HUMAN-COMPUTER INTERACTION

Course Objectives

- To understand the principles of human computer interaction Design
- To be able to undertake the evaluation and Design of Usable computer interfaces

Course administration

- Deadlines are hard deadlines, you can submit early.
- Plagiarism will not be tolerated
- 75% attendance is needed to write the exam
- Continuous Assessment (60%)
  - Attendance and Class participation (10%)
  - Impromptu tests
  - Group projects
  - Individual projects
- Final Exam – 40%
  - Written Exam

Introduction

Chapter 1 and 2

WHAT IS HCI

- A field of computer science concerned with studying how people relate with computers and how to make that interaction better (more natural).
- It deals with the design, execution and assessment of computer systems and related phenomenon that are for human use
- A central concern of interaction design is to develop interactive products that are usable.

Why are we studying it?

- **It contributes to and over laps with many disciplines:** IS, SE, Graphics, Industrial Design etc
- **Many people are involved in it:** Interaction design is ideally carried out by multidisciplinary teams, where the skill sets of engineers, designers, programmers, psychologists, anthropologists, sociologists, marketing people, artists, toy makers, product managers, and others
- **It's a viable career path:** UI/UX Designers, Researchers

Good and Poor Design

Products should be designed to support the activities of users.

Designing interactive products requires:

- Considering who is going to be using them, how they are going to be used, and where they are going to be used.
- Understanding the kind of activities people are doing when interacting with these products.

The process of interaction Design

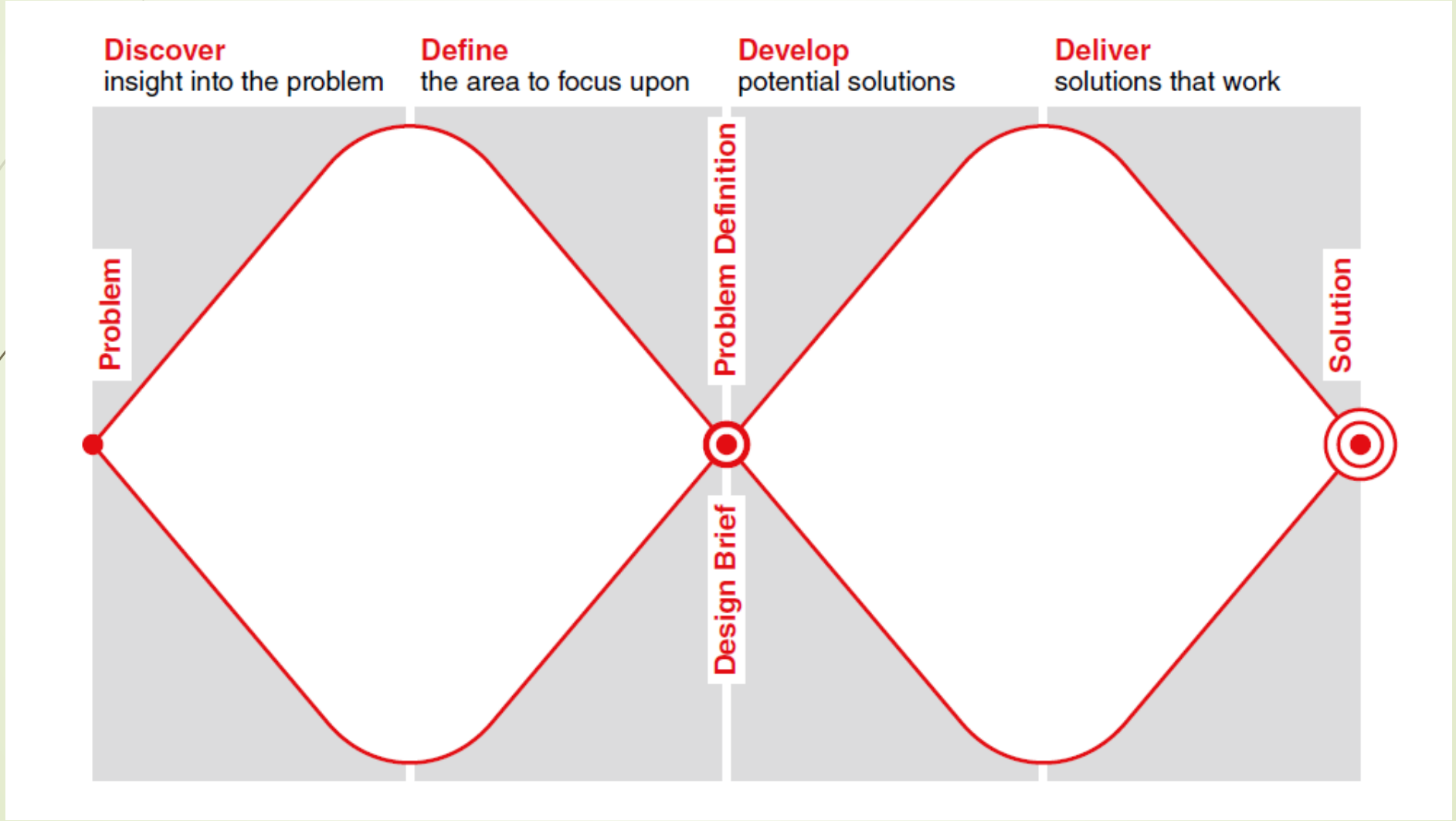
- Interaction design has specific activities focused on discovering requirements for the product, designing something to fulfil those requirements, and producing prototypes that are then evaluated.

- Interaction design focuses attention on users and their goals.

4 Activities in Interaction Design

- **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.

USER-CENTERED DESIGN



Interaction Design Life Cycle

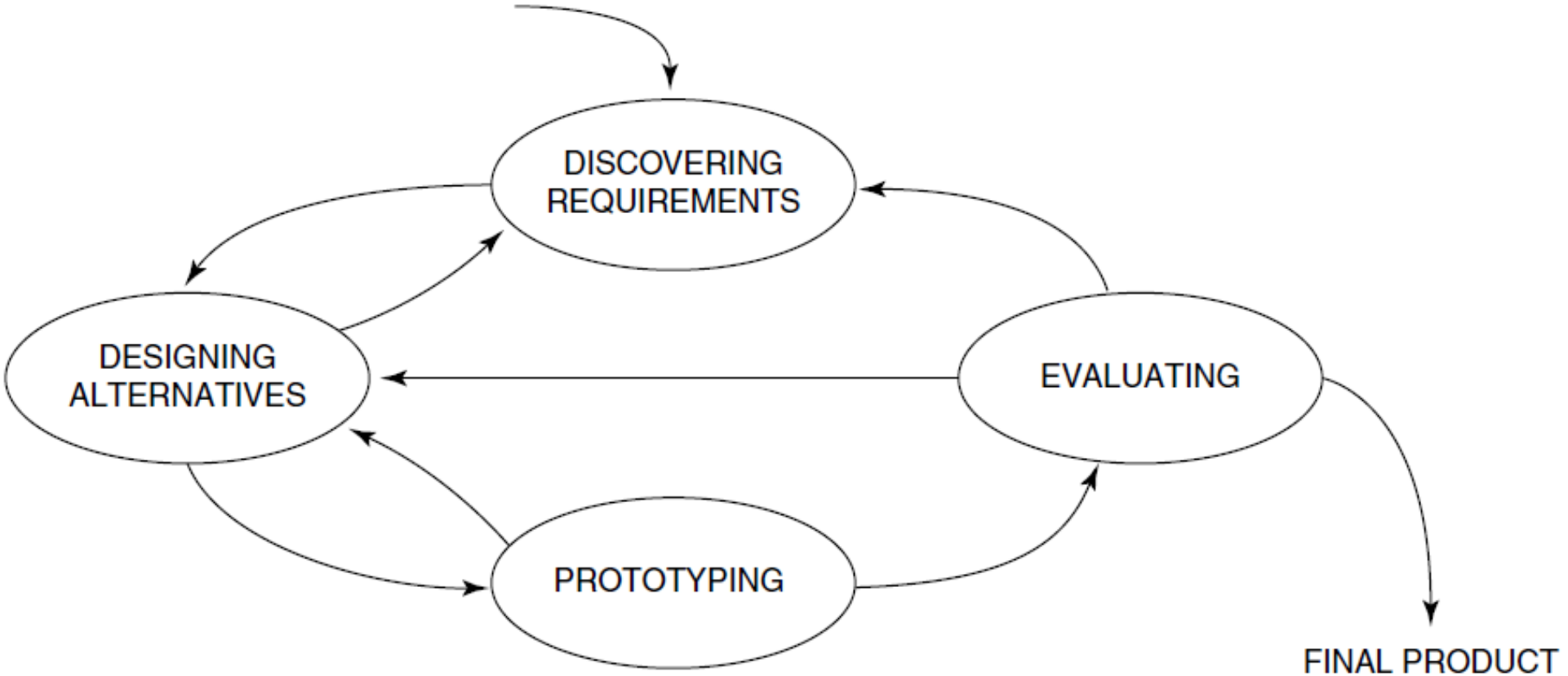


Figure 2.5 A simple interaction design lifecycle model

Activity

- Imagine that you want to design a product that helps you organize a trip. This might before a business or vacation trip, to visit relatives halfway around the world, or for a bike ride on the weekend—whatever kind of trip you like. In addition to planning the route or booking tickets, the product may help to check visa requirements, arrange guided tours, investigate the facilities at a location, and so on.
- 1. Using the first three phases of the double diamond of design, produce an initial design using a sketch or two, showing its main functionality and its general look and feel. This activity omits the fourth phase, as you are not expected to deliver a working solution.
- 2. Now reflect on how your activities fell into these phases. What did you do first? What was your instinct to do first? Did you have any particular artifacts or experiences upon which to base your design?

Discover

Chapter 3,4,8,9,11

Discover – Understand the problem

- the artifact's use and target domain are investigated by taking a **user-centered approach** to development, users' opinions and reactions to early designs are sought, and users are involved appropriately in the development process itself.
- Understand what is currently the user experience or the product, why a change is needed, and how this change will improve the user experience

Understanding the problem

- Are there problems with an existing product? If so, what are they? Why do you think there are problems?
- Why do you think your proposed ideas might be useful? How do you envision people integrating your proposed design with how they currently do things in their everyday or working lives?
- How will your proposed design support people in their activities? In what way does it address an identified problem or extend current ways of doing things? Will it really help?

Understanding users

- **What is cognition?** Conscious mental activities – thinking, learning, remembering, daydreaming, understanding
  - What goes on in the mind.
  - attention
  - perception and recognition
  - memory
  - learning
  - reading, speaking, and listening
  - problem solving, planning, reasoning, decision making

Understanding users

- **User classes:**
  - Direct Users
  - Indirect Users
  - Remote Users
  - Support Users
  - Mandatory Users
  - Discretionary users
- **Levels of Expertise:**
  - Novice User
  - Intermittent User
  - Expert User

Understanding users

- **Gathering Information from Users**
  - **Informal and formal discussion**
  - **Observations**
  - **Use of expert**
  - **Questionnaire**
  - **interview**

Understanding Users

- **Applying knowledge from the physical world to the digital world**
  - understand the nature of the problem being addressed in the electronic world in relation to the various coping and externalizing strategies people have developed to deal with the physical world.

Understanding Users

- **Cognition**
  - **Experiential cognition** is a state of mind where people perceive,
  - **Reflective cognition** involves mental effort, attention, judgment, and decision-making, which can lead to new ideas and creativity
  - **external cognition:** explaining the cognitive processes involved when we interact with different external representations
    - 1. externalizing to reduce memory load
    - 2. computational offloading
    - 3. annotating and cognitive tracing

Understanding Users

- **Cognitive processes**
  - **Attention:** What to concentrate on. Clear goals, Information Presentation, Multitasking
  - **Perception:** Acquiring information form the environment.
  - **Memory:** Recalling knowledge. Personal Information Management, memory Load,
  - **Learning:** Accumulation of skills and knowledge. Incidental and Intentional learning.
  - **Reading, Listening, Speaking:** Forms of language processing.
  - **Problem Solving, Planning, Reasoning, and decision-making:** Thinking about what to do.

Understanding Users

- **Conceptual frameworks for understanding cognition**
  - **Mental models:** develop knowledge of how to use the system and, to a lesser extent, how the system works. Mental models have been postulated as internal constructions of some aspect of the external world that are manipulated enabling predictions and inferences to be made
  - **Information processing:** Information is thought to enter and exit the mind through a series of ordered processing stages. Within these stages, various processes are assumed to act upon mental representations
  - **External cognition:** explaining the cognitive processes involved when we interact with different external representations
    - 1. externalizing to reduce memory load
    - 2. computational offloading
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Data Gathering

Data can be numbers, words, measurements, descriptions, comments, photos, sketches, films, videos, or almost anything that is useful for understanding a particular design, user needs, and user behaviour. Data can be quantitative or qualitative. For example, the time it takes a user to find information on a web page and the number of clicks to get to the information are forms of quantitative data.

- 5 IMPORTANT ISSUES
  - Goal setting,
  - Identifying participants
  - the relationship between the data collector and the data provider,
  - Triangulation, and
  - Pilot studies.

Data Gathering

- DATA RECORDING
  - Notes Plus Photographs
  - Audio Plus Photographs
  - Video

Data Gathering

- DATA RECORDING – Activity

Imagine that you are a consultant who is employed to help develop a new augmented reality garden planning tool to be used by amateur and professional garden designers. The goal is to find out how garden designers use an early prototype as they walk around their clients' gardens sketching design ideas, taking notes, and asking the clients about what they like and how they and their families use the garden. What are the advantages and disadvantages of the three approaches (note-taking, audio recording with photographs, and video) for data recording in this environment?

Data Gathering

- METHODS
  - Interviews – structured, unstructured, semi structured, focus groups, remote interviews/focus groups.
  - Questionnaires – structure, question and response format, administering questionnaires
  - Observations – direct (field or controlled), indirect (diaries, logbooks, blogs, web analytics,

Data Analysis

Making sense of data collected.

Scenario: A global company ran a survey of it's customer service department. The results show that the average time to respond to a customer request is much higher in the London office than in the New York office. What does this result say about the London office customer service department?

Data Analysis

- METHODS
  - Quantitative: uses numerical methods to ascertain the magnitude, amount, or size of something
  - Qualitative: focuses on the nature of something and can be represented by themes, patterns, and stories
  - Note: Quantitative data can be extracted from qualitative data

Data Analysis

- STEPS
  - Initial Steps: Data immersion, Data Cleaning, Data Entry, Transcription

"Looks good. Let me run it past the number-crunchers."

Source: Mike Baldwin / Cartoon Stock

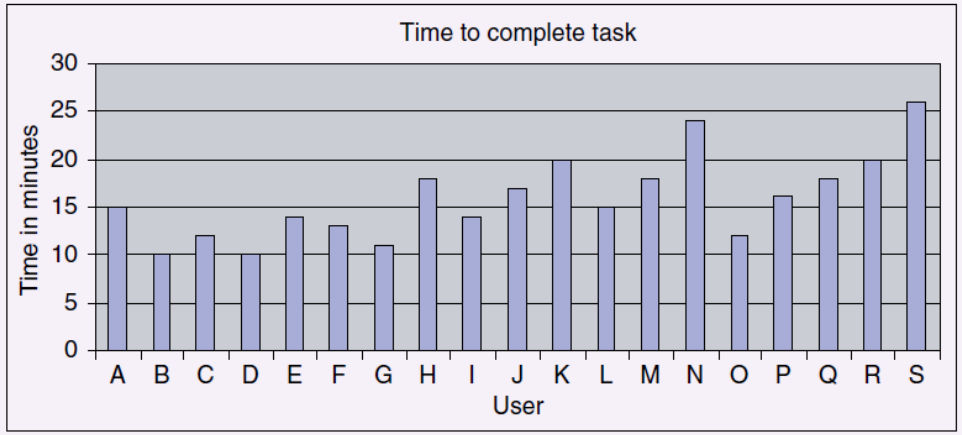
Data Analysis

- STEPS
  - Basic Quantitative Analysis: Using statistical summaries – averages, percentages, standard deviation

User	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Time to complete (mins)	15	10	12	10	14	13	11	18	14	17	20	15	18	24	12	16	18	20	26

Comment

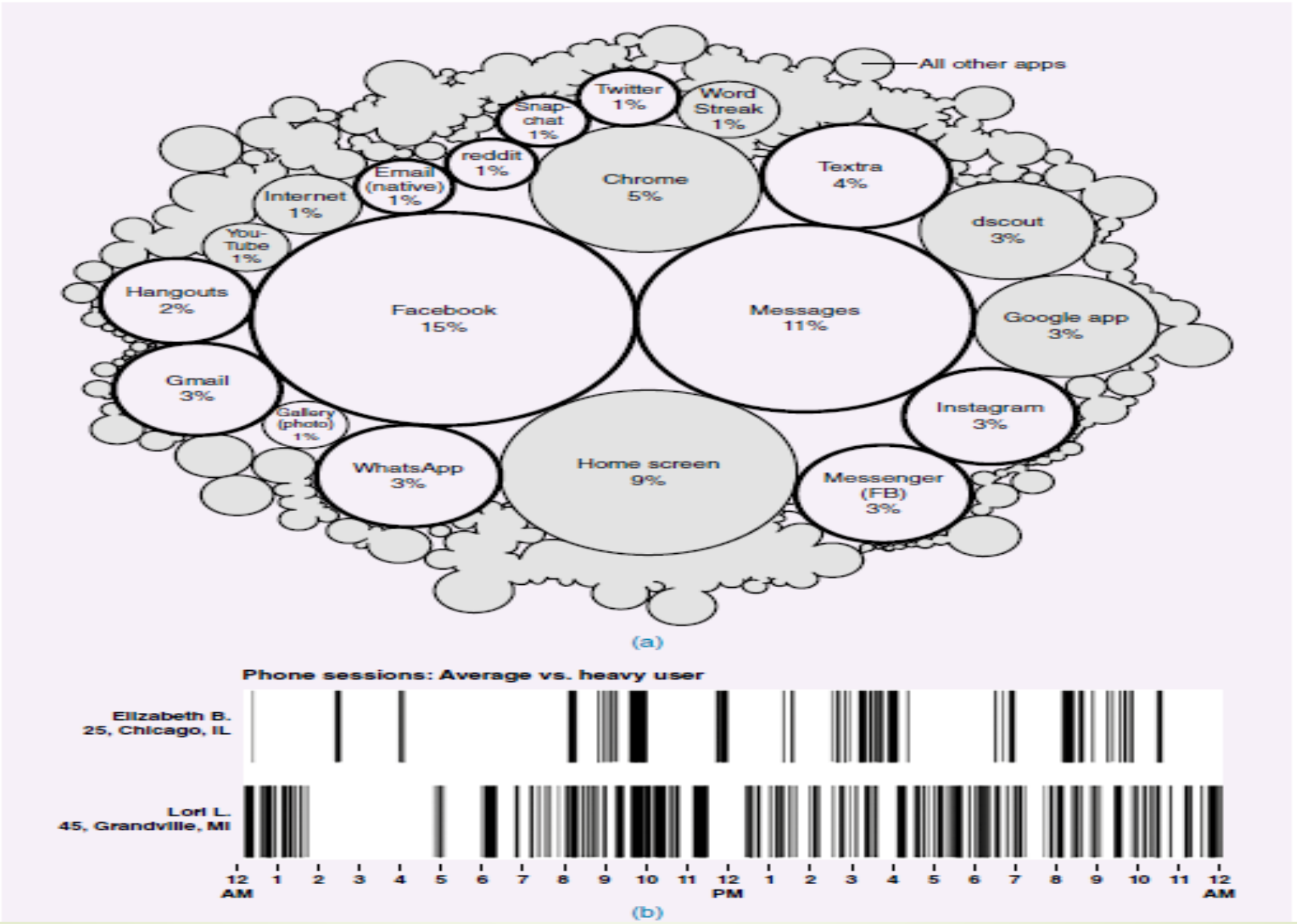
The bar graph and scatter diagram are shown here.



Data Analysis

- STEPS
  - **Basic Qualitative Analysis:** identifying themes, categorizing data, and analysing critical incidents.
  - A **theme** represents a pattern of some kind, perhaps a particular topic or feature found in the data set, which is considered to be important, relevant, and even unexpected with respect to the goals driving the study.
  - **Affinity Diagrams** are used to collate themes
  - **Categories** can be derived deductively or inductively
  - **Critical Incidents:** identify specific incidents that are significant and then to focus on these and analyze them in detail, using the rest of the data collected as context to inform interpretation.

Data Interpretation and Presentation



Data Interpretation and Presentation

- **Charts and graphs:** Bar chart, Pie Chart, Scatter plot, box plot
- **Structured notations:** UML, Flowchart, Mind Maps
- **Stories :** Using narratives
- **Summarizing:** combining the presentations to form a summary of the findings.

- Note: Careful interpretation and presentation of the study results is just as important as choosing the right analysis technique so that findings are not over-emphasized, and evidence is not misrepresented

Define

Chapter 3 - 7

Define

- Involving users in development is important because it's the best way to ensure that the end product is usable and that it indeed will be used.
- The best way to ensure that developers gain a good understanding of users' goals, leading to a more appropriate, more usable product, is to involve target users throughout development.
- **User-Centred Design:** the real users and their goals, not just technology, are the driving force behind product development

Identify needs and establishing requirements

- Establishing requirements is also not simply writing a wish list of features.
- What, how, why?
  - Understand users, their work and context
  - Gather data, interpret, extract requirement
  - Requirements can make or break your product

Identify needs and establishing requirements

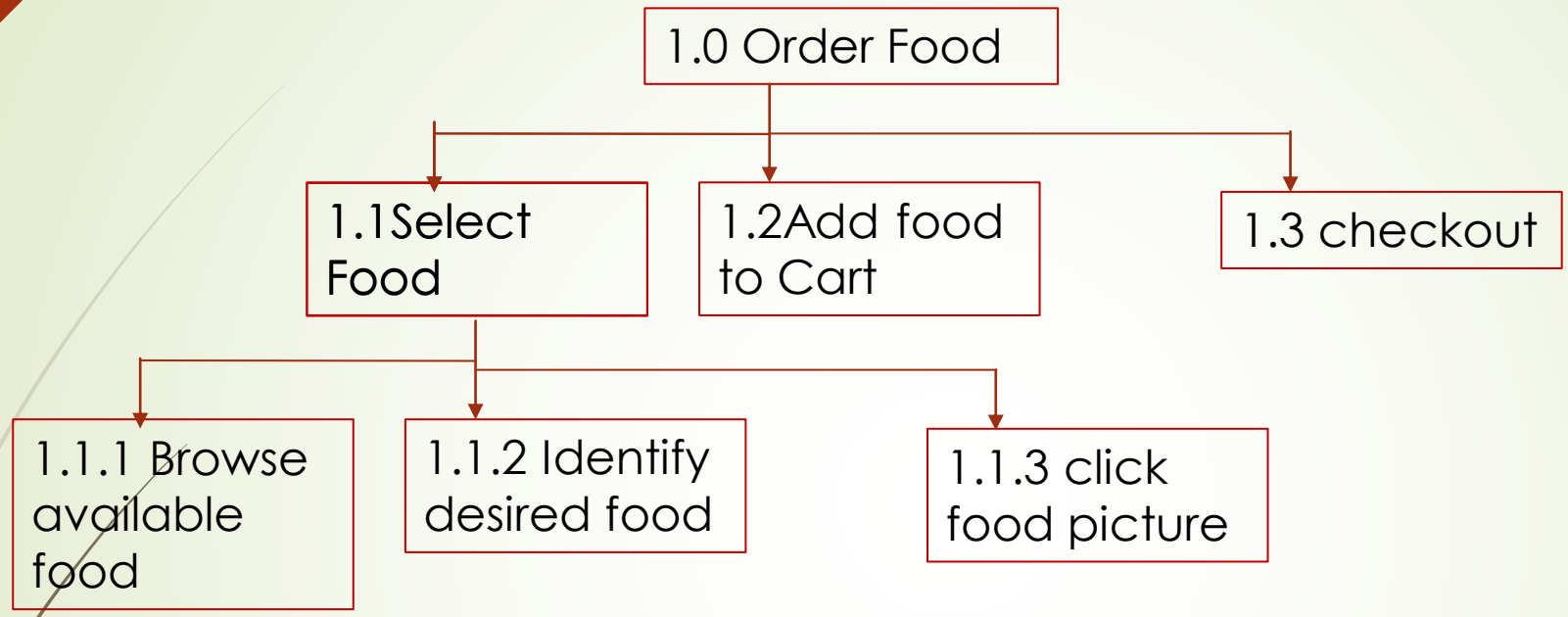
- What is a requirement?
  - A requirement is a statement about an intended product that specifies what it should do or how it should perform.
- Types of requirements
  - Functional: what the system should do
  - Non-Functional: constraints on the system and its development
  - Data, Environment (social, org, tech, physical), User, usability,

Identify needs and establishing requirements

- Data gathering techniques: questionnaires, interviews, focus groups and workshops, natural observations, studying documentation
- Which technique should you choose?
  - It depends on the
- Data gathering guidelines
  - Focus on your stakeholders
  - Involve representative number of stakeholders
  - Combine data gathering techniques
  - Run pilots

Identify needs and establishing requirements

- Data analysis
  - Scenarios - stories
  - Use cases –focuses on user goals
  - Essential use cases - represent abstractions from scenarios
- Task analysis
  - techniques for investigating cognitive processes and physical actions, at a high level of abstraction and in minute detail.
  - HTA: It involves breaking a task down into subtasks and then into sub-subtasks and so on


1.0 Order Food
1.1Select Food
1.2Add food to Cart
1.3 checkout
1.1.1 Browse available food
1.1.2 Identify desired food
1.1.3 click food picture

USER-CENTERED DESIGN

- Designing usable interactive products thus requires considering who is going to be using them and where they are going to be used.
- What activities will they be doing while interacting with the system
- Understand the user and the problem

Conceptualizing Design

- When coming up with new ideas as part of a design project, it is important to conceptualize them in terms of what the proposed product will do.
- One reason for needing to do this is as a reality check where fuzzy ideas and assumptions about the benefits of the proposed product are scrutinized in terms of their feasibility
- Another reason is to enable designers to begin articulating what the basic building blocks will be when developing the product.
- We can ask why? What problem would this address?
- It is important to be clear about the underlying assumptions and claims.

Conceptual Models

- A model is a simplified description of a system or process that helps describe how it works
- ***a conceptual model provides a working strategy and a framework of general concepts and their interrelations***
- ***"a high-level description of how a system is organized and operates"***
- ***"a description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"***
- Based on activities
  - instructing
  - conversing
  - manipulating and navigating
  - exploring and browsing
- Based on Objects e.g spreadsheet, mobile phone

Conceptual Models

- Consists of
  - Metaphors and analogies
  - Concepts users are exposed to (e.g. domain objects, the attributes and operations)
  - Relationships between concepts
  - Mappings between concepts and user experience

Conceptual Models

- Interface Methaphors developed to be similar in some way to ***aspects*** of a physical entity (or entities) but that also has its own behaviors and properties (using familiar knowledge with new concepts)
  - Look alikes e.g. recycle bin, system message symbols
- Issues with interface methaphors
  - Breaks rules

Interface Metaphors

- They provide a structure that is similar in some way to aspects of a familiar entity (or entities), but they also have their own behaviours and properties. More specifically, an interface metaphor is one that is instantiated in some way as part of the user interface, such as the desktop metaphor.
- Interface metaphors are intended to provide familiar entities that enable people readily to understand the underlying conceptual model and know what to do at the interface.

Interaction types

- these are the ways a person interacts with a product or application.
- Based on activities
  - instructing
  - conversing
  - manipulating and navigating
  - exploring and browsing
  - responding
- Based on Objects e.g spreadsheet, mobile phone

Interaction paradigms

- ubiquitous computing (technology embedded in the environment)
- pervasive computing (seamless integration of technologies)
- wearable computing (or wearables)
- tangible bits, augmented reality, and physical-virtual integration
- attentive environments (computers attend to user's needs)
- the Workaday World (social aspects of technology use)

User Experience (UX)

- The user experience refers to how a product behaves and is used by people in the real world.
- Jakob Nielsen and Don Norman (2014) define it as encompassing “all aspects of the end-user's interaction with the company, its services, and its products.”

Understanding Users

- Understanding of people in the contexts in which they live, work, and learn
  - What do they want to achieve
  - What challenges do they face and why?

Accessibility and Inclusiveness

- Accessibility refers to the extent to which an interactive product is accessible by as many people as possible.
- Catering to different abilities (disabilities)

Usability and User Experience Goals

- Usability is ensuring that interactive products are easy to learn, effective to use, and enjoyable from the user's perspective.

Some ideas on usability

- easy to learn,
- effective to use,
- provide an enjoyable user experience.
- usability of a design depends on : ***where*** it is going to be used and ***who*** is going to use it.

USABILITY GOALS

- **Usability Goals:**
  - effective to use (effectiveness)
  - efficient to use (efficiency)
  - safe to use (safety)
  - have good utility (utility)
  - easy to learn (learnability)
  - easy to remember how to use (memorability)

USER EXPERIENCE GOALS

- **User Experience Goals:**
  - range of emotions and felt experiences.
  - Could be positive or negative

Usability Principles

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

Design Principles

Are generalizable abstractions intended to orient designers toward thinking about different aspects of their designs. Aid designer's thinking when designing for the user experience.

- Feedback
- Visibility
- Constraints
- Mapping
- Consistency
- Affordance

Other Design Concepts

- Paradigms - a general approach that has been adopted by a community of researchers and designers for carrying out their work in terms of shared assumptions, concepts, values, and practices
- Visions - a future scenario that frames research and development in interaction design— often depicted in the form of a film or a narrative
- Theories - a well-substantiated explanation of some aspect of a phenomenon;
- Models - a simplification of some aspect of human-computer interaction intended to make it easier for designers to predict and evaluate alternative designs
- Frameworks - a set of interrelated concepts and/or a set of specific questions that are intended to inform a particular domain area

Develop

Chapter 12,14,15

Develop

- Develop alternatives
- Prototypes

Designing Prototypes

- **Prototypes** provide concrete manifestation of concepts allowing users to interact with it and explore its suitability

Design

- Two aspects
  - Conceptual aspect: the idea – what the product will do and how it will behave
  - Concrete aspect: the details – actual implementation of features and behaviour

Designing Prototypes

- How to prototype
  - Paper prototypes
  - Wireframes
  - Physical mockup
  - Software
    - Graphics software – simulation,video
    - HTML/CSS

Designing Prototypes

Figure 12.1 The PalmPilot wooden prototype

Source: https://www.computerhistory.org/revolution/mobile-computing/18/321/1648. © Mark Richards

Designing Prototypes

Figure 12.14 Cards 1–3 of a card-based prototype for the travel organizer

Designing Prototypes

ACTIVITY 12.1

Produce a storyboard that depicts how to fill a car with fuel.

Comment

Our attempt is shown in Figure 12.6.

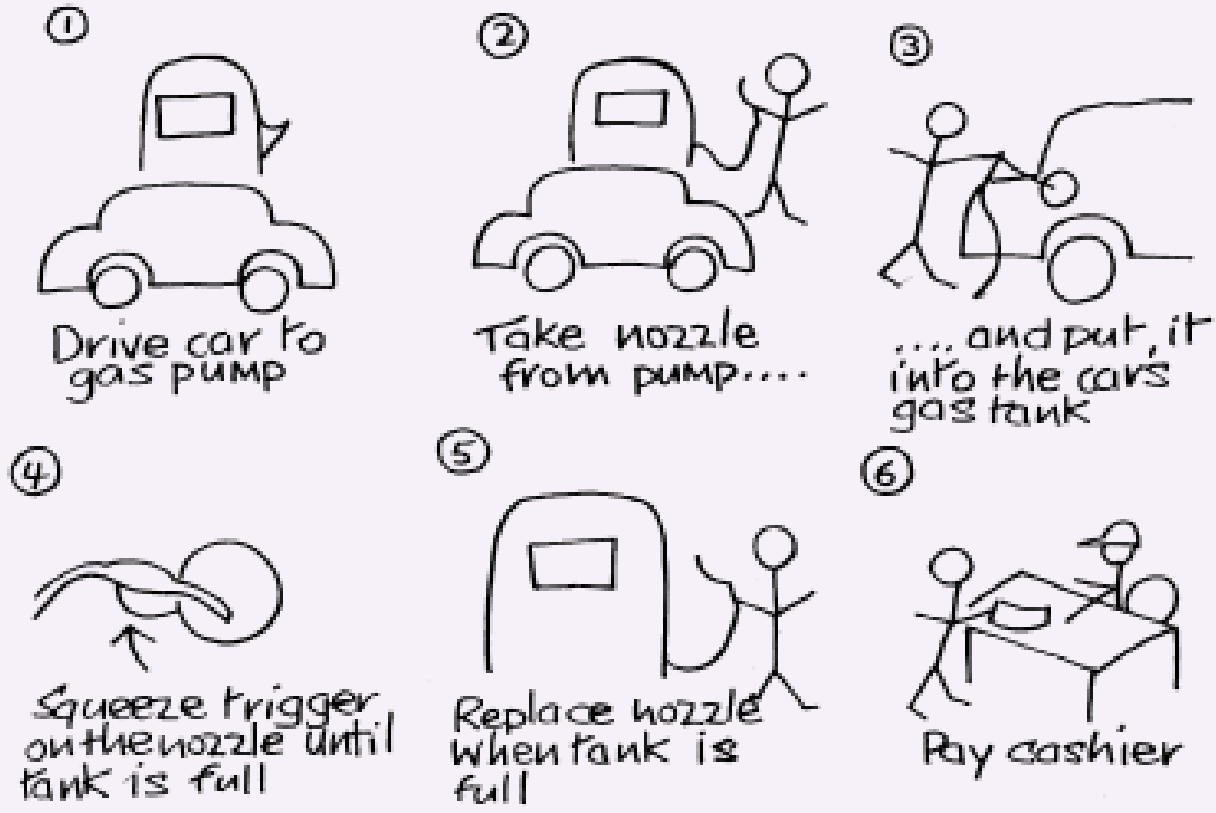


Figure 12.6 A storyboard depicting how to fill a car with fuel ■

Designing Prototypes

- Why prototype
  - Helps user figure out what they need
  - Helps designers choose between alternatives and determine feasibility

Designing Prototypes

- Types of prototypes
  - **Low-Fidelity**: simple, cheap, quick to make and modify e.g storyboards, sketching, using Index cards, Wizard of Oz
  - **High-Fidelity:** look more like the final product,

Designing Prototypes

- What will the prototype contain?

Designing Prototypes

- Other issues
  - Conceptual Model
  - Interface metaphors
  - Interaction Types
  - Interface Types: sharable, tangible, virtual reality

Designing Prototypes

- Activity: Produce a story board on how to get your lunch

Interaction Design Process

- **What is interaction Design?** In interaction design, we investigate the artifact's use and target domain by taking a user-centered approach to development.
- Design is also about trade-offs
- Four basic activities of interaction design:
  - Identifying needs and establishing requirements
  - Developing alternative designs
  - Building interactive versions of the designs
  - Evaluating designs

Interaction Design Process

- Three key characteristics of the interaction design process:
  - ***focus on users***
  - ***Specific usability and user experience goals***
  - ***Iteration***

- ***Practical Issues***
  - Who are the users?
  - What do we mean by needs?
  - How do you generate alternative designs?
  - How do you choose among alternatives?

Interaction Design Process

- Lifecycle models in HCI
  - The ***Star* Lifecycle Model**
  - **The Usability Engineering Lifecycle**

Design for collaboration and communication

- **Conversational mechanisms**
  - **HOW IS CONVERSING BY SMS AND WHATSAPP DIFFERENT?**
- **Coordination mechanisms:** a group of people act or interact together to achieve something
- **Awareness mechanisms:** involves knowing who is around, what is happening, and who is talking with whom

- **Ethnographic studies of collaboration and communication:** Observations of the setting, be it home, work, school, public place, or other setting, are made, examining the current work and other collaborative practices people engage in

How user Interfaces affect users

- An affective interface is one that produces a certain desired emotional response from the user.
- **Expressive interfaces:**
- **User frustration caused by:**
  - **1. Gimmicks**
  - **2. Error Messages**
  - **3. Overburdening** the **user**
  - **4. Appearance**

Evaluation

How would you find out whether it would appeal to them and whether they will use it?

- Why – To certify user satisfaction and product appropriateness
- What – What part(s) of the product to evaluate? Feature or whole?
- Where – Where should the evaluation take place? Lab or natural?
- When – At what phase of the design and development? Formative or summative?

Evaluation

- Types of Evaluation
  - Controlled setting with users
  - Natural setting with users
  - Any setting without users (inspections, cognitive walkthroughs etc)

Evaluation

- Types of Evaluation
  - Controlled setting with users
    - Usability Testing – conducted in labs with the aim of testing specific features or behaviours of the product.
    - The primary goal is to determine whether an interface is usable by the intended user population to carry out the tasks for which it was designed. This involves investigating how typical users perform on typical tasks.

Evaluation

- Types of Evaluation
  - Natural setting with users
    - Help identify opportunities for new technology
    - Establish the requirements for a new design
    - Facilitate the introduction of technology or inform deployment of existing technology in new contexts
    - Methods: observation, interviews, interaction logging

Evaluation

- Types of Evaluation
  - Any setting without users (inspections, cognitive walkthroughs etc)
    - Carried out by researchers: using modelling, heuristic evaluation, analytics etc

Evaluation

- Evaluation Studies
- Conducting experiments:
  - Have hypothesis
  - Experimental Design
  - Data Analysis – t-test
- Field Studies
  - Data collection and Participants
  - Data Analysis and Presentation

Evaluation

Other Issues

- Informing participants about their rights
- Making sure you take into account biases and other influences that impact how you describe your evaluation findings

Evaluation

1. Describe the tool being evaluated
2. What kind of setting was used for the evaluation?
3. What was the goal of the evaluation?
4. Describe the participants selected for the evaluation
5. Describe the research design – the experiment setup ans task given to the participants
6. What data collection methods were used?
7. What data analysis methods were used?
8. How was data recorded (what methods were used)?
9. What was the result of the evaluation
10. Outline three things you can do differently to improve the evaluation

DECIDE : An Evaluation Framework

- Determine Goals
- Explore the questions
- Choose the evaluation method
- Identify the practical issues
- Decide how to deal with them
- Evaluate, analyse, interpret and present data

Deliver

- Deliver the project to the user

FINAL PROJECT

- Create an interactive product using the knowledge from chapter 6-9.
  - Follow the lifecycle model for interaction design.
  - Discuss how your product satisfies the usability criteria discussed in chapter 1.
  - How would you measure these criteria?
  - Pg196 z

Exam Question

CMP441 restaurant is a 5-star restaurant serving over 3000 orders per day across their food, snacks and drinks selection. They serve walk-in customers (eat-in and take-away), off-site customers (telephone orders)

- **Problem:** CMP441 restaurant is finding it difficult to keep up with orders because
  - 1. Many times orders are mixed up or delayed for walk-in customers. They management wants to resolve this by using a mobile app for taking orders from walk-in customers using tablets/kiosks inside the restaurant.
  - 2. Customers complain that the telephone ordering system is cumbersome since they don't have access to the current list of food available. They would prefer web-based ordering to enable them make quick selections.
- **Job:** You have been contracted to proffer a solution to Problem 1 **or** Problem 2 above.
  - Show at least two iterations of your design.
  - Evaluate your final design

Exam Question

- **Your Submission: Report (max 10pg A4,12pt + final prototype**
  - Discuss your Design decisions
  - Discuss your usability decisions
  - Discuss your conceptual model (interface metaphors, interaction types, interface types, features, supported activities, information req, data req. etc)
  - Discuss the design process based on the "Four basic activities of interaction design"
  - Screenshots of final prototype/product

- **Submission:** 6th February group presentation @softwarelab 10am