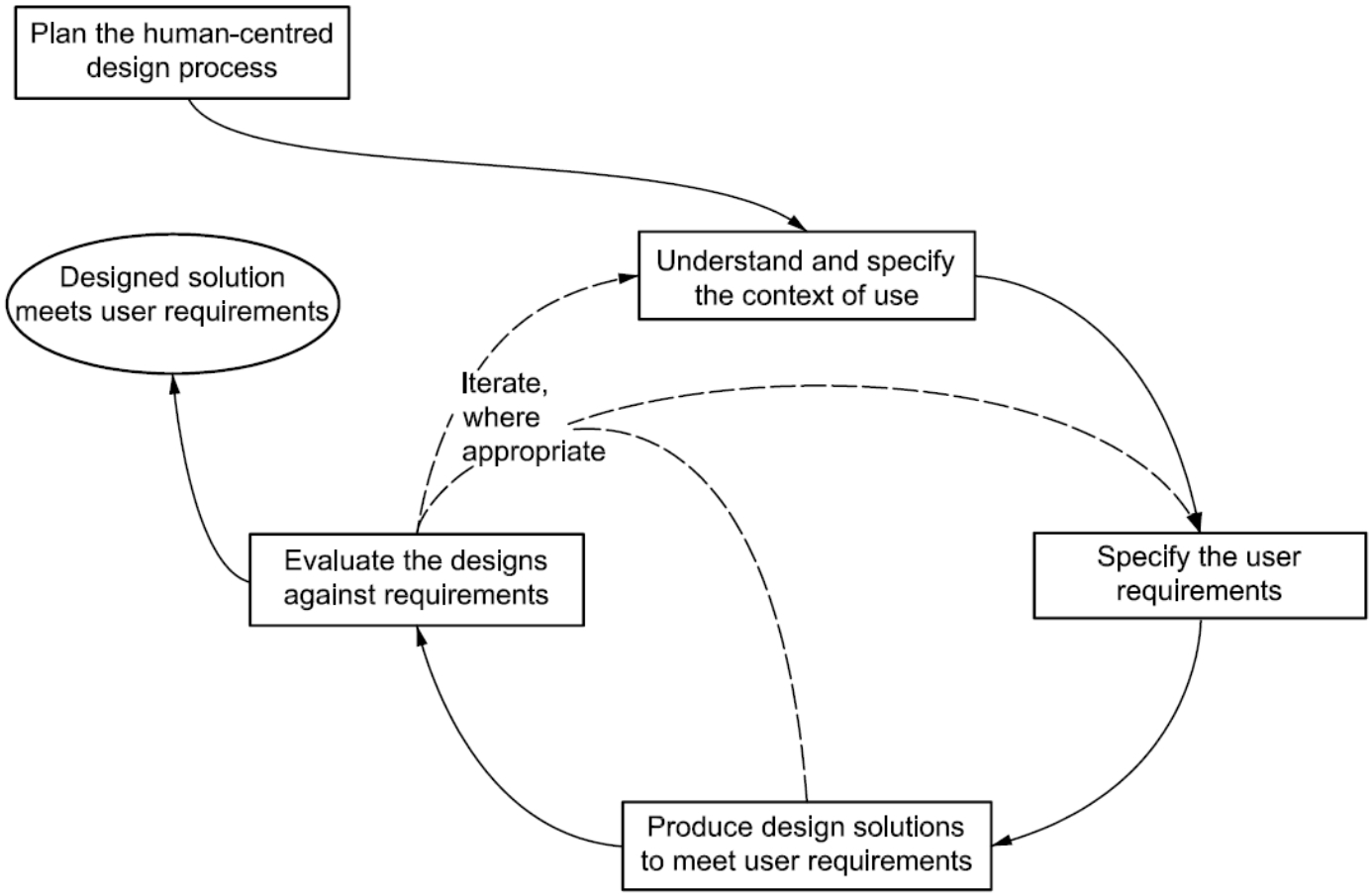


Figure 1 — Interdependence of human-centred design activities

User-Centred Design

- User-Centred Design (UCD) is a user interface design process that focuses on usability goals, user characteristics, environment, tasks, and workflow in the design of an interface.
- UCD follows a series of well-defined methods and techniques for analysis, design, and evaluation of mainstream hardware, software, and web interfaces.
- The UCD process is an iterative process, where design and evaluation steps are built in from the first stage of projects, through implementation.

~~Skeuomorphism~~

Flat Design (Minimalism)

Material Design (Google)

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The Patterns (basic – single view)

(TIDWELL, 2006)

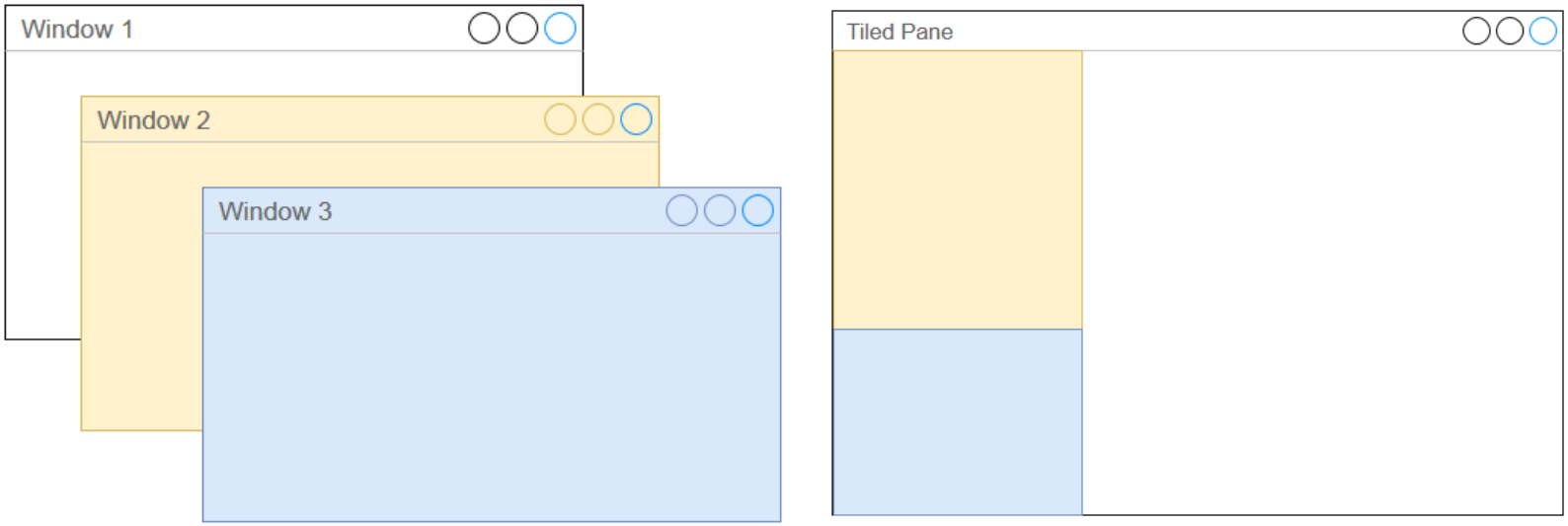
Physical Presentation

- Two-Panel Selector
- Canvas Plus Palette
- One-Window Drilldown
- Alternative Views

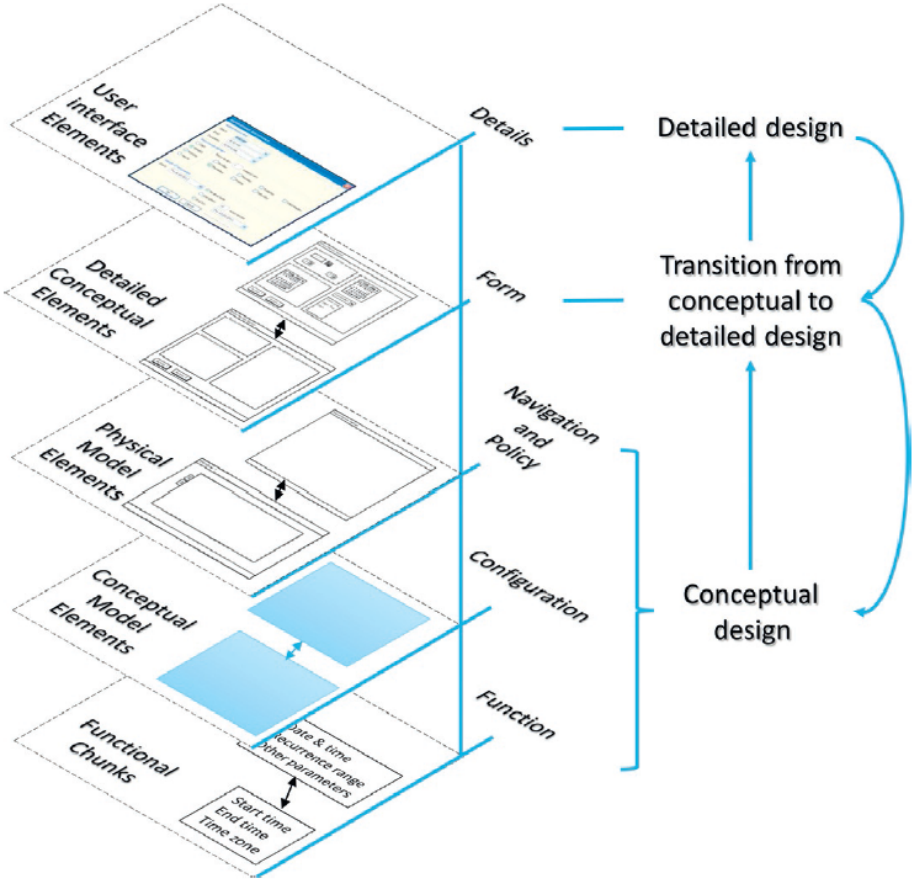
Abstract Concepts

- Wizard
- Extras on Demand
- Intriguing Branches
- Multi-level help

Multiple Windows vs Tiled Panes



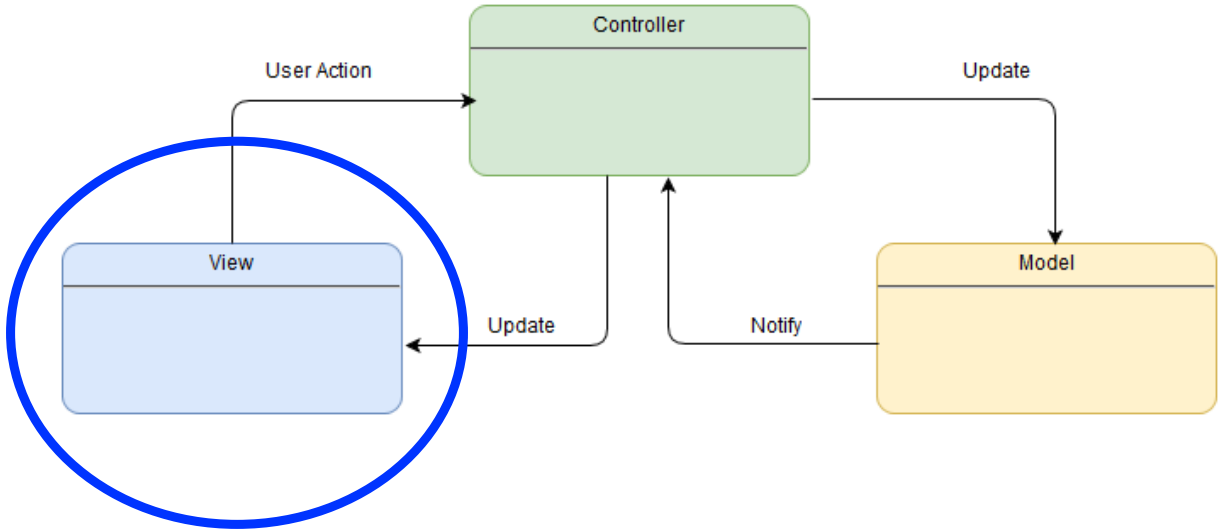
Layered Framework (Parush, 2015)



Interaction Sequences

- Single Sequence
- Hierarchy sequence
- Hub and Spoke
- Matrix
- Networked

Model-View-Controller (MVC) Design Pattern



Menus

- A number of menu interface styles
  - Flat lists
  - Ribbon
  - Drop-down
  - Pop-up
  - Contextual
  - Expanding, e.g., scrolling and cascading

Style Guides

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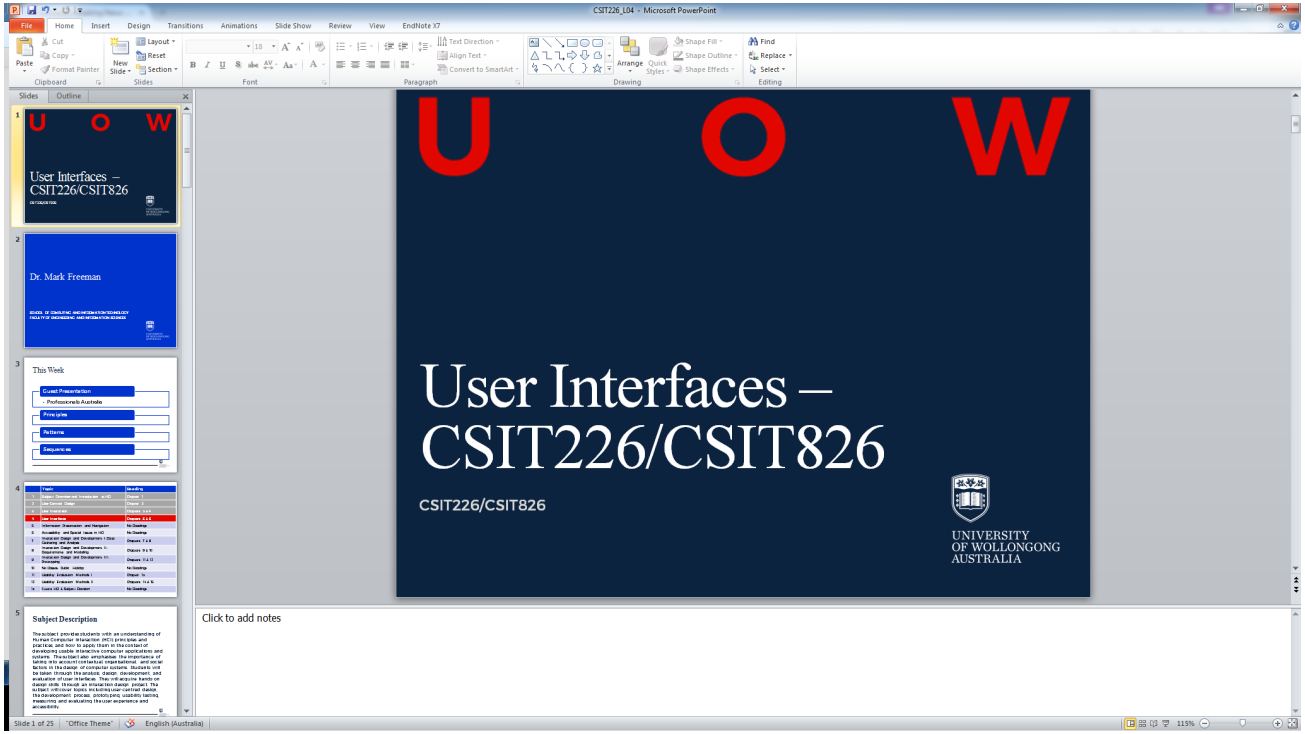
User Interfaces – example (PowerPoint)



What is DESIGN? What are we DESIGNING?

NEVER one single solution

- If any algorithm could generate a perfect solution to multi-dimensional constraint satisfaction problem…

THEN…

- There’d be NO engineers, architects or designers

Gathering Data

AIMS

- Plan and run a successful data gathering program

- Plan and run an interview
- Design a simple questionnaires
- Plan and carry out an observation

Gathering Data - Methods

- Business Documents
- Observation
- One-on-one Interviews
- Group Interviews (focus groups)
- Questionnaires
- Use case analysis
- Brainstorming sessions
- Requests for {information, proposals, tenders, quotation}

Interviews

- **Unstructured** - are not directed by a script. Rich but not replicable.
- **Structured** - are tightly scripted, often like a questionnaire. Replicable but may lack richness.
- **Semi-structured -** guided by a script but interesting issues can be explored in more depth. Can provide a good balance between richness and replicability.
- **Focus groups** – a group interview

Quantitative and qualitative

- Quantitative data – expressed as numbers
- Qualitative data – difficult to measure sensibly as numbers, e.g. count number of words to measure dissatisfaction

- Quantitative analysis – numerical methods to ascertain size, magnitude, amount
- Qualitative analysis – expresses the nature of elements and is represented as themes, patterns, stories

Presenting the Findings

- Only make claims that your data can support
- The best way to present your findings depends on the audience, the purpose, and the data gathering and analysis undertaken
- Graphical representations can be appropriate for presentation

- Other techniques are:
  - Rigorous notations, e.g. UML
  - Persona Development
  - Using stories, e.g. to create scenarios
  - Summarizing the findings
  - What needs to be changed in the system – CRUD (Create, Read, Update, Delete)

Use Case Description

Use Case Name:		
Scenario:		
Triggering Event:		
Brief Description:		
Actors:		
Related Use Cases:		
Stakeholders:		
Pre-conditions:		
Post-conditions:		
Flow of Activities:	Actor	System
Exceptions:		

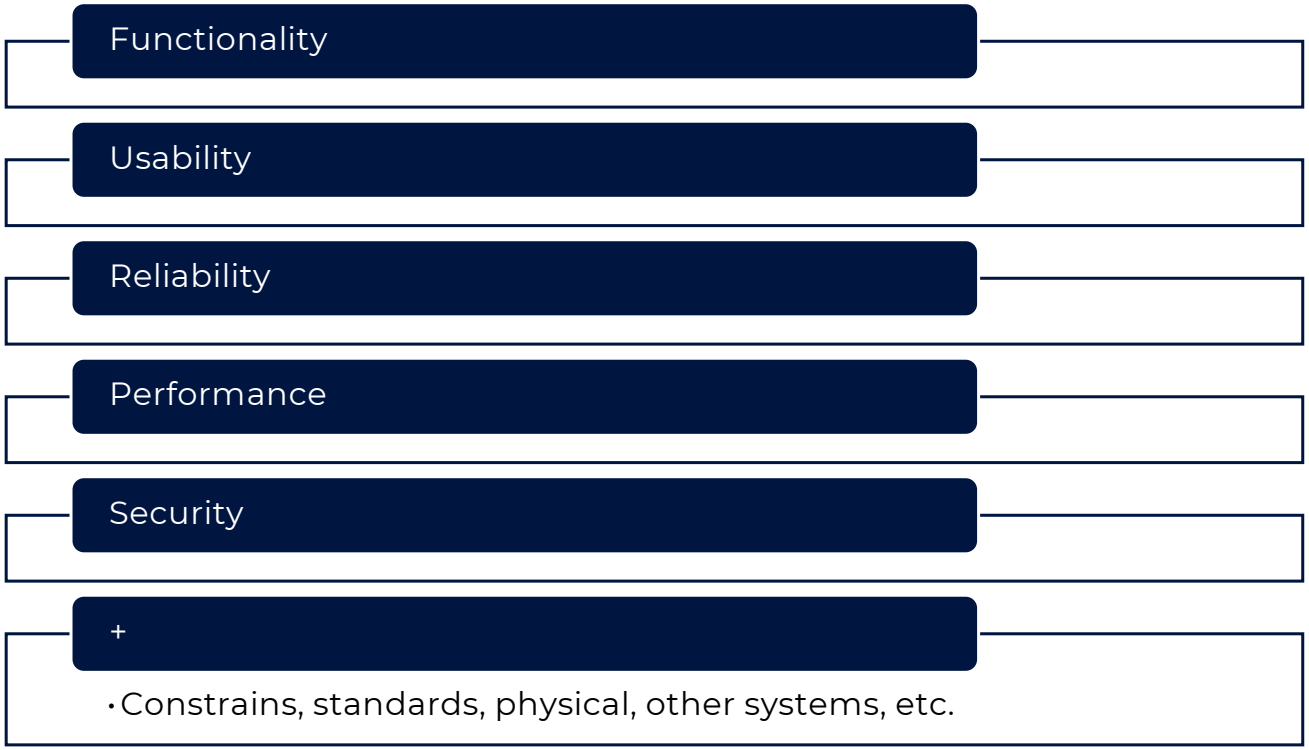
User Story

- Less structure than a ‘use case’

- A User Story is a one-sentence description of a work-related task done by a user to achieve some goal or result
- Acceptance Criteria identify the features that must be present at the completion of the task

- The template for a user story description is:
  - “As a <role> I want to <goal> so that <benefit>”

FRUPS+


Functionality
Usability
Reliability
Performance
Security
+
• Constrains, standards, physical, other systems, etc.

Who are the users/stakeholders?

- Not as obvious as you think:
  - those who interact directly with the product
  - those who manage direct users
  - those who receive output from the product
  - those who make the purchasing decision
  - those who use competitor's products

- Three categories of user (Eason, 1987):
  - **Primary:** frequent hands-on
  - **Secondary:** occasional or via someone else
  - **Tertiary:** affected by its introduction, or will influence its purchase

What do we mean by the user's 'needs'?

ALSO CONSIDER WHEN CONDUCTING INTERVIEWS

- Users rarely know what is possible
- Users can't tell you what they 'need' to help them achieve their goals

- Instead, look at existing tasks:
  - their context
  - what information do they require?
  - who collaborates to achieve the task?
  - why is the task achieved the way it is?

- Envisioned tasks:
  - can be rooted in existing behaviour
  - can be described as future scenarios

What, how and why?

- What needs to be achieved?
- Understand as much as possible about users, task, context
- Produce a stable set of requirements
- How can this be done?
- Data gathering activities
- Data analysis activities
- Expression as ‘requirements’

All of this is iterative

Personas

- Capture a set of user characteristics (user profile)
- Not real people, but synthesised from real users
- Should not be idealised
- Bring them to life with a name, characteristics, goals, personal background
- Develop a small set of personas with one primary

Task analysis

- Task descriptions are often used to envision new systems or devices
- Task analysis is used mainly to investigate an existing situation
- It is important not to focus on superficial activities
  - What are people trying to achieve?
  - Why are they trying to achieve it?
  - How are they going about it?
- Many techniques, the most popular is Hierarchical Task Analysis (HTA)

Example Hierarchical Task Analysis

0. In order to buy a DVD
1. locate DVD
2. add DVD to shopping basket
3. enter payment details
4. complete address
5. confirm order

- Plan 0: If regular user do 1-2-5.
  If new user do 1-2-3-4-5.

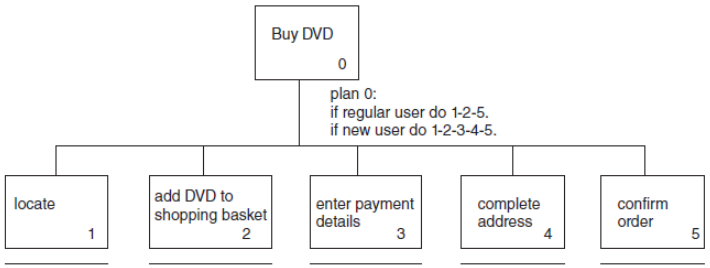


Figure 10.15 A graphical representation of the task analysis for buying a DVD

Card Sorting

- generate information about the associations and grouping of specific data items
- Technology:
  - Low-tech method using index cards or post-it notes
  - High-tech method (e.g. uxSort or UserZoom)
- Typically conducted as a:
  - Series of individual exercises
  - Concurrent activity in a small group
  - Mixed approach (individual then group discussion - differences)
- Typically conducted early in the design phase of a project for defining a systems architecture
- Open vs. Closed sorts
- See:
  - http://measuringuserexperience.com/CardSorting/index.htm
  - https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/card-sorting

The value of Wireframing

- Identify the interfaces functionality
- Identify a pages space allocation
- Ensure consistency for particular elements in an interface
- Links between a systems information architecture and its visual design

Storyboards

- Designed to illustrate the interaction between the user and the product
- Drawings, sketches and pictures that tell a story
- Creates meaning beyond a typical technical drawing (e.g. flowchart)

- https://blogs.msdn.microsoft.com/crm/2006/11/02/using-storyboard-prototypes-in-your-design-process/
- http://www.usabilitybok.org/storyboard
- https://uxmag.com/articles/storyboarding-in-the-software-design-process

Prototyping

- What is a prototype?
- Why prototype?

- Different kinds of prototyping
  - Low fidelity
  - High fidelity

- Compromises in prototyping
  - Vertical: provide a wide range of functions, but with little detail
  - Horizontal: provide a lot of detail for only a few functions

- Final product needs to be engineered

Type	Advantages	Disadvantages
Low-fidelity prototype	Lower development cost Evaluates multiple design concepts Useful communication device Addresses screen layout issues Useful for identifying market requirements Proof of concept	Limited error checking Poor detailed specification to code to Facilitator-driven Limited utility after requirements established Limited usefulness for usability tests Navigational and flow limitations
High-fidelity prototype	Complete functionality Fully interactive User-driven Clearly defines navigational scheme Use for exploration and test Look and feel of final product Serves as a living specification Marketing and sales tool	More resource-intensive to develop Time-consuming to create Inefficient for proof-of-concept designs Not effective for requirements gathering

Table 11.3 Advantages and disadvantages of low- and high-fidelity prototypes

Testing Concepts

- Testing – the process of examining a component, subsystem, or system to determine its operational characteristics and whether it contains any defects
- Test case – a formal description of a starting state, one or more events to which the software must respond, and the expected response or ending state
  - Defined based on well understood functional and non-functional requirements
  - Must test all normal and exception situations
- Test data – a set of starting states and events used to test a module, group of modules, or entire system
  - The data that will be used for a test case

Usability Evaluation Methods (UEMs)

Quick and Dirty Evaluations

- Informal (throughout UCD)

Usability Testing

- Measuring user performance

Field Studies

- In natural settings

Predictive Evaluation

- Expertise

Usability Evaluation Methods (UEMs)

- User-Based Evaluation
  - Performance, non-verbal behaviour, attitude, cognition, stress and motivation
  - user experience and the interconnectivity that exists between usability and user experience (Vermeeren et al., 2010)
    - *(Quick and Dirty, Usability Testing, Field Studies)*
- Expert-Based Evaluation
  - Conformance and attitude
    - *(Quick and Dirty, Predictive Evaluation)*
- Theory Based Evaluation
  - Performance (idealised)
    - *(Predictive Evaluation)*

(Sweeney et al. 1993)

Revised version (2014) of Nielsen's original heuristics

- Visibility of system status
- Match between system and real world
- User control and freedom
- Consistency and standards
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help users recognize, diagnose, recover from errors.
- Help and documentation

Accessibility and Special Issues in HCI

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Disabilities affecting computer accessibility

- Visual impairments
  - Blindness, low vision, colour blindness
- Hearing disabilities
- Speech impairments
- Mobility impairments
- Cognitive impairments

- Literacy

Assistive Technologies

- Devices designed to provide people with solutions to allow them to perform typical activities that they would not have otherwise be unable to do.

- Assistive technology: hardware or software added to or connected to a system that increases accessibility for an individual NOTE 1: Examples are Braille displays, screen readers, screen magnification software and eye tracking devices that are added to the ICT.
- NOTE 2: Where ICT does not support directly connected assistive technology, but which can be operated by a system connected over a network or other remote connection, such a separate system (with any included assistive technology) can also be considered assistive technology. (EN 301 549, 2014)

- Can be: Low Tech, Medium Tech, High Tech

Web Content Accessibility Guidelines (WCAG) 2.1

- Stable, referenceable technical Stranded.
- 13 Guidelines
  - Organised under 4 principles
    - Perceivable
    - Operable
    - Understandable
    - Robust
- Testable Criteria
- Three levels
  - A, AA and AAA

WCAG 2.1 at a Glance

- Perceivable
  - Provide text alternatives for non-text content.
  - Provide captions and other alternatives for multimedia.
  - Create content that can be presented in different ways, including by assistive technologies, without losing meaning.
  - Make it easier for users to see and hear content.
- Operable
  - Make all functionality available from a keyboard.
  - Give users enough time to read and use content.
  - Do not use content that causes seizures or physical reactions.
  - Help users navigate and find content.
  - Make it easier to use inputs other than keyboard.
- Understandable
  - Make text readable and understandable.
  - Make content appear and operate in predictable ways.
  - Help users avoid and correct mistakes.
- Robust
  - Maximize compatibility with current and future user tools.

https://www.w3.org/WAI/standards-guidelines/wcag/glance/

Models, Theories and Risks

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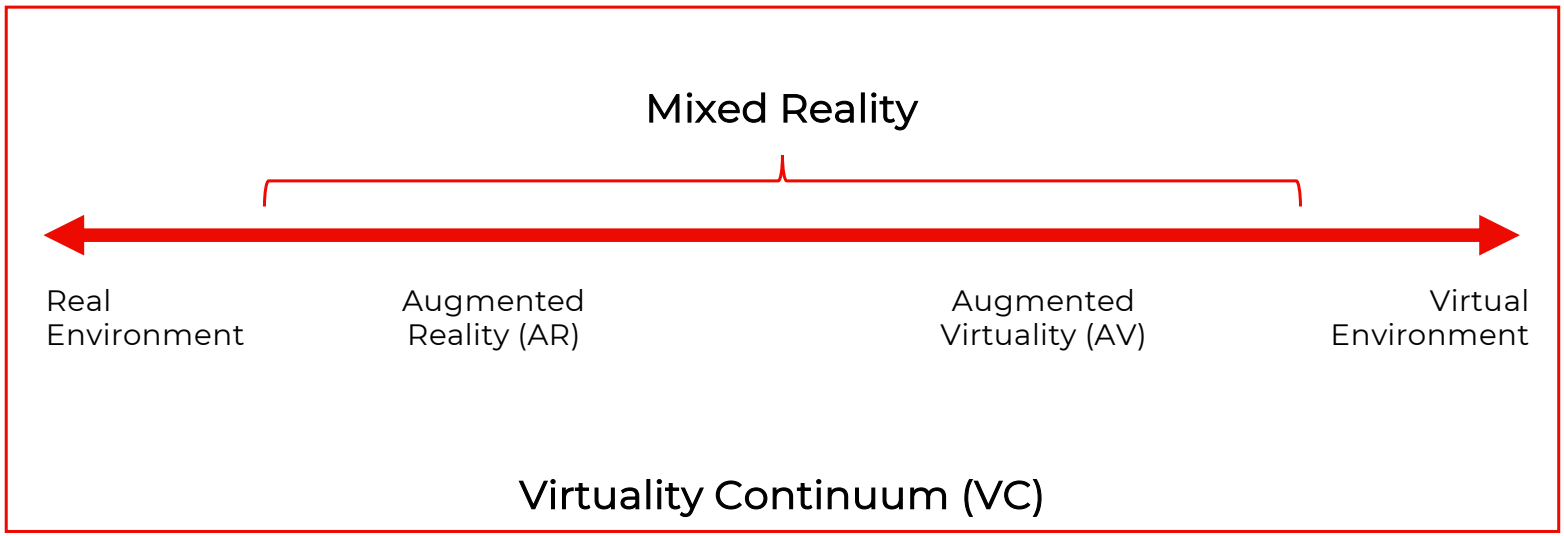
Models and Theories in HCI

- Technology Acceptance Model
- NASA:TLX
- Digital Convergence
- Diffusion of Innovations/ Consequences of Innovations
- Anthropomorphic Approaches
- Cognitive Approaches
- User Centred Design
- Fitt's Law
- Activity Theory
- Persuasive Systems Design
- Gamification

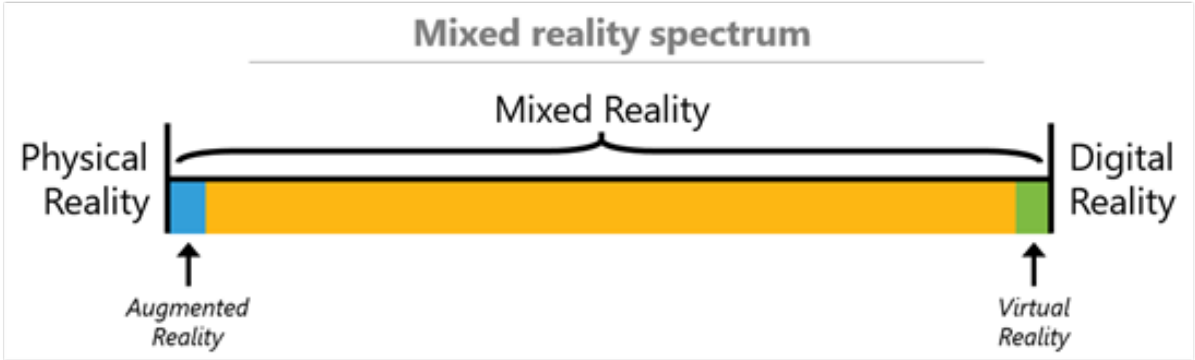
Risks in HCI

- Errors
- System Failures
- Consequences
  - Desirable
  - Anticipated
  - Direct

Milgram and Kishino (1994)



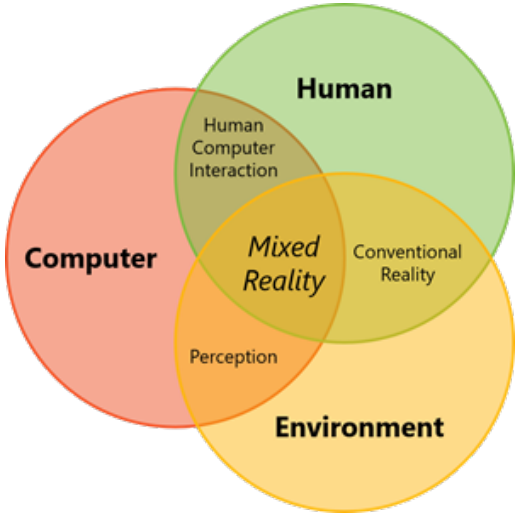
Still referenced today (Microsoft [Bray and Zeller] 2018)



Definitions

- Mixed Reality (MR)
  - The merging of real and virtual worlds
- Augmented Reality (AR)
  - Computer graphic enhancement of video images of real scenes
- Virtual Reality (VR)
  - “Environment is one in which the participant-observer is totally immersed in, and able to interact with, completely synthetic world” (Milgram and Kishino 1994)
  - Exceeds the bounds of space, time, mechanics and material properties

Mixed Reality – Microsoft



- Augmented Reality example:
  - https://www.youtube.com/watch?v=0J-JjHam3zQ

Future Interfaces – how will each of these change the human-computer paradigm?

SENSORS
WEARABLE
GESTURE
BRAIN-COMPUTER INTERFACES
FLEXIBLE SCREENS
TANGIBLE

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Questions

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