HUMAN COMPUTER INTERACTION

Lecture 1 Overview: Introduction to HCI

- What is HCI?
- History / Evolution of HCI
- Future of HCI
- Does HCI Matter?

WHAT IS HCI?

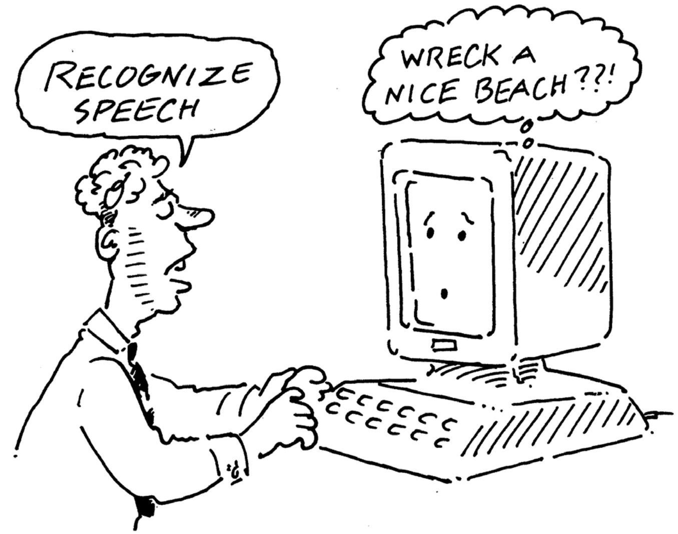
*"A discipline concerned with the **design**, **evaluation** and **implementation** of interactive computing systems for human use, and with the study of major phenomena surrounding them."*

(ACM SIGCHI, 1992)

WHAT IS HCI?

"HCI has grown to be broader, larger and much more diverse than computer science itself. HCI expanded from its initial focus on individual and generic user behavior to include social and organizational computing, accessibility for the elderly, the cognitively and physically impaired, and for all people, and for the widest possible spectrum of human experiences and activities. It expanded from desktop office applications to include games, learning and education, commerce, health and medical applications, emergency planning and response, and systems to support collaboration and community. It expanded from early graphical user interfaces to include myriad interaction techniques and devices, multi-modal interactions, tool support for model-based user interface specification, and a host of emerging ubiquitous, handheld and context-aware interactions."

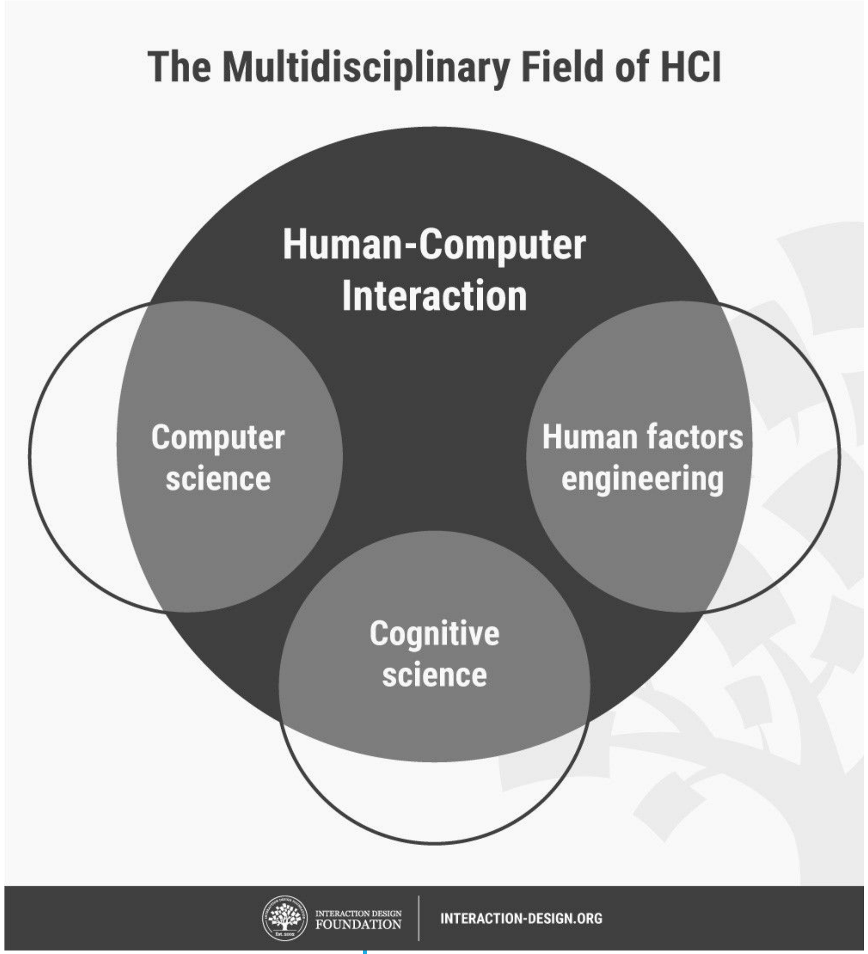
John M. Carroll, author and a founder of the field of human-computer interaction.



HUMAN COMPUTER INTERACTION?

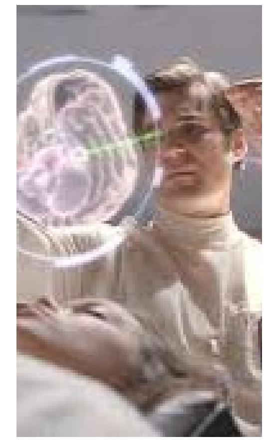
Initial HCI focus on computers and first-time use evolved to consider:

- Overall user Experience
- Flow (how users make use of and/or move through an interface)
- Fun/User Enjoyment
- Well-being (addiction, dependency, positive computing)
- Support for human development



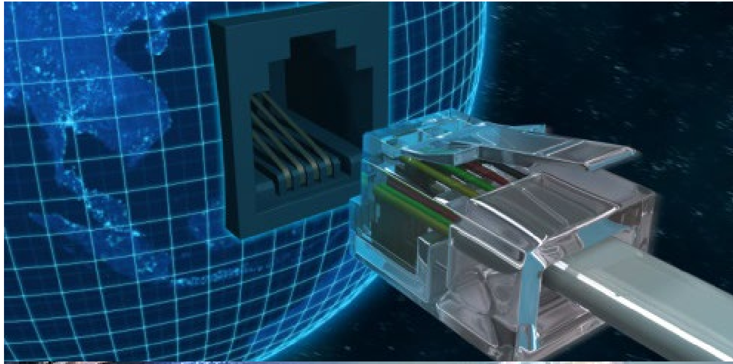
HISTORY / EVOLUTION OF HCI

- Start of Human Computer Interaction?
- First Computer?
- First Mechanical Computer?
- First Electronic Computer?
- Personal Computer?
- Mobile Computer?
- Wearable Computer?



FUTURE HCI?

- Technologies
- Applications
- Novelty: Le Petit Chef

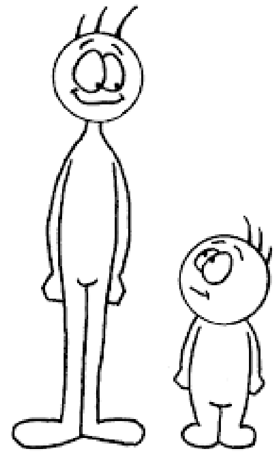


DOES IT MATTER?

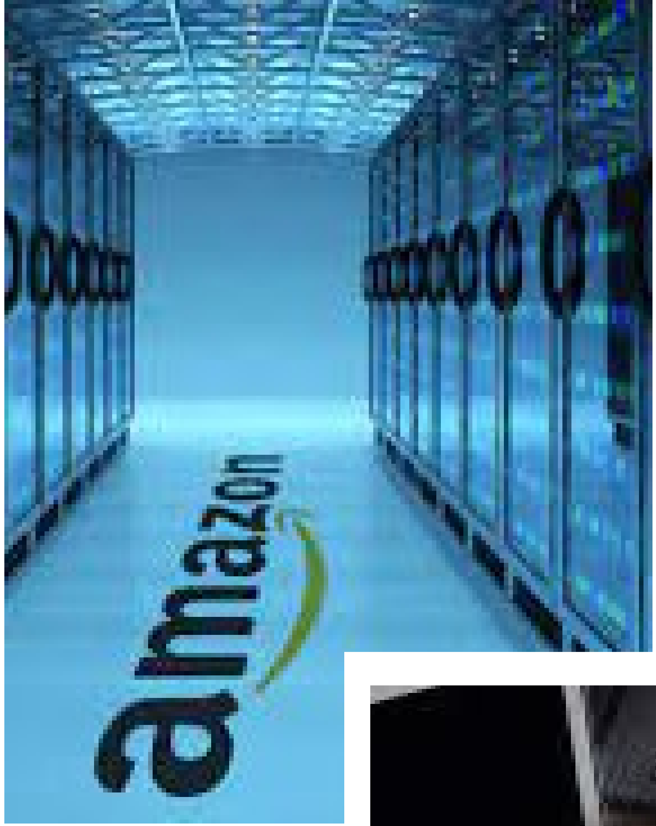
- Design of computer systems that serve human purpose

- “*Interaction designers can make an effort to keep simple tasks easy for the user, and to make complex tasks possible.*”
  Alan Kay

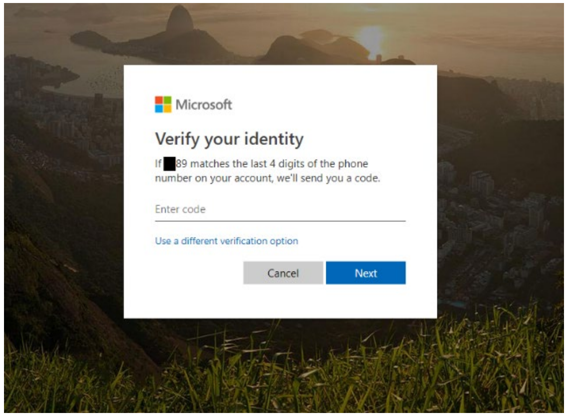
- Examples?



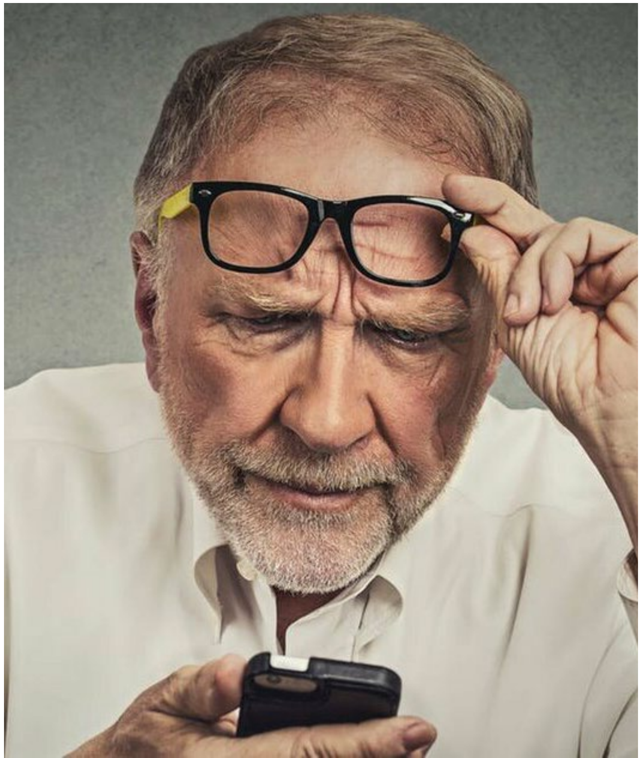
HUMAN?



COMPUTER?



INTERACTION?



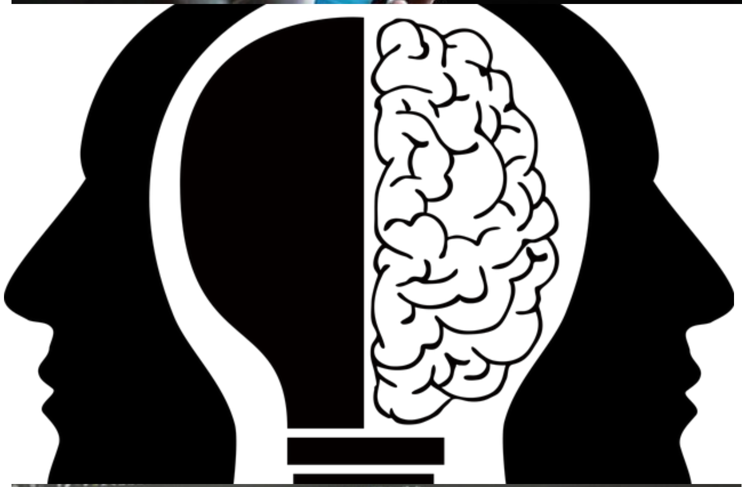
KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE,
UNIVERSITY OF GALWAY, SEMESTER I 2023-2024

WHY DOES IT MATTER?

- What is computer doing?
  - Computing: algorithms, DP
  - Information: storage, retrieval
  - Data: data analysis, visualization
  - AI: prediction, creation
- What is human doing?
  - Interacting: how?
  - Manipulating
  - Selecting
  - Memory
  - Creating

HCI: ALAN DIX

- HCI: Academic and Applied Design discipline
- Academic study of technology and its impact on people (psychology, physiology, social)
- Design: practical translation of academic insights into technical interventions that make a difference to people
- HCI:
  - Knowledge: facts/information
  - Analysis: problems, opportunities
  - Creativity: creation of effective designs



What will I do in HCI?

hottrixdownload.com

1. Define Problems: Requirements Identification / Ask Questions
2. Represent Requirements / User Needs: maps, stories
3. Create Alternative Designs: Prototyping
4. Create Interactive Technical Solutions
5. Critique: Good Design?
6. Evaluate prototypes and working systems

➔ Knowledge, Analysis, Design to benefit humanity (Attitude) Dix

HCI ASSESSMENT:

Course Assignments:

MCQ * 5: [5 Marks]

Group Project: [25 Marks]

- User Research
- Conceptual Prototypes
- Interactive Prototype
- Evaluation

Examination [70 Marks]

HCI PROJECT

HCI: Design Project:

“The end product is intended to enhance the quality of life of the people who will use it.

- **It does not rush to a solution**. Given a problem, it stops to observe and study the issues to ensure that the correct problem is being addressed, namely, the fundamental causes and needs, not surface symptoms.
- **It is evidence-based,** using careful observations and analyses to determine needs and experimental deployment of potential solutions in an iterative cycle of observation, ideation, prototyping, and testing.
- **It is action-oriented**, learning by doing, through repeated iterations of making, testing, and observation.”

HCI PROJECT

HCI: Design Project:

- **Problem** Space: Health / Security
- **What** is the problem?
- **Who** has the problem?
- **How** could it be solved?
- **Outcome:** Prototype: proof of concept solution

DOES IT MATTER?

"Through HCI, we see virtual reality, intuitive technology, and more efficient machines being created, using our roots as human beings to allow technology to serve us better. Above all, Human-Computer Interaction opens up new doors of possibilities to the digital world, because it begs the question:
"How can technology better serve us, as humans?"

Dix, A., Finlay, J., Abowd, G. D., and Beale, R. (Feb, 2005). *'Human-Computer Interaction'.*

HUMAN COMPUTER INTERACTION

Week 2: Design

- Design?
- Good Design?
- Design: Art or Engineering?
- Human Diversity
- Computing Diversity
- Design Principles
- Design Project

What is Design?

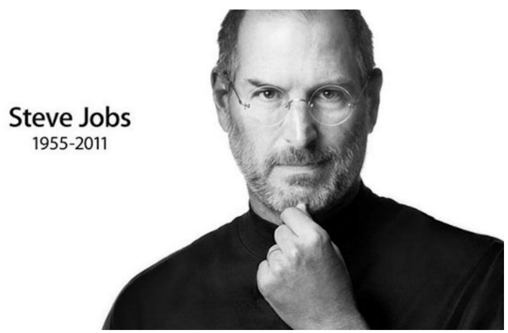
DESIGN

*“**Design** has many connotations. It is the organisation of materials and processes in the most productive, economic way, in a harmonious balance of all elements necessary for a certain function. It is not a matter of facade, of mere external appearance; rather it is the **essence** of products and institutions, penetrating and comprehensive.*

***Designing** is a complex and intricate task. It is the integration of technological, social and economic requirements, biological necessities, and the psychophysical effects of materials, shape, colour, volume, and space: thinking in **relationships**.”*

Moholy-Nagy, László (1947). Vision in Motion (Chicago: Theobald), p. 42

DESIGN



*“In most people’s vocabularies, **design** means veneer. It’s interior decorating. It’s the fabric of the curtains and sofa. But to me, nothing could be further from the meaning of design. **Design** is the fundamental soul of a man-made creation that ends up expressing itself in successive outer layers of the product or service.”*

***Steve Jobs:** CEO, Apple Computer, as cited in Fortune magazine, January 24, 2000*

DESIGN

"Design is a multi-faceted, complex enterprise*. It involves the initial choice of what to make, a deep understanding of people, of materials, and of technology. It requires understanding how people decide upon purchase, and then use products. It covers an extremely wide range of activities and different disciplines of study and training. It is this depth and richness that makes design such a wonderful, fascinating field."*

Donald Norman, JND.org. (2016)
"*The Future of Design: When you come to a fork in the road: Take it.*"

Q: What does this mean for Design Education?

DESIGN

“ What is design? … It’s where you stand with a foot in two worlds – the world of ***technology*** *and the world of people and* ***human purposes*** *– and you try to bring the two together.”*

Mitch Kapor in Winograd (1996), p.1.

“*Modern design is the interface between* ***technology*** *and* ***people***.”

Donald Norman, JND.org

POET: DONALD NORMAN (1988)

"The human mind is exquisitely tailored to make sense of the world. Give it the slightest clue and off it goes, providing explanation, rationalization, understanding.

Consider the objects - books, radios, kitchen appliances, office machines, and light switches - that make up our everyday lives. Well-designed objects are easy to interpret and understand. They provide visual clues to their operation.

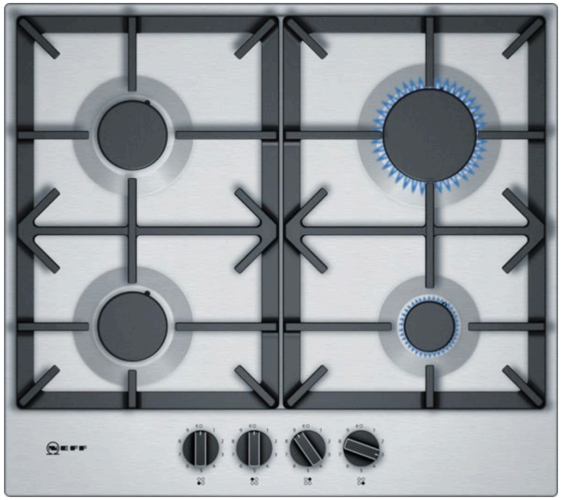
Poorly designed objects can be difficult and frustrating to use. They provide no clues - or sometimes false clues. They trap the user and thwart the normal process of interpretation and understanding. Alas, poor design predominates. The result is a world filled with frustration, with objects that cannot be understood, with devices that lead to error."

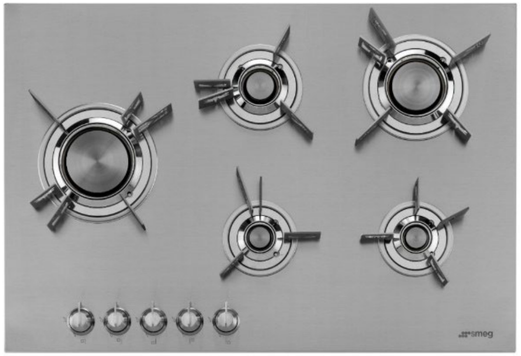
GOOD & BAD DESIGNS

- There is no “right” design, just good and bad designs

- List the following and reasons for your choice:
  - Well-designed object:
    - non-computer
    - computer system
  - Poorly-designed object:
    - non-computer
    - computer system

From: www.baddesigns.com






So...which way do I go?
Rooms
101-113
Rooms
114-128

The best designs speak without words:

Physically, intentionally, or otherwise


PUSH


TO OPEN DOOR
LOOK TO YOUR LEFT
PUSH SIGN
MARKED
DOOR

GOOD DESIGN

- Good design is about ***communication***
- Communicates its purpose clearly: doors, vending machines, chairs
- Design is concerned with finding the representation best suited to the ***communication*** of some specific information
- HCI design: communication is the overriding concern; creative expression is simply one means to this end

GOOD DESIGN

"I am convinced that a well-thought-out design is decisive to the quality of a product. A poorly-designed product is not only uglier than a well-designed one but it is of less value and use. Worst of all, it might be intrusive."

Dieter Rams, 1976

GOOD DESIGN?

Good Design (Dieter Rams):

1. Is innovative
2. Makes a product useful
3. Is aesthetic
4. Makes a product understandable
5. Is unobtrusive
6. Is honest
7. Is long-lasting
8. Is thorough down to the last detail
9. Is environmentally friendly
10. Involves as little design as possible

DESIGN: ART OR ENGINEERING?

ART / DESIGN?

- *"A designer who wants to achieve good design must not regard himself as an artist who, according to taste and aesthetics, is merely dressing-up products with a last-minute garment.*

  *The designer must be the gestaltingenieur or **creative engineer**. They synthesize the completed product from the various elements that make up its design. Their work is largely rational, meaning that aesthetic decisions are justified by an understanding of the product's purpose."*

Dieter Rams (NY, Dec 1976)

ART / DESIGN?

- Design: ***Form*** (aesthetics) and ***Function*** (purpose)
- *Art* is valued for its originality and expressiveness: exists for its own sake
- *Design* is valued for its fitness to a particular user and task: must always solve a real-world problem
- Design aesthetic is always related to the intended function of the resulting product
- Designers constantly resolve conflicting demands imposed by the problem, the budget, the schedule and the desired quality level

ART / DESIGN?

- Art creates problems; Design solves problems
- Art is interpretative; Design is unanimous
- Art is exploration; Design is observation & iteration
- Art has no goal; Design has specific goals
- Art creates for the artist; Design creates for the end user
- Designers follow function; Artists follow form

- Design: Art or Engineering?

Goran Peuc, Principal UX Designer,

SAP Dublin

"WHILE GREAT ART MAKES YOU WONDER, GREAT DESIGN MAKES THINGS CLEAR"

JOHN MAEDA, PRESIDENT RISD

GOOD DESIGN?

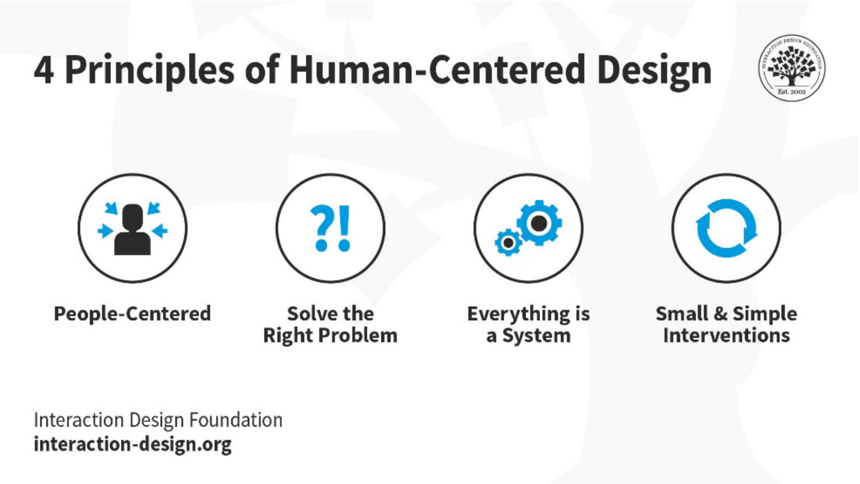
" Designing an object to be simple and clear takes at least twice as long as the usual way. It requires concentration at the outset on how a clear and simple system would work, followed by the steps required to make it come out that way - steps which are often much harder and more complex than the ordinary ones. It also requires relentless pursuit of that simplicity even when obstacles appear which would seem to stand in the way of that simplicity."

T. H. Nelson, *The Home Computer Revolution*, 1977

HUMAN CENTRED DESIGN

"Design is the central discipline for humanising all technologies: turning them to human purpose and enjoyment"

(Buchanan)



HUMAN DIVERSITY

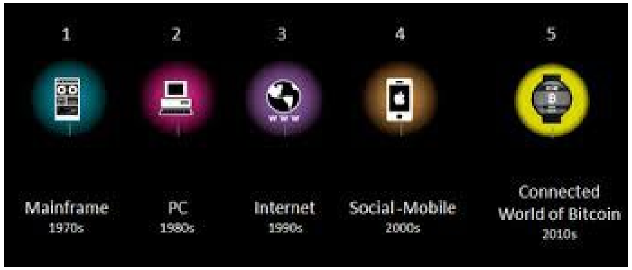
- Human Purpose & Enjoyment
- Human?
- Universal Design: Design for all
- Human Diversity:
  - Perception
  - Cognition
  - Physical: abilities & disabilities
  - Emotional
  - Personality
  - Cultural
- Human Diversity increases design complexity

INCLUSIVE DESIGN

- Barriers to inclusivity:
  - Permanent
  - Temporary
  - Situational
- *Inclusive design is a methodology, born out of digital environments, that enables and draws on the full range of human diversity. Most importantly, this means including and learning from people with a range of perspectives.*

  - Microsoft
- How to? User Research

COMPUTER DIVERSITY



- Computer?
- Computing Paradigms:
  - Large Scale Computing
  - Personal / Networked Computing
  - Mobile Computing
  - Wearable / Ubiquitous Computing
  - Collaborative Environments
  - Virtual Reality / Augmented Reality
  - Architectures: Kiosks, Appliances, Robots
  - IOT

COMPUTING PARADIGMS

GOOD DESIGN?

- *Effective Design: exploiting power of technology to support human needs and limitations:*
  - From “user” to “human” to “humanity”
  - Understand human needs
  - Anticipate human interactions with systems
  - EG: Save prompts; Aviation?

Donald Norman: What is User Centred Design?

DESIGN CONCERNS

Question: How to design effectively for human diversity?

- Access: barriers
- Usability: quality
- Acceptability: context
- Engagement: wow factor

GOOD DESIGN

Design Principles Inform Design

- Generalisable abstractions for thinking about designs
- Guide designer during design process & to critique and evaluate design ideas
- Derived from a mix of theory-based knowledge, experience and common-sense

➔ *The computer does the work and the person does the thinking*

DESIGN PRINCIPLES

- *How to design?*
  - ***Learnability***: help people "learn" the system
  - ***Accommodation***: help people "use" the system in a way that suits them

    and
  - ***Effectiveness***: help people use the system effectively

DESIGN PRINCIPLES

- *Learnability*: help people access, learn and remember the system
- Reduce user's cognitive load:
  - **Visibility**: voice-mail vs. answer machine; hamburger menus
  - **Consistency**: word processing menus
  - **Affordance**: door handle affords pulling: clues
  - **Familiarity**: familiar language and symbols

From: www.baddesigns.com

(a) phones, remote controls

1	2	3
4	5	6
7	8	9
	0	

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		


Why
Won't
They
Work?

DESIGN PRINCIPLES

- *Accommodation*: in a way that suits them
- Increase user confidence:
  - **Flexibility**: accommodate different levels of experience
  - **Style**
  - **Conviviality**: polite, friendly and generally pleasant

DESIGN PRINCIPLES

- *Effectiveness*: increase users' sense of being in control, know what to do & how to do it:
  - **Navigation**
  - **Control**: allow people to take control (clear mappings)
  - **Constraints**: helps people not to do things that are inappropriate (greyed menu options) CUI
  - **Recovery**
  - **Feedback**: constant and consistent feedback enhance sense of control (cursor movement) Google's Material Design

LECTURE 2 SUMMARY

Week 2 Review:

- Design?
- Good Design?
- Design: Art or Engineering?
- Human Diversity
- Computing Diversity
- Design Principles
- Design Project

CT318 LECTURE 3

Design Process

- What? UX Design
- Interaction Design Model
- Design Process:
  - Double Diamond Design Process Model
  - Design Funnel
  - Interaction Design Process
  - **Design Thinking**
- Group Design Projects

DESIGN PROCESS

How to Design?

- First: What are we "designing"?
- And then: How do we design it?
  - What steps are involved?
  - What tools and techniques?

DESIGN

"Designers are action-oriented … today's world of design produces deep, thoughtful doers. The design philosophy is to think by doing. Designers do their research by designing … they move rapidly to experimentation, to construction of artifacts or new procedures which they use to probe the world relevant to the issue at hand, using the responses as evidence on how to proceed… deep embodied thought, embodied in action, in physical structure .. by the real evidence of the responses to the probe"

Donald Norman, JND.org. (2016)
"*The Future of Design: When you come to a fork in the road: Take it.*"

WHAT ARE WE DESIGNING?

UX DESIGN?

- Don Norman joined Apple as their first "User Experience Architect" In the early 90s
- He used the term "user experience design" because he wanted to cover all aspects of the person's experience with a system
- "*User experience encompasses all aspects of the end-user's interaction with the company, its services, and its products.*"

USER EXPERIENCE

- What is User Experience?
- Usage leads to experience
- What is Experience?

- Hassenzahl:

“*Meaningful, personally encountered events rather than knowledge gained from events*”

“*Psychologically, an experience emerges from the integration of perception, action, motivation and cognition into an inseparable, meaningful whole*”

USER EXPERIENCE

- How a product behaves and is used by people in the real world: the way people feel about it and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it

- Cannot design **a** user experience, only design **for a** user experience

UX DESIGN

"It's about enhancing the experience that people have while interacting with your product.

If UX is the experience that a user has while interacting with your product, then **UX Design** is, by definition, the process by which we determine what that experience will be.

UX Design always happens. Whether it's intentional or not, somebody makes the decisions about how the human and the product will interact. Good UX Design happens when we make these decisions in a way that understands and fulfills the needs of both our users and our business"

Laura Klein, UX for Lean Startups

UX DESIGN

"UX design is a commitment to building products that are created with the customer in mind. It starts with studying who the customers are and what they need and taking that information to provide products and services that improve the quality of people's lives."

Marieke McCloskey

UX DESIGN

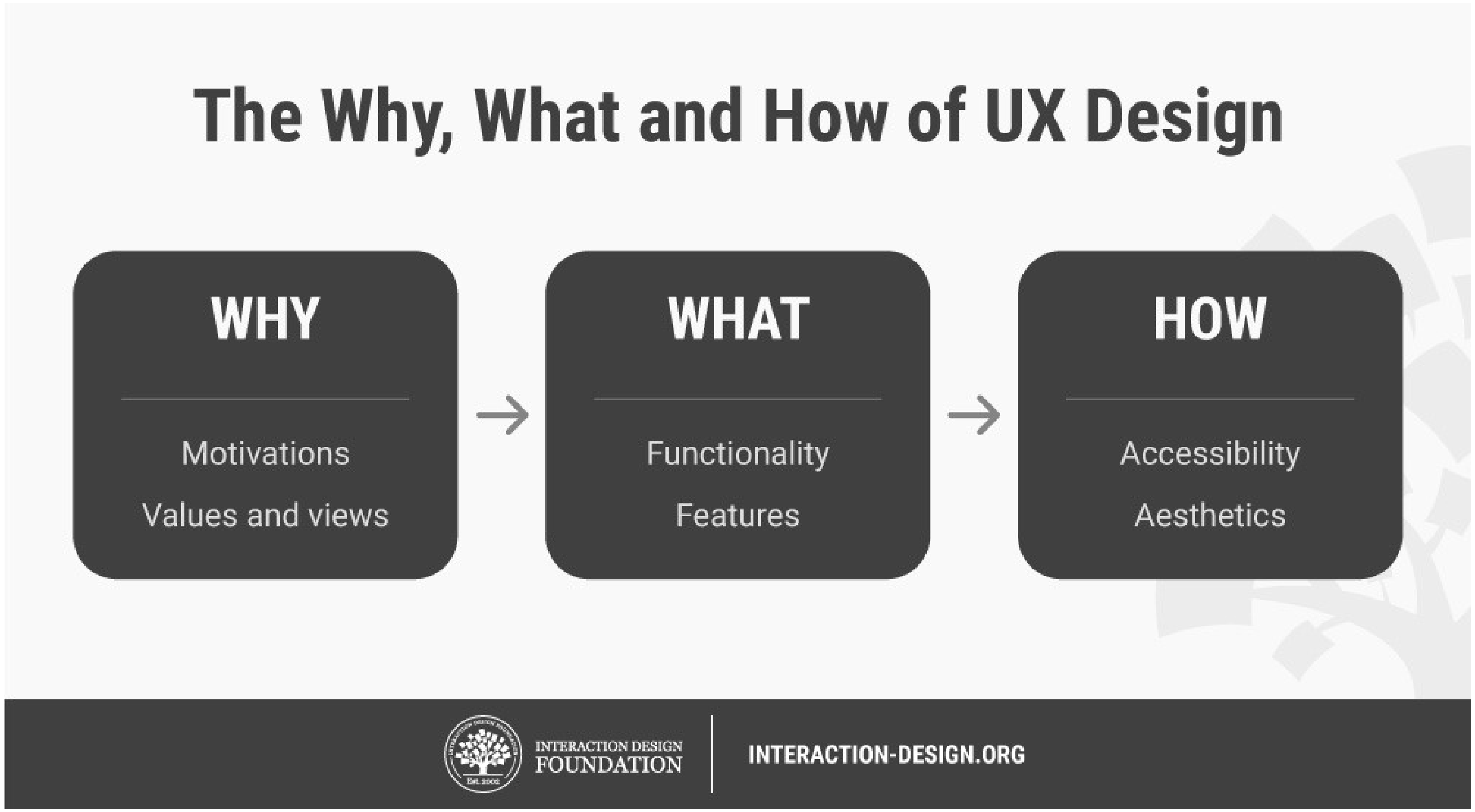
"UX Design is the purposeful application of logic and rationale for creating experiences that offer both utility and value to the end user. It's a process of deeply understanding the user's needs and objectives, identifying where their greatest problems exist, and working generatively to ideate ways to solve these problems."

Scott Johnson, Head of Design, Alto

UX DESIGN

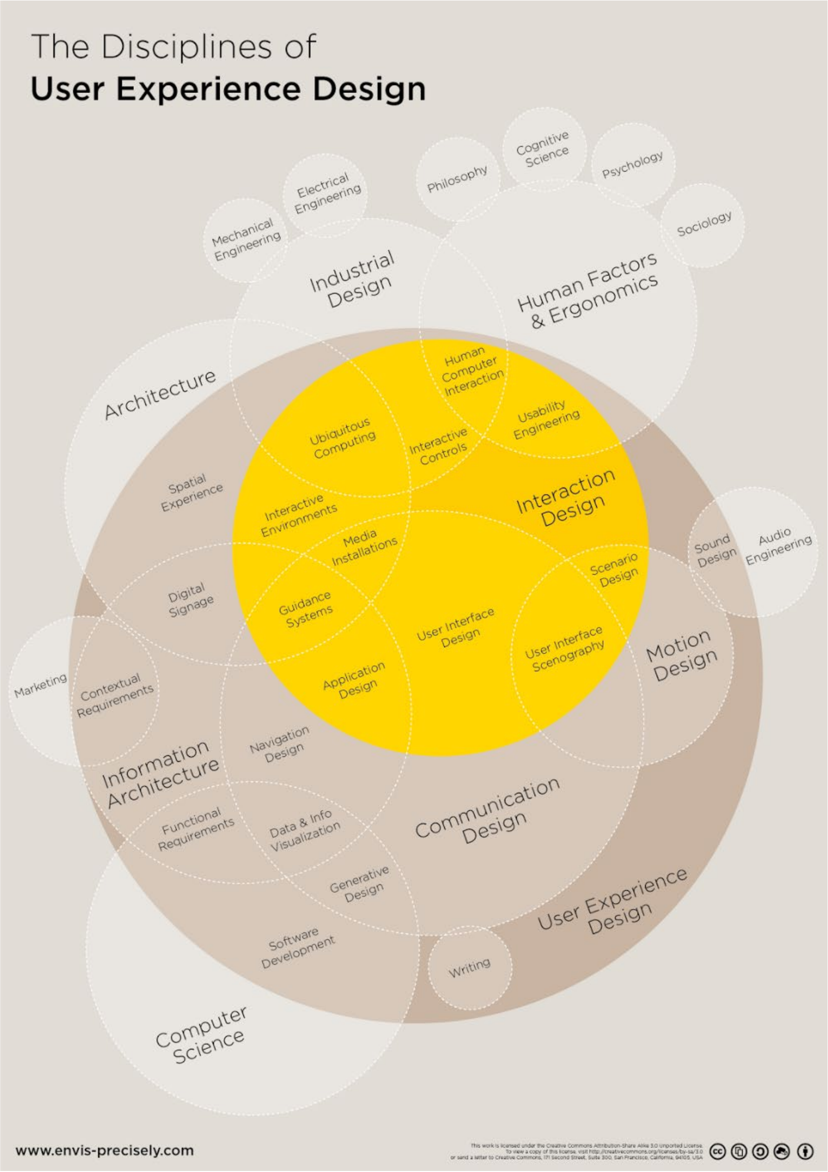
"User Experience Design (UXD or UED) is a design process whose sole objective is to design a system that offers a great experience to its users. Thus, UXD embraces the theories of a number of disciplines such as user interface design, usability, accessibility, information architecture, and Human Computer Interaction."

Justin Mifsud (Usability Geek Founder)


The Why, What and How of UX Design
WHY
Motivations
Values and views
WHAT
Functionality
Features
HOW
Accessibility
Aesthetics
INTERACTION DESIGN FOUNDATION
INTERACTION-DESIGN.ORG

UX DESIGN

- Why, What and How of Experience Design
- UX starts from the *Why*: the needs and emotions involved in an activity, the meaning, the experience
- Then the functionality that is able to provide the experience (the *What*) and
- An appropriate way of putting the functionality to action (the *How*).
- Experience Design integrates the *Why*, *What* and *How*, with the *Why* setting the tone


The Disciplines of
User Experience Design
Mechanical Engineering
Electrical Engineering
Philosophy
Cognitive Science
Psychology
Sociology
Industrial Design
Human Factors & Ergonomics
Architecture
Human Computer Interaction
Ubiquitous Computing
Interactive Controls
Usability Engineering
Spatial Experience
Interactive Environments
Interaction Design
Media Installations
Sound Design
Audio Engineering
Digital Signage
Guidance Systems
Scenario Design
User Interface Design
User Interface Scenography
Motion Design
Marketing
Contextual Requirements
Application Design
Navigation Design
Information Architecture
Communication Design
Functional Requirements
Data & Info Visualization
Generative Design
User Experience Design
Software Development
Writing
Computer Science
www.envis-precisely.com


ExS
Experience Strategy
IxD
Interaction Design
UR
User Research
IA
Information Architecture

UX

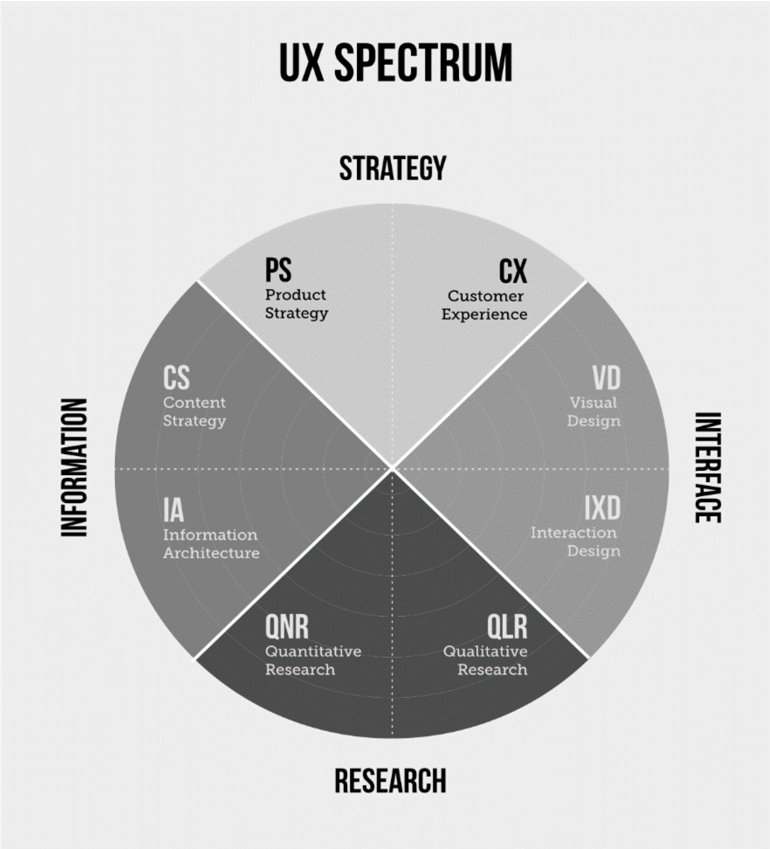
IXD & IA

INTERACTION DESIGN: DESIGN THINKING & ID LIFECYCLE

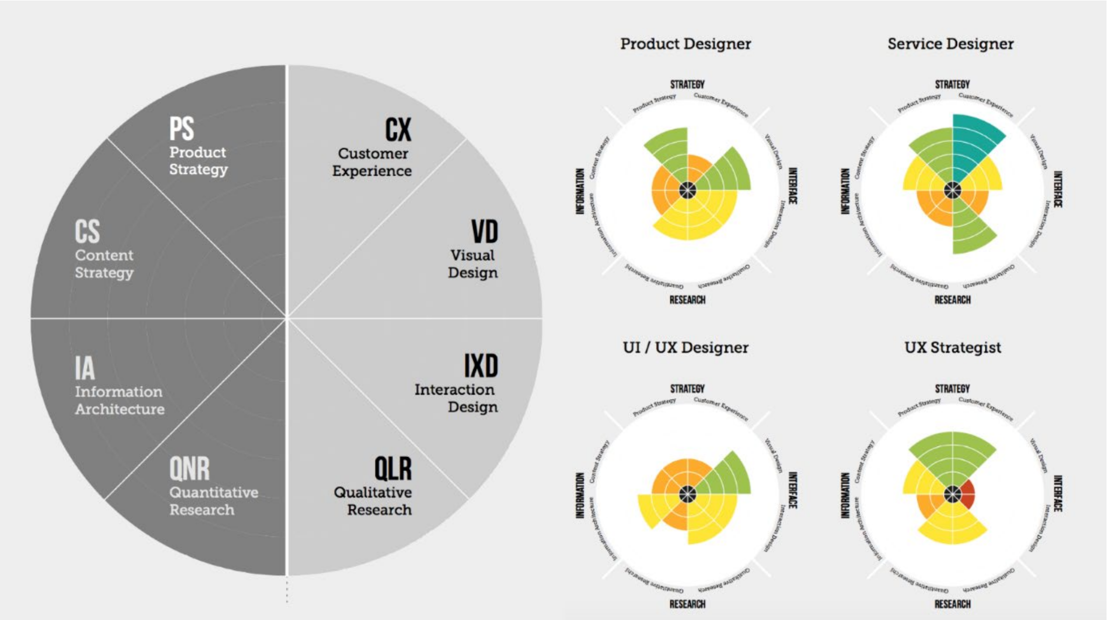
IA: INFORMATION ARCHITECTURE: ONTOLOGY, DATABASE, INFORMATION VISUALISATION AND PRESENTATION

UX SPECTRUM

(JASON MESUNT)



https://medium.com/amplify-design/shapes-of-ux-designer-ad047bddac7f



UX SPECTRUM: EXAMPLES

INTERACTION MODEL

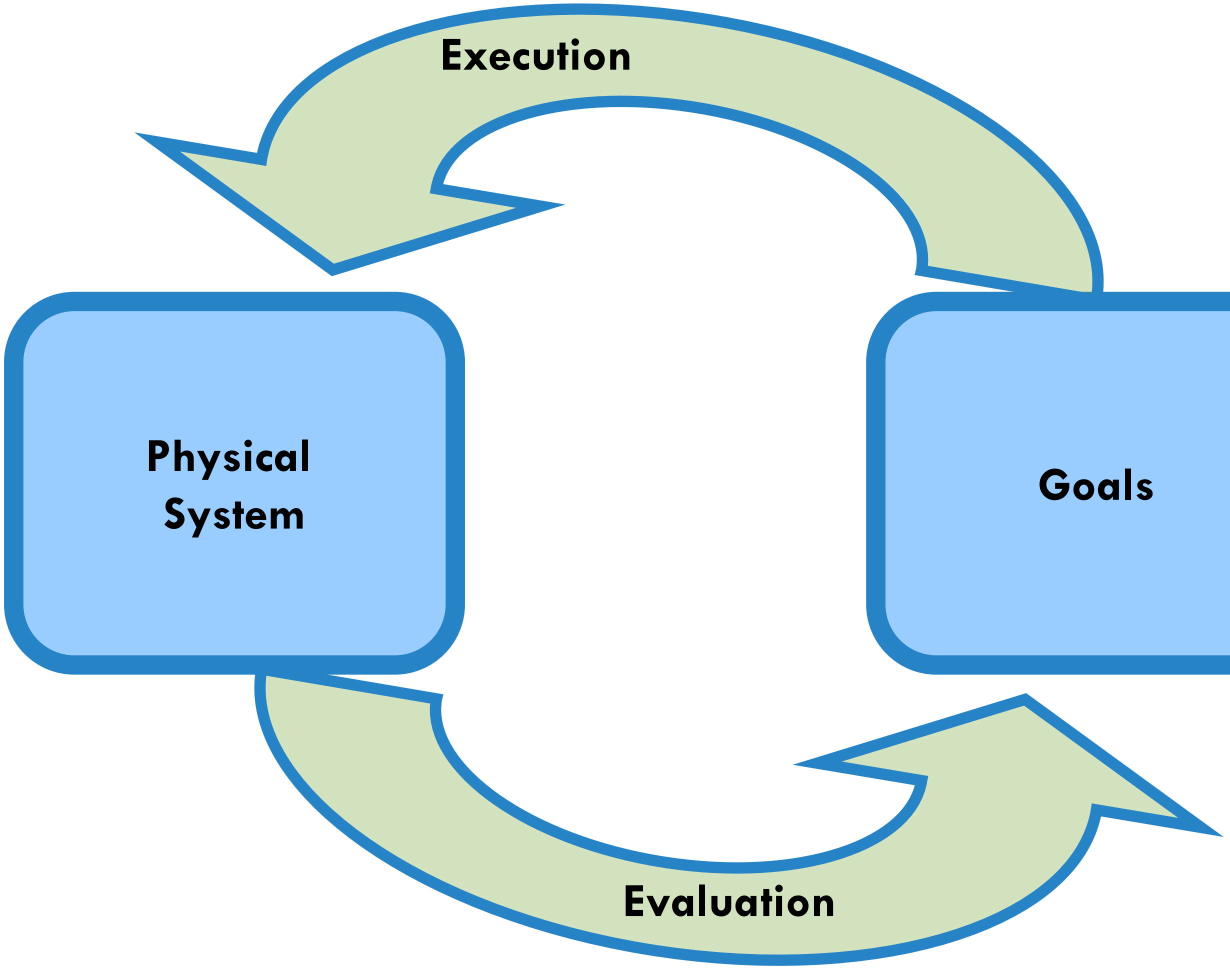
INTERACTION MODEL (NORMAN)

- Norman's model of interaction (1988): stages of action in using interactive product
- Interactive cycle:
  - User formulates a plan of action - *intention*
  - Executes this at the interface - *action*
  - When executed the user observes the interface for the result to determine future actions - *evaluation*

INTERACTION MODEL

- These two phases are subdivided into seven stages - each a user activity:
  - establishing the goal
  - forming the intention
  - specifying the action sequence
  - executing the action
  - perceiving the system state
  - interpreting the system state
  - evaluating the system state wrt goals and intentions

Action Cycle



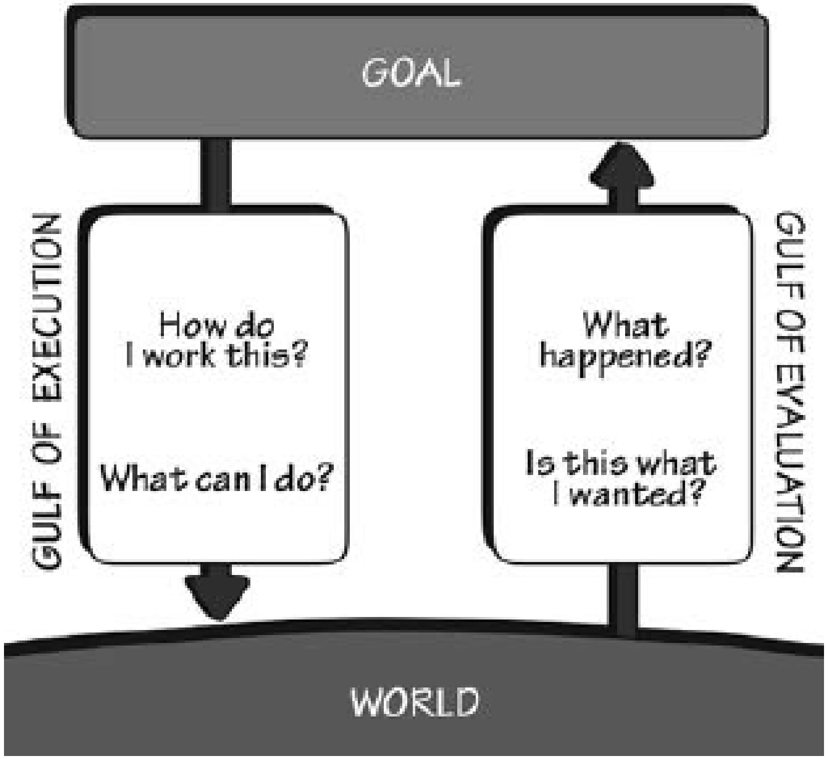
INTERACTION MODEL: EXECUTION

- User and system use different languages: translation
- If system actions correspond to user actions, the interaction will be effective
- ***Gulf of execution***: *difference between user's formulation of actions to reach the goal & actions allowed by system*
- Interfaces should be designed to reduce this gulf

INTERACTION MODEL: EVALUATION

- ***Gulf of Evaluation**: the distance between the physical presentation of the system state and the user's expectation*
- Goal is for user to easily evaluate the presentation in terms of his/her goal: the more effort required, the less effective the interaction
- Interfaces should be designed to reduce this gulf

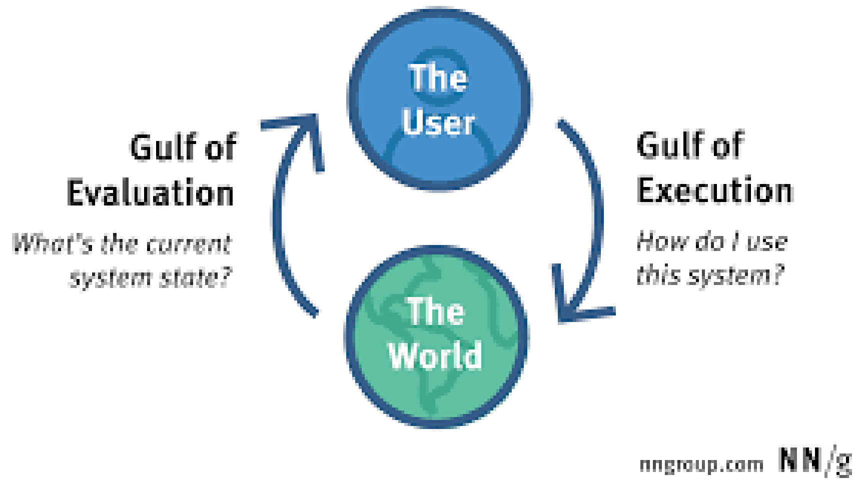
INTERACTION MODEL: GULFS



INTERACTION MODEL: DESIGN

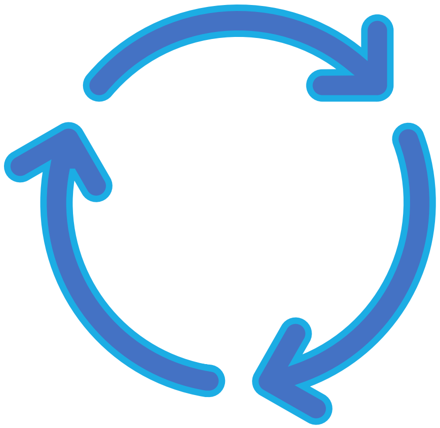
"With every interaction, users must overcome the twin challenges of understanding the current state of a system and figuring out how to change it. Designers can support them by being aware of these gulfs and bridging them with a transparent conceptual model."

(Whitenton, NNG 2018)



INTERACTION MODEL: DESIGN

- Design to reduce the gulfs: create visual & functional similarities with familiar designs
  - Visibility (affordances: cues to action)
  - Feedback
  - Consistency
  - Non-destructive operations (undo; exploration)
  - Discoverability (systematic; e.g. rollover of menus)
  - Reliability
- Example: Vending machines



INTERACTION GULFS IN DESIGN

- Seven stages of action: checklist for effective interaction design:
  - Establishing the goal:
  - **What do I want to do?**
  - Forming the intention:
  - **What are my alternatives?**
  - Specifying the action sequence:
  - **What can I do now?**
  - Executing the action:
  - **How can I do it?**
  - Perceiving the system state:
  - **What happened?**
  - Interpreting the system state:
  - **What does it mean?**
  - Evaluating the system state wrt goals and intentions:
  - **Is this ok? Have I accomplished my goal?**

HOW TO INTEGRATE INTERACTION DESIGN ACTIVITIES WITHIN OTHER MODELS?

Integrating interaction design activities in lifecycle models from other disciplines requires careful planning

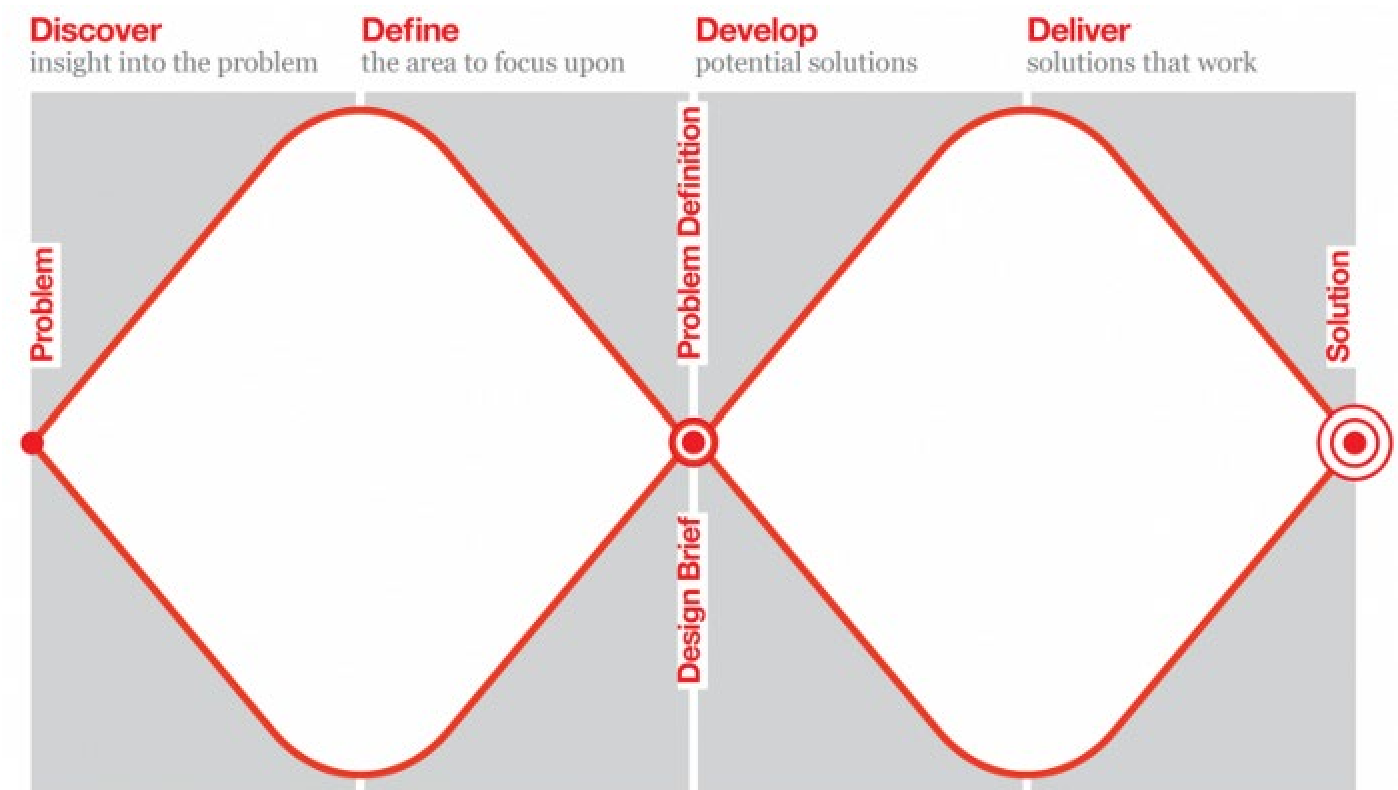
Software development lifecycle models are prominent

Integrating with agile software development is promising because:

- It incorporates tight iterations
- It champions early and regular feedback
- It handles emergent requirements
- It aims to strike a balance between flexibility and structure

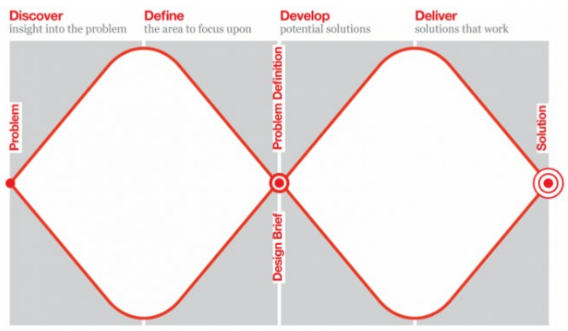
DESIGN PROCESS?

DOUBLE DIAMOND DESIGN PROCESS

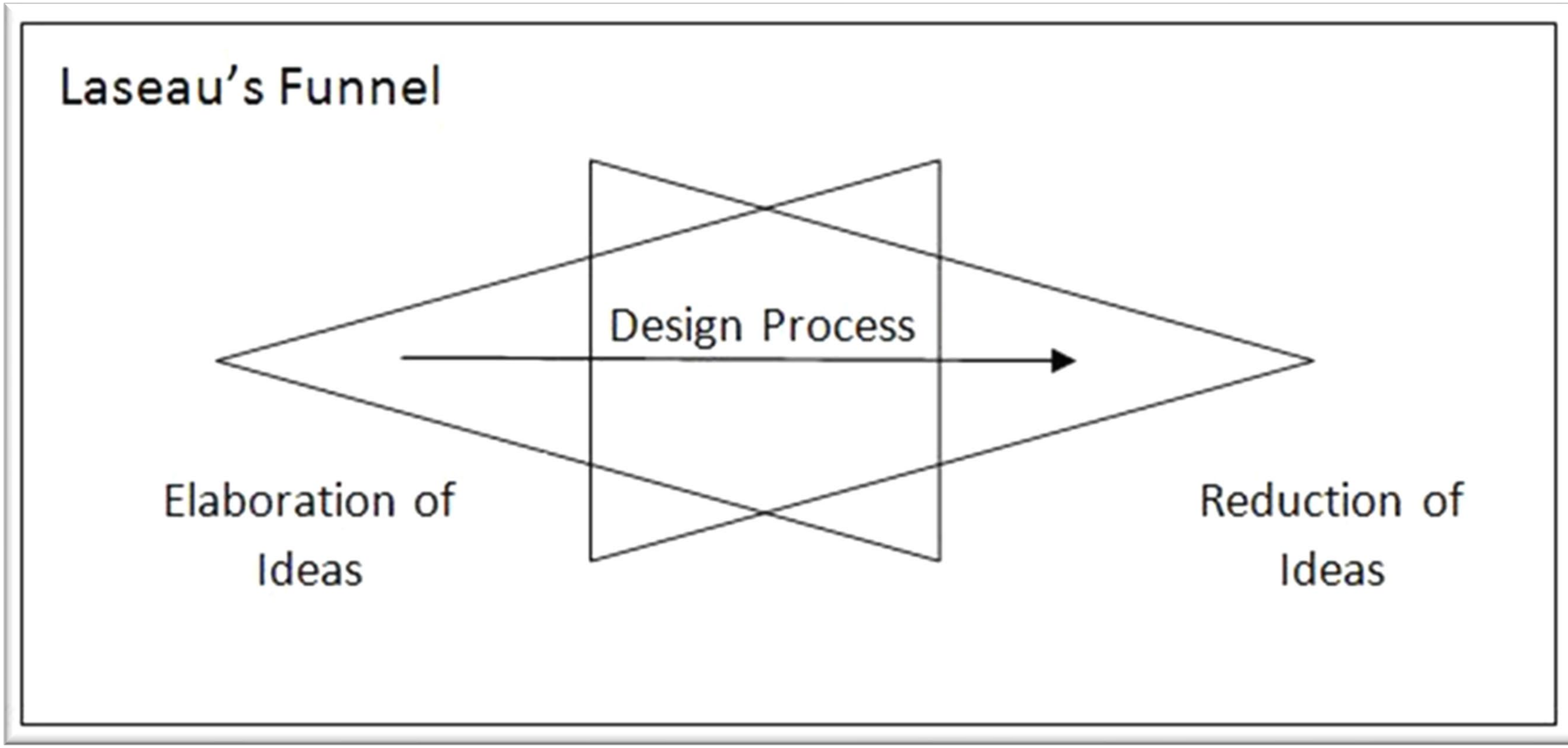


Source: https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond

DOUBLE DIAMOND DESIGN PROCESS



- Discovering something about the world: insights, innovation
- Understanding users: user research: data gathering and analysis
- Defining what will be developed
- Develop: core design activity: propose ideas to meet requirements; conceptual and physical design; prototyping: evaluating designs through interaction



DESIGN FUNNEL

INTERACTION DESIGN

Interaction Design **process:**

- A goal-directed problem solving activity informed by intended use, target domain, materials, cost, & feasibility
- A creative activity
- A decision-making activity to balance trade-offs

Interaction design is also a **representation:**

- A plan for development
- A set of alternatives & successive elaborations

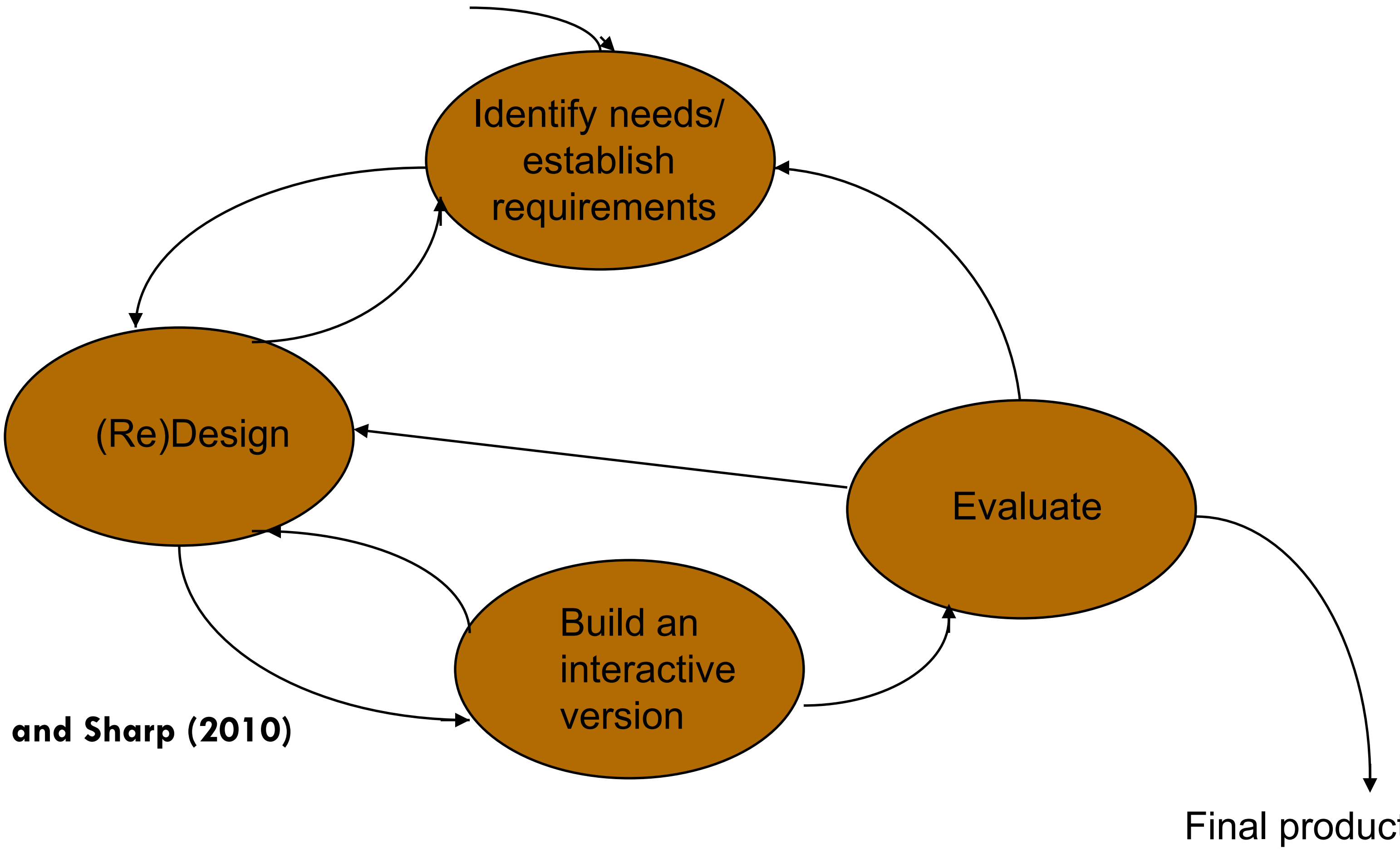
INTERACTION DESIGN PROCESS MODEL (PREECE ET AL)

- There are four basic activities in Interaction Design:

  1. Identifying needs and establishing requirements
  2. Developing alternative designs
  3. Building interactive versions of the designs
  4. Evaluating designs

Preece, Rogers and Sharp (2010)

A SIMPLE INTERACTION DESIGN MODEL



Preece, Rogers and Sharp (2010)

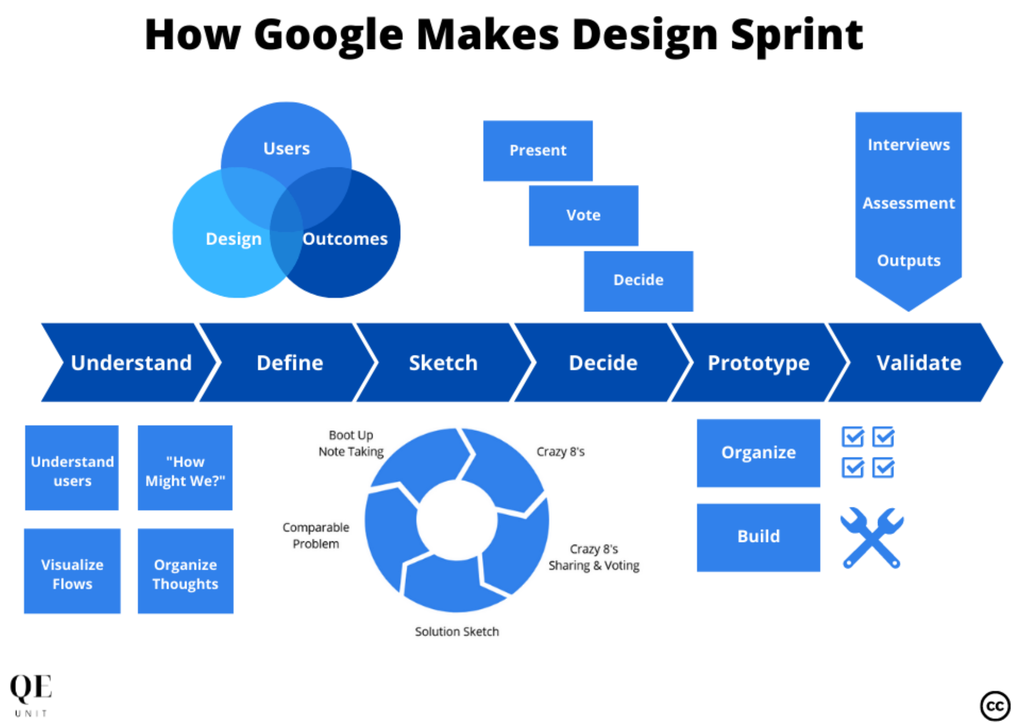
INTERACTION DESIGN PROCESS MODEL

Three key characteristics permeate these four activities:

- **1. Focus on users** early in the design and evaluation of the artefact
- **2.** Identify, document and agree specific **usability** and user experience goals
- **3. Iteration** is inevitable. Designers never get it right first time

Preece, Rogers and Sharp (2010)

ANOTHER LIFECYCLE MODEL: GOOGLE DESIGN SPRINTS

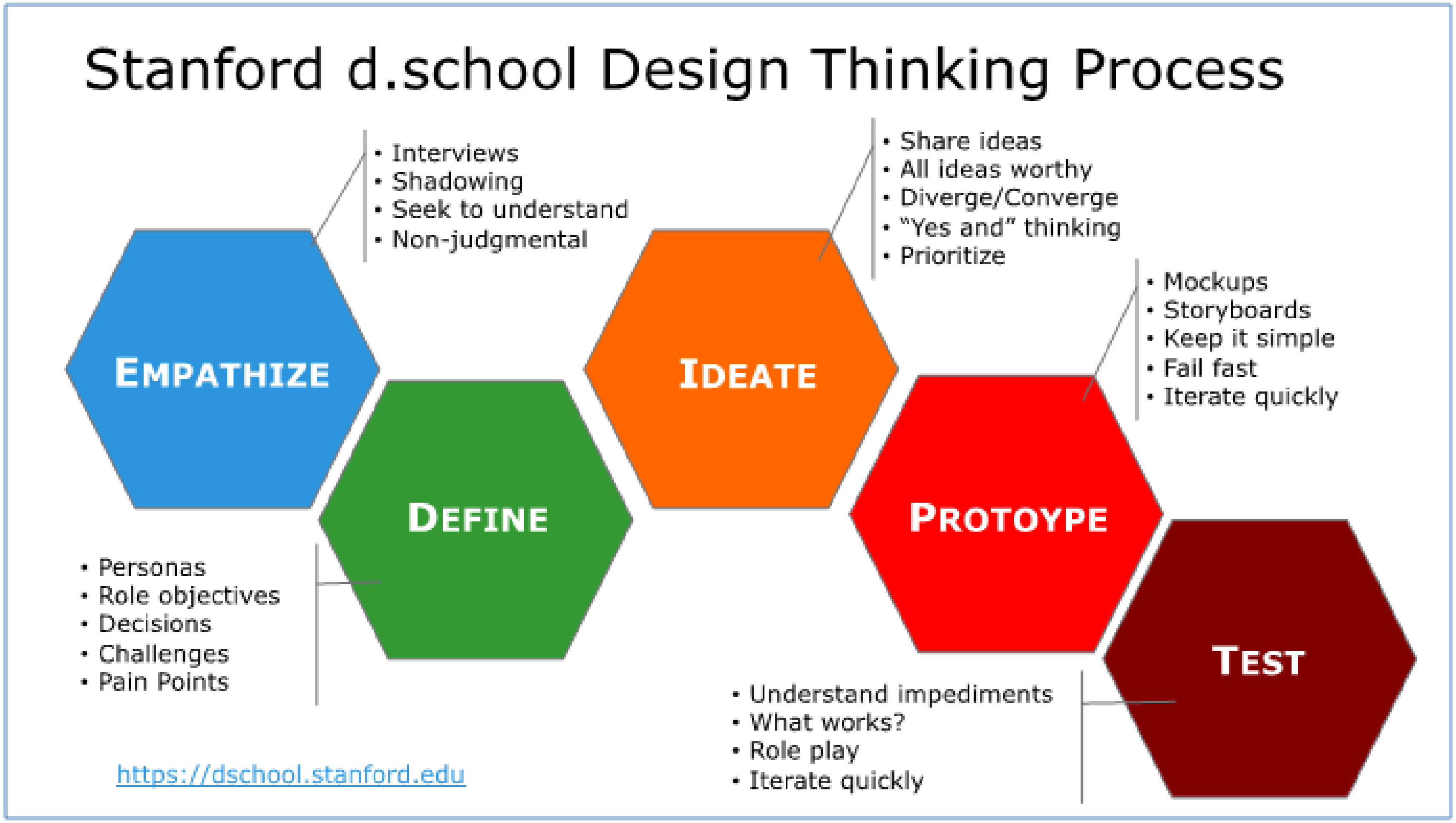


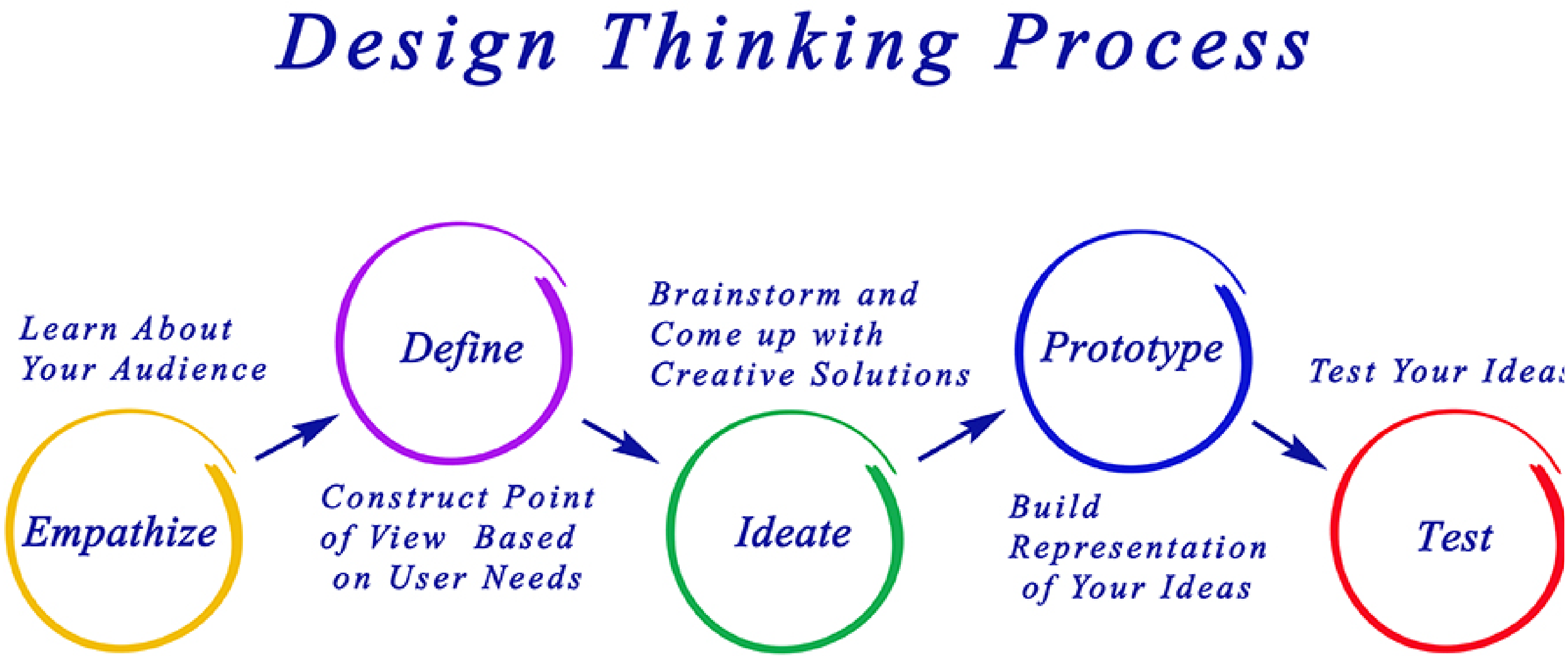
DESIGN THINKING

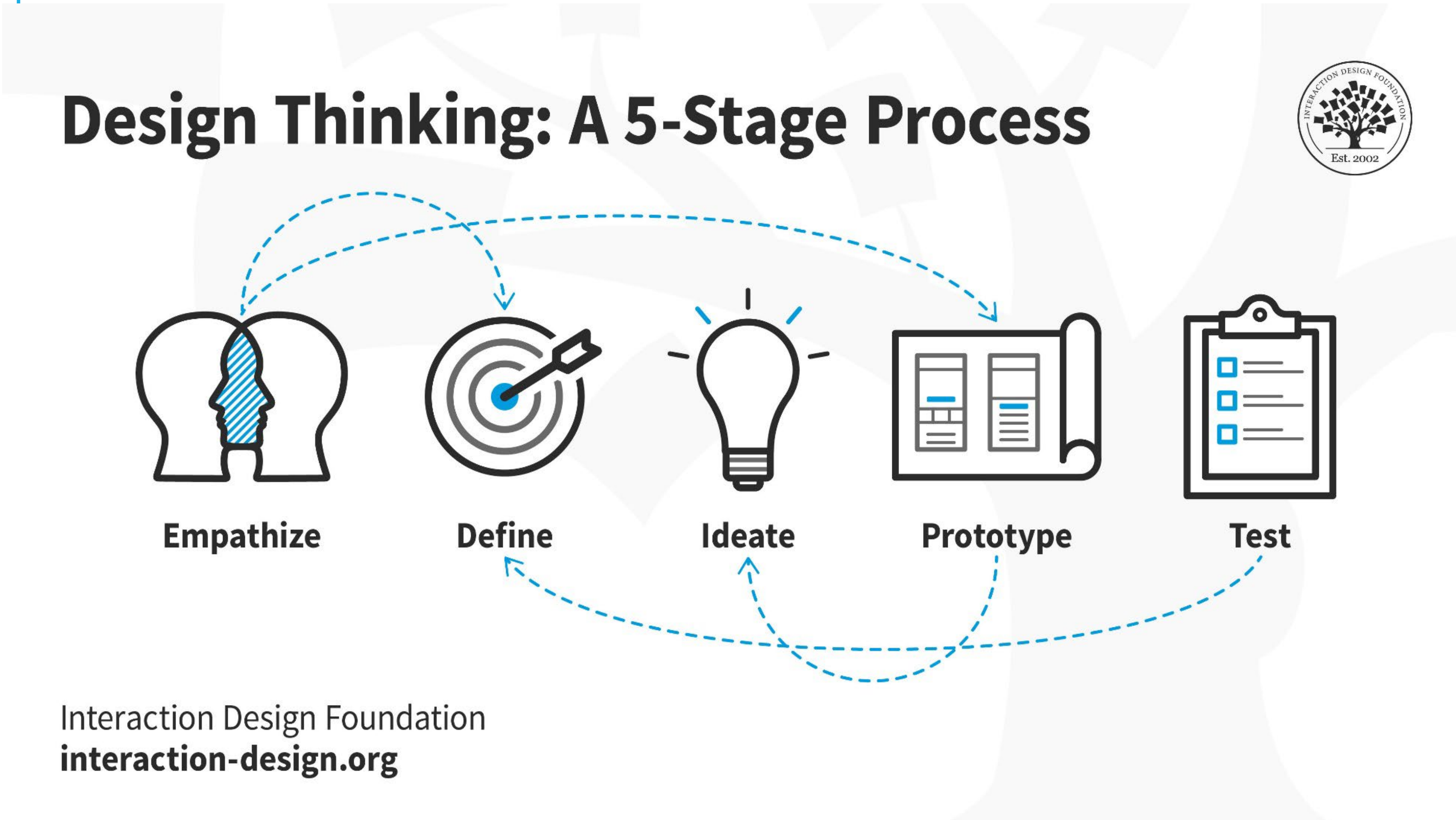
DESIGN THINKING

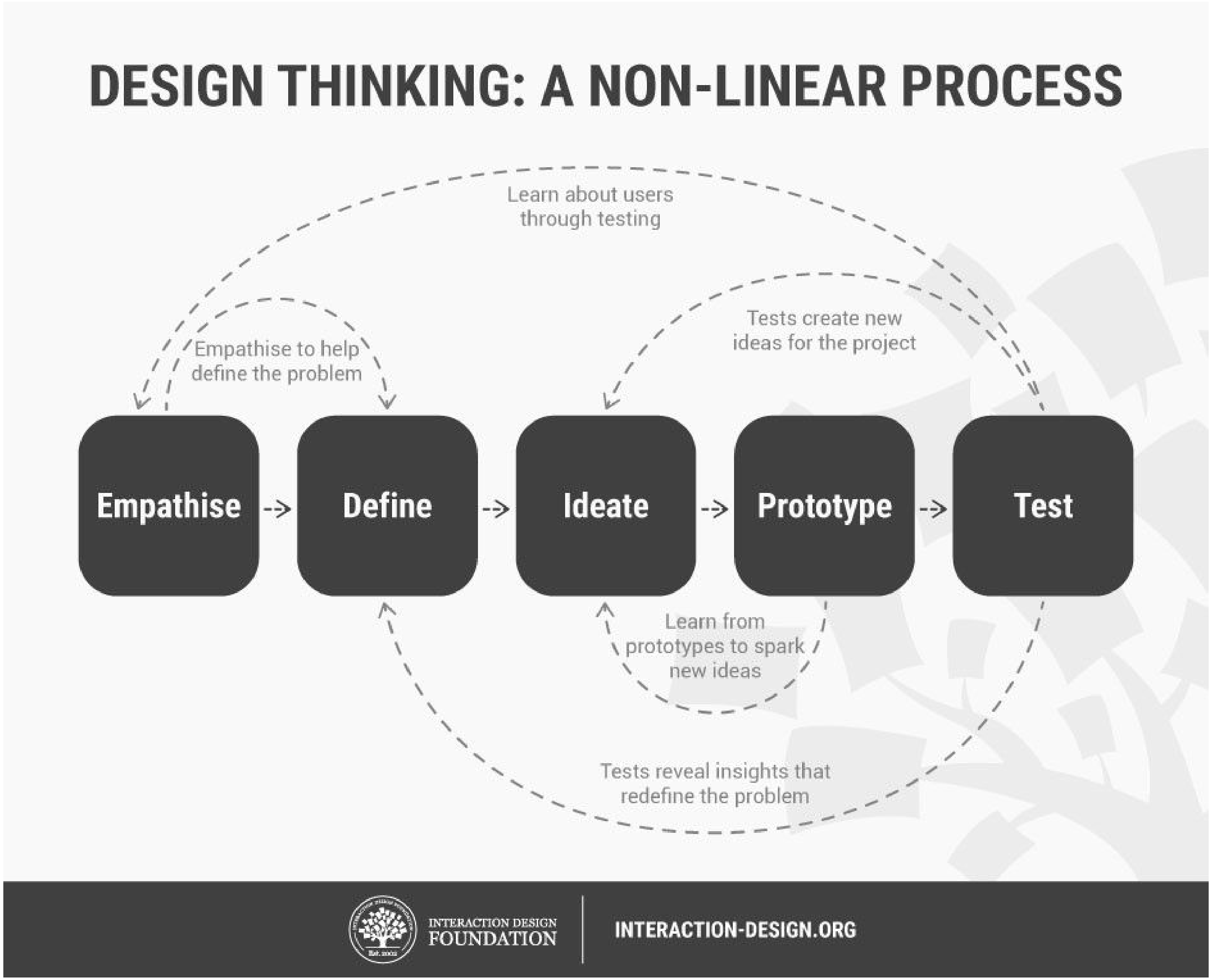
- A non-linear, iterative design process
- Suited to ill-defined, unknown problems
- Supports designers in understanding users, challenging assumptions and creating innovative solutions
- Involves five phases:

1. Empathise
2. Define
3. Ideate
4. Prototype
5. Test


Stanford d.school Design Thinking Process
• Interviews
• Shadowing
• Seek to understand
• Non-judgmental
• Share ideas
• All ideas worthy
• Diverge/Converge
• "Yes and" thinking
• Prioritize
• Mockups
• Storyboards
• Keep it simple
• Fail fast
• Iterate quickly
EMPATHIZE
IDEATE
DEFINE
PROTOYPE
TEST
• Personas
• Role objectives
• Decisions
• Challenges
• Pain Points
• Understand impediments
• What works?
• Role play
• Iterate quickly
https://dschool.stanford.edu


Design Thinking Process
Learn About Your Audience
Empathize
Define
Construct Point of View Based on User Needs
Brainstorm and Come up with Creative Solutions
Ideate
Prototype
Build Representation of Your Ideas
Test Your Idea
Test


Design Thinking: A 5-Stage Process
INTERACTION DESIGN FOUNDATION
Est. 2002
Empathize
Define
Ideate
Prototype
Test
Interaction Design Foundation
interaction-design.org


DESIGN THINKING: A NON-LINEAR PROCESS
Learn about users through testing
Empathise to help define the problem
Tests create new ideas for the project
Empathise
Define
Ideate
Prototype
Test
Learn from prototypes to spark new ideas
Tests reveal insights that redefine the problem
INTERACTION DESIGN FOUNDATION
INTERACTION-DESIGN.ORG

INTERACTION DESIGN & DESIGN THINKING?

- Both non-linear and iterative design processes
- Phases? 3, 4 or 5?
- Design Thinking: More support for initial user understanding and problem definition phases: *empathy*
- Creative interdisciplinary brainstorming

DESIGN PROJECT

- What Design Problem?
  - Health: SDG 3 Good Health and Wellbeing
  - Security: cyberattacks, scams: behaviour change
- Why is this an important problem? Why address it?
- What is the Problem?
  - Gulfs of Interaction?
  - Double Diamond: Discover and Define before Design activity
- Who is it a Problem for?
  - Stakeholders?
- Examples?

DESIGN PROJECT

UNDERSTANDING THE PROBLEM SPACE

Explore

- What is the current user experience?
- Why is a change needed?
- How will this change improve the situation?

Articulating the problem space

- Team effort
- Explore different perspectives
- Avoid incorrect assumptions and unsupported claims

DESIGN PROJECT

- **Miro**: collaborative design platform; online workspace for innovation https://miro.com/product-overview/

- **Figma**: Interactive prototyping tool

https://www.figma.com/design-overview/

CT318 LECTURE 3 REVIEW

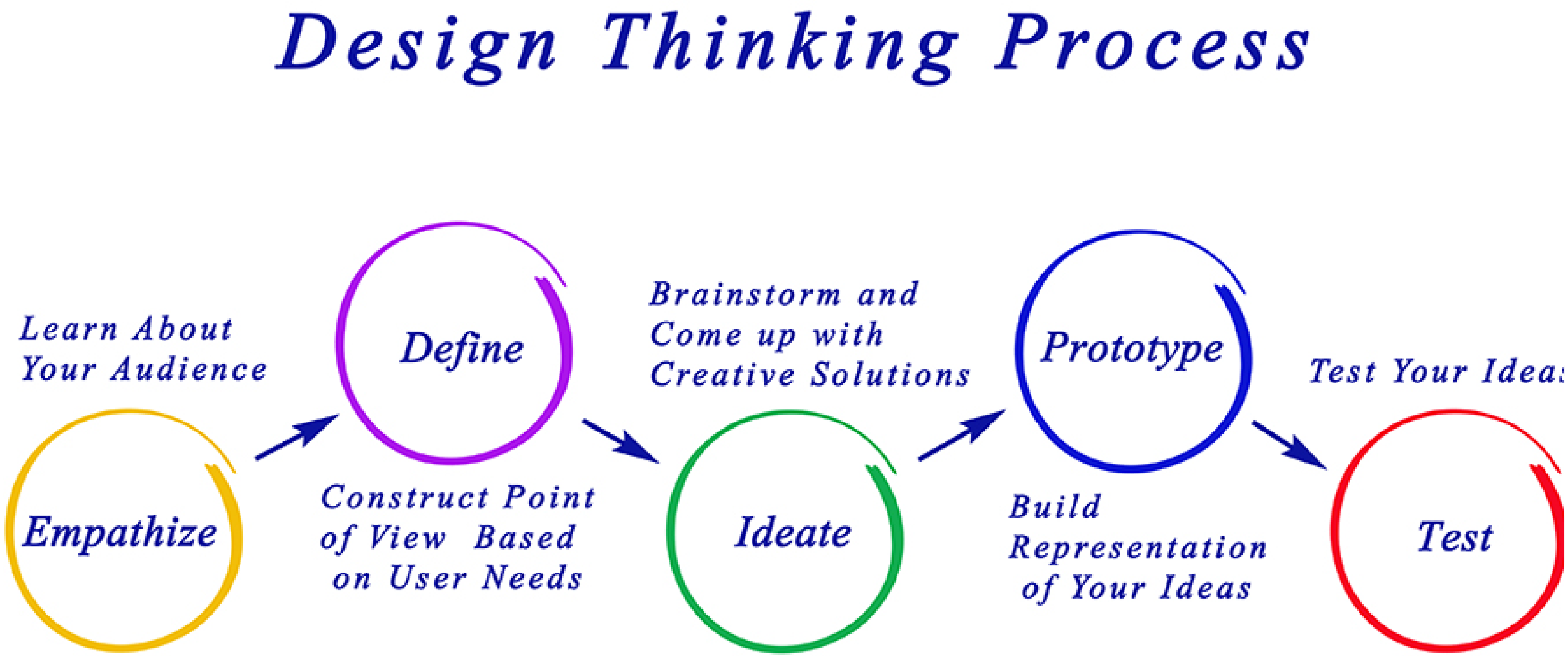
Design Process

- What? UX Design
- Interaction Design Model
- Design Process:
  - Double Diamond Design Process Model
  - Design Funnel
  - Interaction Design Process
  - **Design Thinking**
- Group Design Projects

CT318 LECTURE 4

Design Thinking: Empathise

- Design Thinking 1: Empathise
- User Diversity
- User Research
- Technique: Empathy Mapping


Design Thinking Process
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Your Audience
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Construct Point
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on User Needs
Brainstorm and
Come up with
Creative Solutions
Ideate
Prototype
Build
Representation
of Your Ideas
Test Your Idea
Test

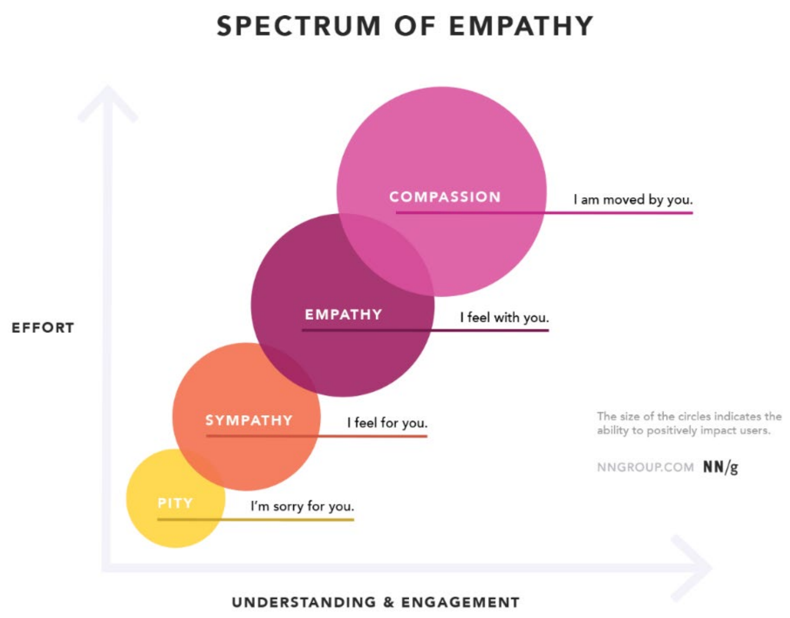
DESIGN THINKING 1: EMPATHISE

UNDERSTANDING USERS

*“**Sympathy** is the acknowledgement of the suffering of others.” (Gibbons, NNg)*

Distance between you and the other person, their adversity is not something you personally relate to or expect to share.

*“**Empathy** is the ability to fully understand, mirror, then share another person’s expressions, needs, and motivations.” (Gibbons, Nng)*



UNDERSTANDING USERS

- Good interaction design typically involves principled approaches to understanding users
- Considering what people are good and bad at
- Considering what might help people with the way they currently do things
- Thinking through what might provide quality user experiences
- Listening to what people want and getting them involved in the design

HUMAN DIVERSITY

- Human diversity evident in:
  - Perception / Attention
  - Cognition
  - Physical: Ergonomics
  - Emotional: Affect
  - Personality; Behaviour
  - Culture
  - Language

PERCEPTION: VISION

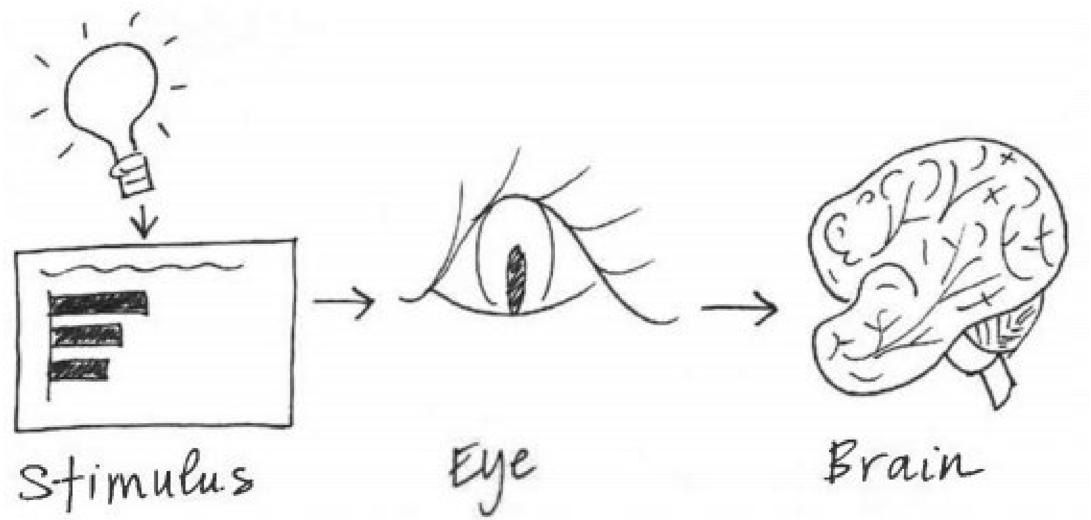


Figure 4.1 A simplified picture of how you see

PERCEPTION: RESPONSE

- Response time:
  - Auditory in 150ms
  - Visual in 200ms
  - Pain in 700 ms
- Combined signal will result in quickest response
- Taste and Smell? – Tillotson aromatic output
- Multimodality – improves the accuracy of the system recognising what user wants to do
- Novel interactions: why?

ATTENTION

"Everyone knows what attention is. It is the taking possession of mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought … It requires withdrawal from some things in order to deal effectively with others."

W. James, 1890

COGNITION

- Need to take cognitive processes and cognitive limitations of users into account
- Knowledge about what users can and cannot be expected to do
- Contributes to understanding the nature and causes of problems users encounter
- Supplies theories, modelling tools, guidance and methods that can lead to the design of better interactive products

COGNITION

- Origins: comes from the Latin verb *cognosco* (**con** 'with' + **gnōscō** 'know'), derived from Ancient Greek verb meaning 'I know, perceive'
- Cognition: all mental abilities and processes related to knowledge: attention, memory, judgement, reasoning, problem solving, decision making & comprehension
- Both conscious and unconscious, intuitive (like knowledge of a language) and conceptual (like a model of a language)
- Cognitive processes use existing knowledge and generate new knowledge

COGNITION: REPRESENTATION

- Representation of problem at different levels of abstraction: higher is more cognitively taxing: EG: Card Number Game:
  - Numbers on a grid
  - Cards on a table
  - Numbers in our head
- Physical representation of problem in line with constraints:
  - Carkeys by door
  - *Proteus Ingestible Networked Pill*: natural interface
  - Word processing "Print": World in miniature: WYSIWYG

COGNITION: REPRESENTATION

- Representation of information at UI: impact on UX
- Good representation: offload and relieve pressure on STM
  - shows only the information needed
  - enables comparison, exploration, problem solving
  - fitness to task (UID vs. Game design)
  - visual / textual (perception / reasoning, London UG)
  - leverages intuitions from real world (brown “earth”, blue “sea”)
- Poor representation:
  - “Password is not valid: please change”: change what?
  - “You must fill out all required fields”: what’s missing?

DISTRIBUTED COGNITION

- Enable people to think more fluidly & effectively by distributing cognition into artefacts in world:
  - Encourages experimentation: Tetris
  - Scaffold learning & reduce errors through redundancy: Montessori blocks
  - Show only differences that matter: London UG Map
  - Convert slow calculation / reasoning into fast perception: Coloured map
  - Support chunking: Chess
  - Increase efficiency: diagrammatic representations
  - Facilitate collaboration (cockpit)

LONDON UNDERGROUND (TUBE):

EXTERNAL COGNITION

- Externalising to reduce cognitive load
- Remind us we **need** to do something, **what** we need to do and **when** we need to do it
  - Diaries, reminders, calendars, to-do lists, notes
  - Post its, Piles, marked e-mails
- Use of a tool in conjunction with an external representation to carry out a computation
- Annotation: modifying existing representations
- Cognitive Tracing: manipulating items into different orders and structures (scrabble, cards)
- ***ID Implication***: external representations at the UI to reduce memory load and facilitate offloading

EMOTION

- Affect and emotion not as well understood as cognition
  - ***Affective*** system: judgmental
  - ***Cognitive*** system: interpretive
- Evidence to show pleasing things work better, are easier to learn and produce a more harmonious result
- Affect & cognitive task performance: walking plank
- Positive and Negative Affect: concentration (depth first), creativity (breadth first)
- In pleasant, positive situations people are more tolerant of minor difficulties and irrelevancies
- Principles of good human-centred design are especially important in stressful situations

HCI DESIGN CHALLENGE: ANALOG / DIGITAL (NORMAN)

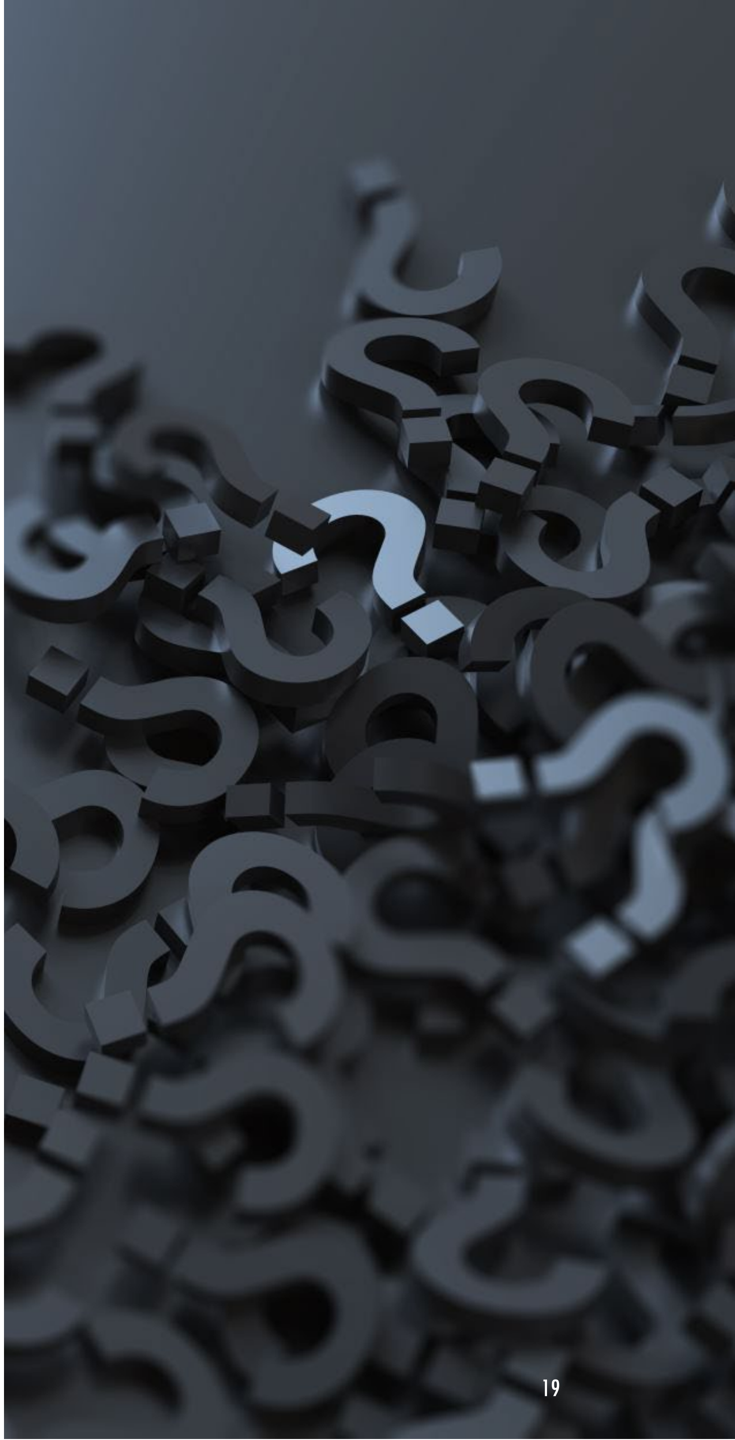
- Norman identifies key problem in ID as distinction between *analogue* humans and *digital* computers
- Biological animals – compliant, flexible, tolerant
- Machines – rigid, fixed, intolerant
- **But**: Digital design: what we are "bad at" matters, and "good at" is ignored
- Noise: the world is not neat and tidy
- "The real problem with being digital is that it implies a kind of slavery to accuracy": precision doesn't matter in the natural world – approximation
- Need to UNDERSTAND human: empathise

NEEDS? USER RESEARCH

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

So?

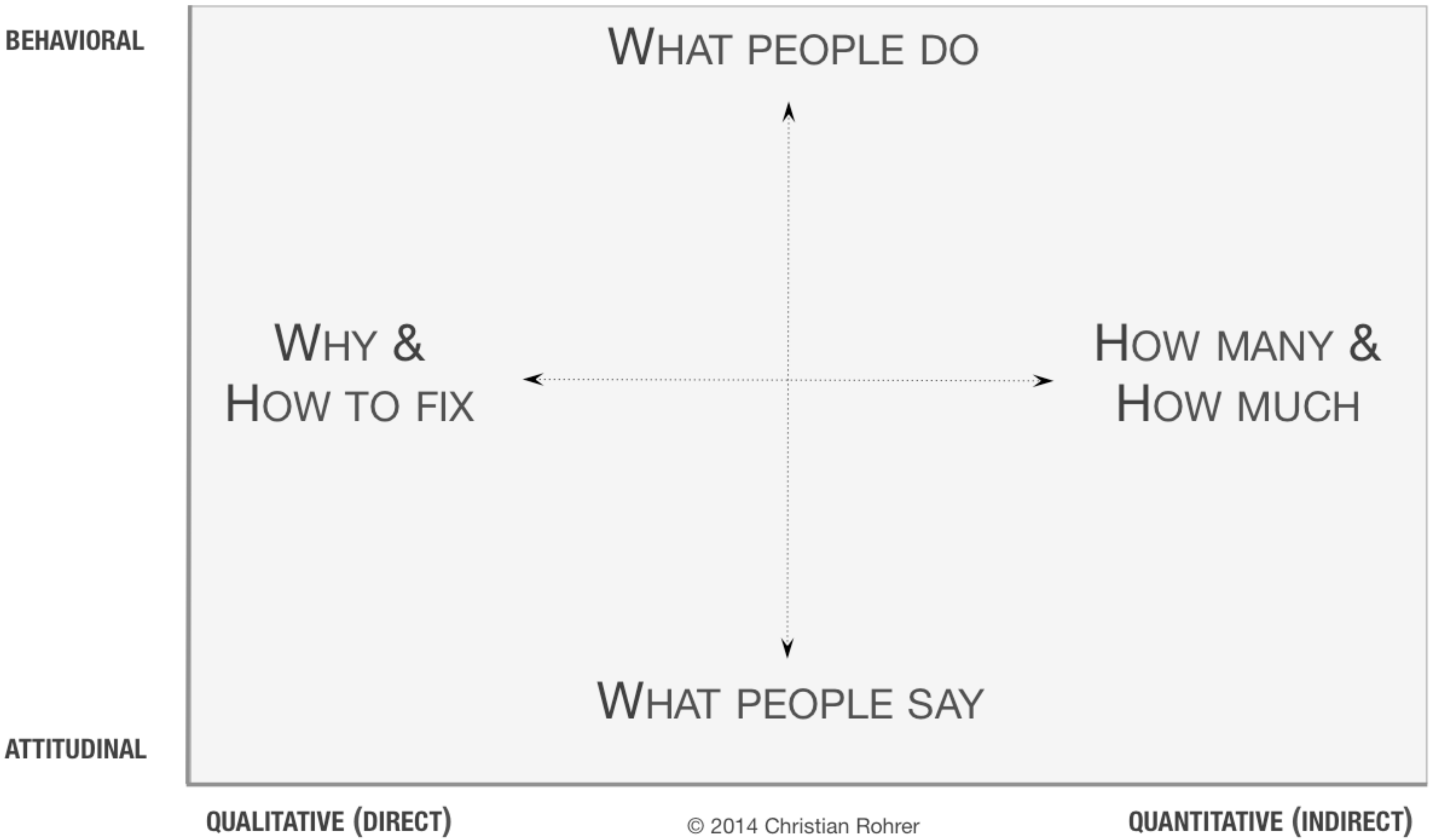
- Need to "find out" or uncover user needs
- Multiple methods
- NNG: 3-Dimensional framework:
  - Attitudinal vs Behavioural
  - Quantitative vs Qualitative
  - Context of Use

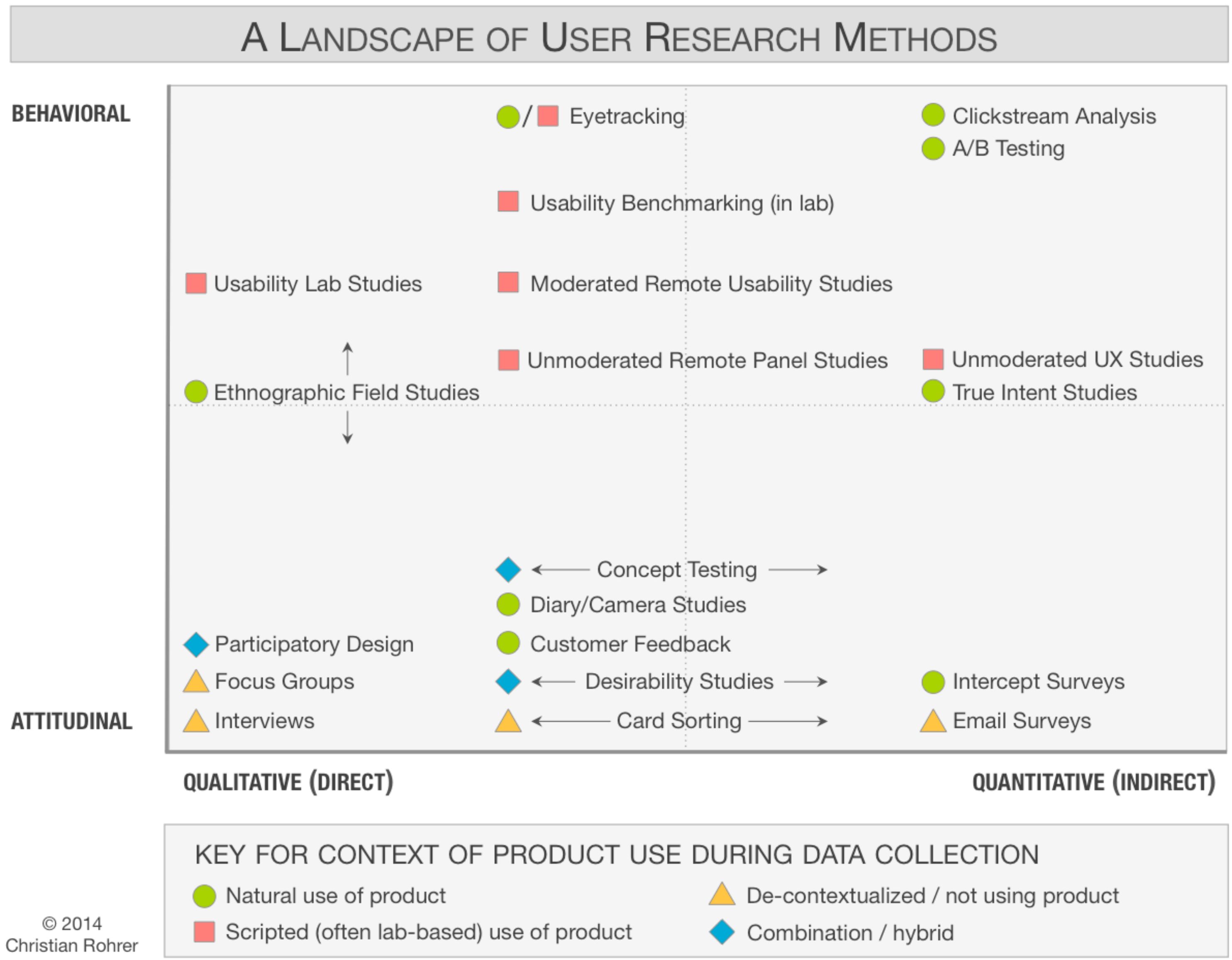


USER RESEARCH TECHNIQUES

- Data gathering techniques differ in:
  - Amount of time, level of detail and risk
  - Knowledge the analyst requires
- The choice of technique is also affected by the kind of task
  - Sequential steps or overlapping series of subtasks?
  - Complex or simple information?
  - Support the process with props such as prototypes

QUESTIONS ANSWERED BY RESEARCH METHODS ACROSS THE LANDSCAPE




A LANDSCAPE OF USER RESEARCH METHODS
BEHAVIORAL
ATTITUDINAL
QUALITATIVE (DIRECT)
QUANTITATIVE (INDIRECT)
/ Eyetracking
Clickstream Analysis
A/B Testing
Usability Benchmarking (in lab)
Usability Lab Studies
Moderated Remote Usability Studies
Unmoderated Remote Panel Studies
Unmoderated UX Studies
Ethnographic Field Studies
True Intent Studies
Concept Testing
Diary/Camera Studies
Participatory Design
Customer Feedback
Focus Groups
Desirability Studies
Intercept Surveys
Interviews
Card Sorting
Email Surveys
KEY FOR CONTEXT OF PRODUCT USE DURING DATA COLLECTION
Natural use of product
Scripted (often lab-based) use of product
De-contextualized / not using product
Combination / hybrid
© 2014
Christian Rohrer

DATA GATHERING TECHNIQUES

- Once you know what questions you want to answer, establish a search strategy:
  - Questioning:
    - Interviewing: preparation, planning
    - Surveys: preparation, design
  - Observation
  - Ethnography
  - Analytics:
    - Task Analysis & Scenario Based Analysis
    - System logging
  - Prototyping

INTERVIEWS

- Process:
  - Select people to interview & create a schedule
  - Design interview questions (open-ended, closed-ended, & probing types of questions): good questions? Ask users about their own lives/goals (*Walmart*)
  - Prepare for the interview
  - Conduct the interview (top-down vs. Bottom-up)
  - Follow-up after the interview

DATA GATHERING: SURVEYS

Select the participants

Identify the population

Use representative samples for large populations

Design the questionnaire

Careful question selection

Remove ambiguities

Administer questionnaire

Working to get good response rate

Offer an incentive

Questionnaire follow-up

Send results & a thank-you to participants

SURVEY RATING SCALES

Number?

- Use a small number (e.g. 3) for limited possibilities: *yes/no/maybe*
- Use a medium-sized range (e.g. 5) for judgments that involve *like/dislike, agree/disagree* statements
- Use a longer range (e.g. 7 or 9) when asking for subtle judgments, e.g. a UE dimension

Order?

- Positive end of the scale comes first and the negative end last, matches the logical way people think about scoring

Even or odd number of points?

- An odd number provides a clear central point
- An even number forces participants to make a decision - no sitting on the fence!

DATA GATHERING: SURVEYS

Begin with non-threatening and interesting questions

Group items into logically coherent sections

No important items at the very end

Do not crowd a page with too many items

Avoid abbreviations

Avoid biased or suggestive items or terms

Number questions to avoid confusion

Pretest to identify confusing questions

Provide anonymity to respondents

OBSERVATION

“*You can observe a lot just by watching*” (yogi berra):

- Insights into stakeholders’ tasks
- Good for understanding the **nature** and **context** of the tasks: broader activity context (e.g. Taking a bus, truckers’ mobile devices, police mobile devices)
- Requires time and commitment
- Can result in huge amount of data

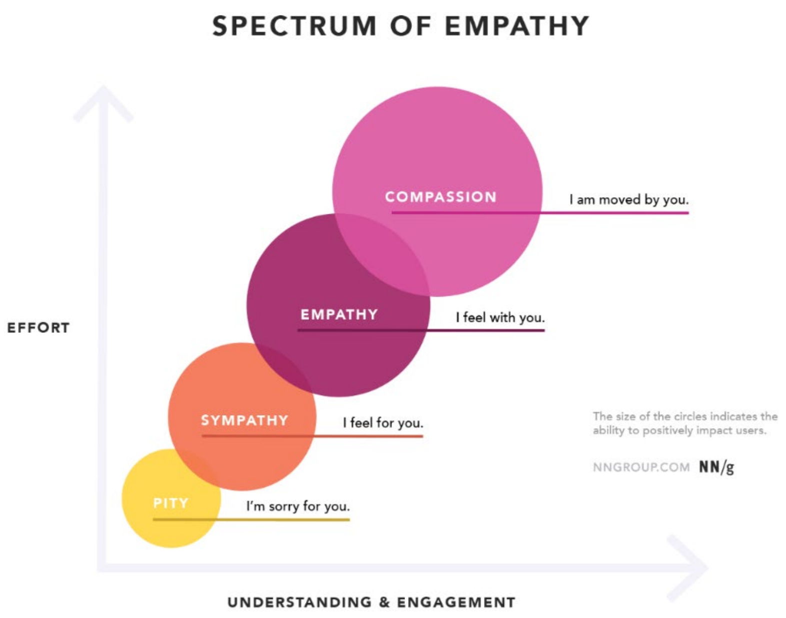
OBSERVATION

- Attunes designer to users' needs: what people say and what they do
- Participant observation: get beyond surface "said" to deeper "done"
- Jack Whalen & colleagues, Xerox PARC: photocopying support apprenticeship model
- Errors as source of design insight: Lucy Suchman & George Seely Brown: Xerox PARC: double sided copy of 50 pages video

EMPATHY & UX

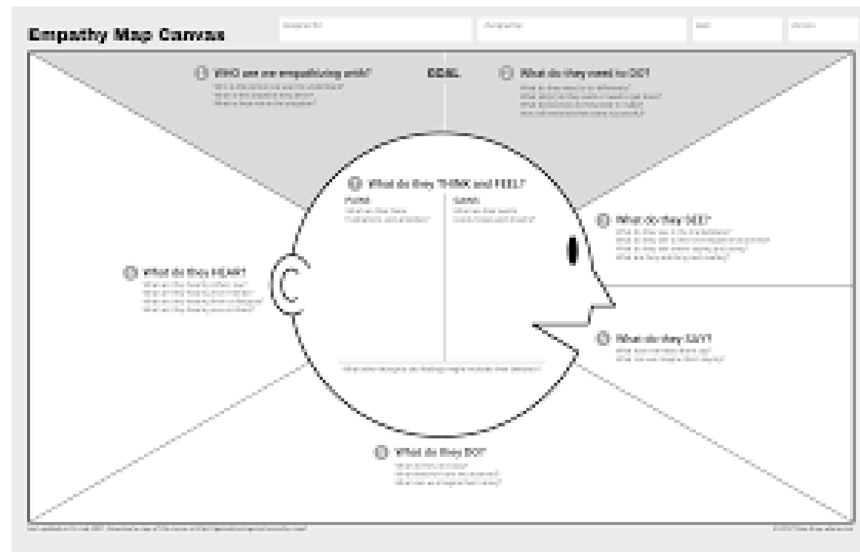
EMPATHY IN UX?

- Qualitative research methods
- Invest in a diverse team
- Consider diverse users
- Watch real users / watch videos of users
- Incorporate empathy into design guidelines
- Make Empathy Maps



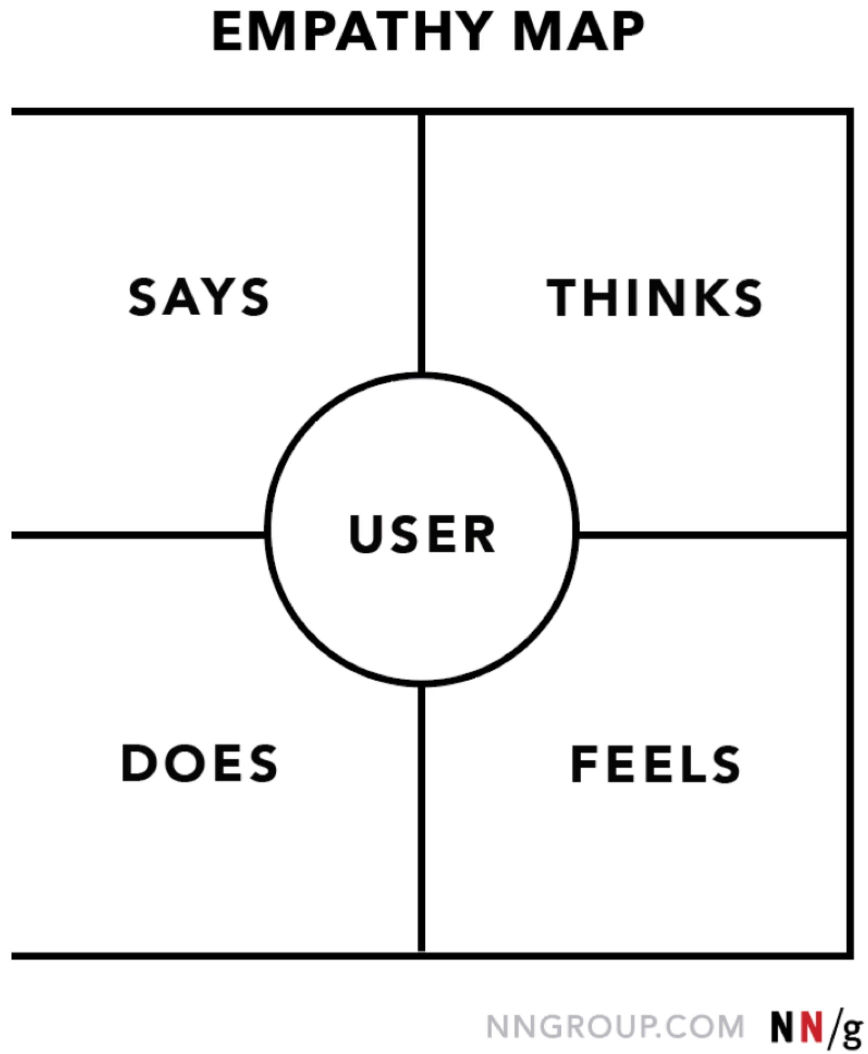
EMPATHY MAPS

- Collaborative visualization to articulate what is known about users (one or an aggregation)
- Push our knowledge about users
- Informed by qualitative research
- Externalises knowledge about users in order to:
  - Create a shared understanding of user needs
  - Aid in decision making
- Gaps highlight need for more user research

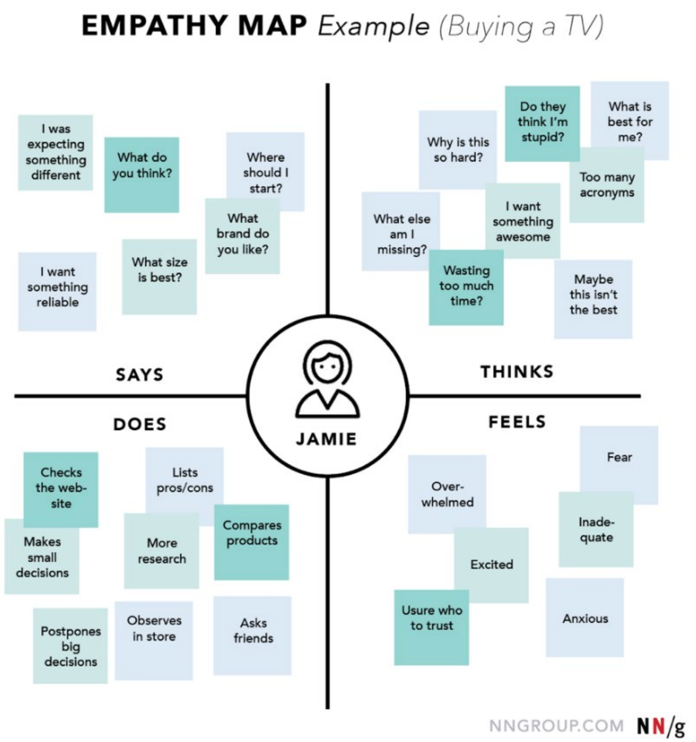


EMPATHY MAP

Says: ideally verbatim, direct quotes from research
Thinks: what occupies users' thoughts, try to **understand** (says and thinks could have same content)
Does: the actions the user takes, what the user physically does and how they go about doing it
Feels: what worries / excites user? How does the user feel about the experience?



EMPATHY MAPPING PROCESS

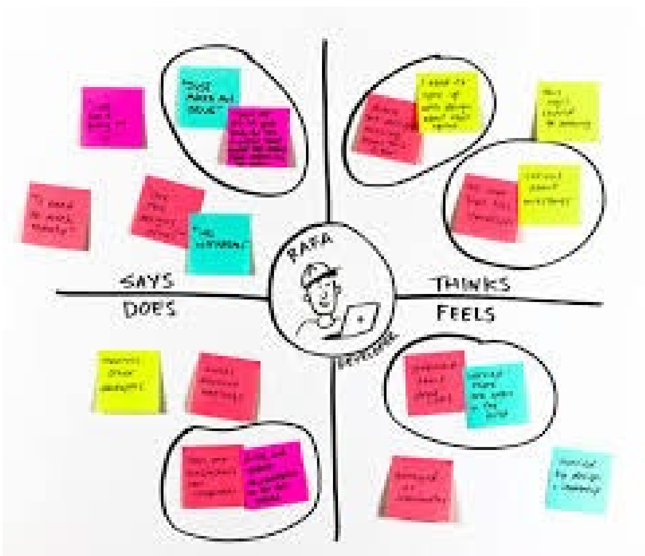


- Define scope and goals
- Gather research & materials
- Assign notes in each quadrant
- Collaborate & review: cluster & synthesise
- Extend with additional information e.g. Goals

EMPATHY MAP

- Aggregated empathy maps summarize qualitative data
- An empathy map can be used to communicate a persona, instead of the traditional 'business card' approach

EMPATHY MAPPING BENEFITS



- Remove **bias** from designs
- Discover weaknesses in research
- Uncover **implicit** user needs
- Understand what drives users' behaviors
- Guide towards meaningful innovation

USER STORIES

- Using storytelling in UX design: Account of events from user's perspective
- Shared vocabulary, focus on common goal, ignite imagination and persuade stakeholders: compelling
- Current (as-is) or Future
- User & user goals are building blocks upon which empathy, context, plot and insight are built
- User, User's goal & motivation, Context, Plot, Insight, Spectacle

DESIGN PROJECTS:

DESIGN PROJECTS

- Approx 7 Week Design Project
  - Design Challenge: Week 5 Monday 02/10/2023
  - User Needs: DT1&2
  - Prototype Design: DT 3&4
  - Evaluation: DT 5

CT318 LECTURE 4 REVIEW

Design Thinking 1

- Design Thinking 1: Empathise
- User Diversity
- User Research
- Empathy Mapping

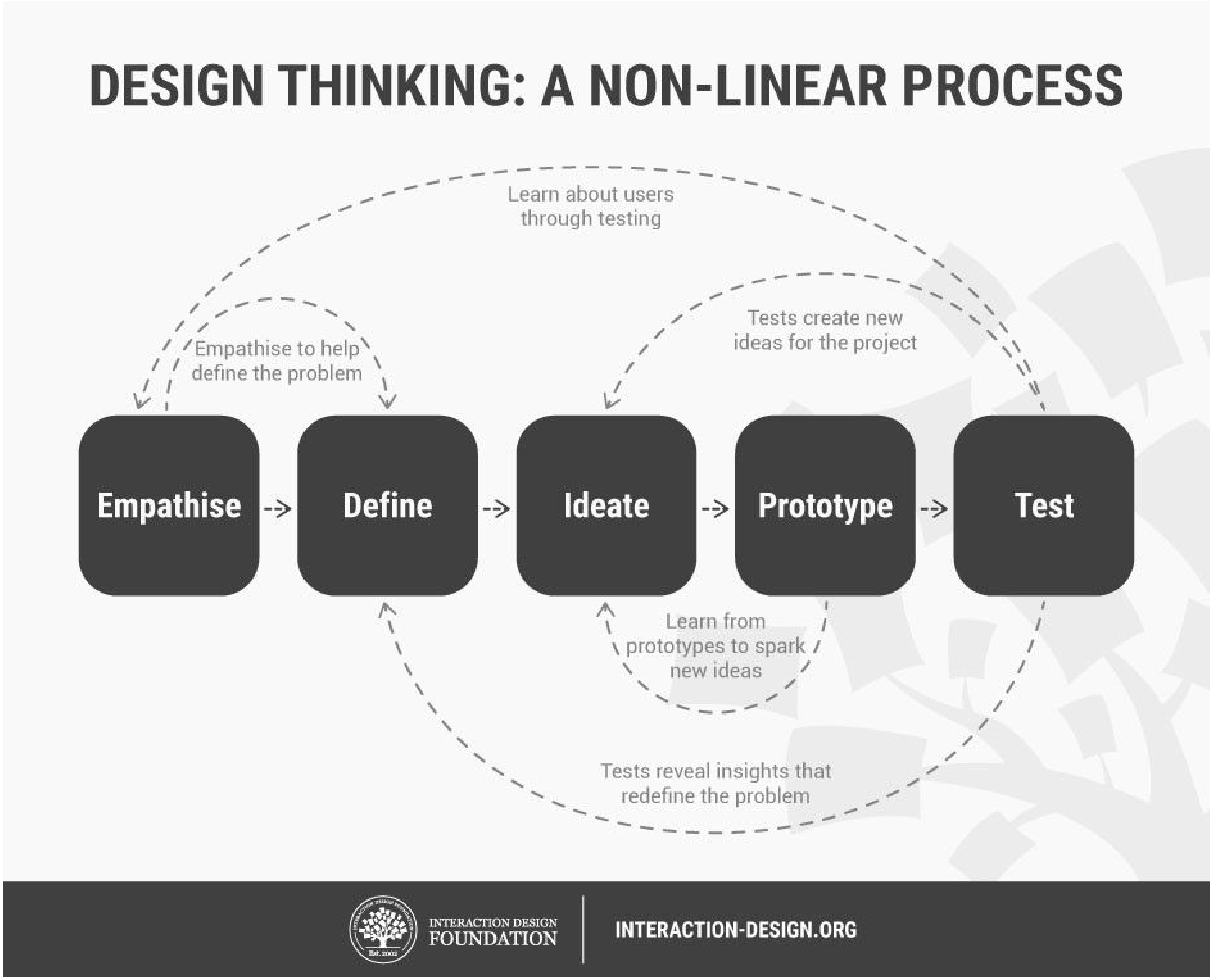
CT318 LECTURE 5

Design Thinking 2:

- Design Projects: Challenges
- Design Thinking Step 2: Define
- Problem Statements
- Represent Requirements: Task & User Needs
- PACT (Preece et al)

DESIGN PROJECTS

- Design Projects
  - Design Challenges to be explored: empathizing, defining will follow
  - What is the problem?
  - Who has the problem? (user centred not technology / product)
  - Problem statements: feedback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INTERACTION-DESIGN.ORG

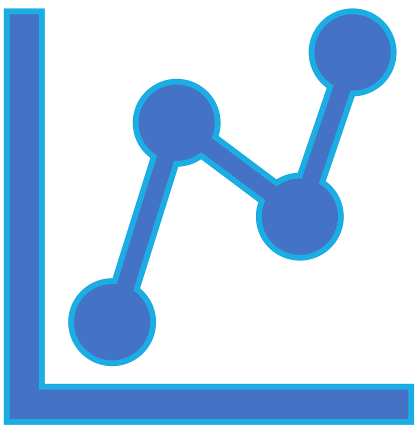
DEFINE

DEFINE: SYNTHESIS

"An integral part of the Design Thinking process is the definition of a meaningful and actionable problem statement, which the design thinker will focus on solving. This is perhaps the most challenging part of the Design Thinking process, as the definition of a problem (also called a design challenge) will require you to synthesise your observations about your users from the first stage in the Design Thinking process, which is called the Empathise stage"

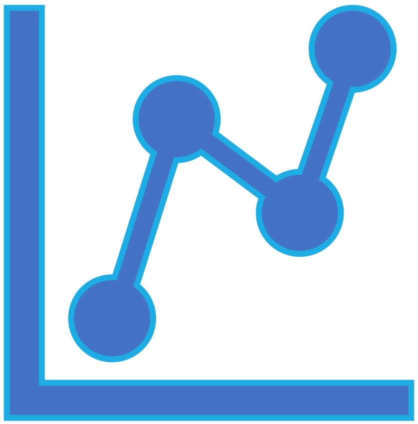
Dam & Siang, IDF 2020

DEFINE: ANALYSIS TO SYNTHESIS?



- Empathise to collect and analyse user needs
- Synthesise output from Empathising stage
- Analyse collected data (qualitative and quantitative)
- Produce problem statements: representations of User Needs

DEFINE: PROBLEM STATEMENTS



- Good problem statements:
  - Human centred: focused on people's needs not technology or product
  - Broad enough for creative freedom: not technical requirements
  - Defined enough to be manageable
  - Begin with an action oriented verb: "create", "define", "adapt"

DEFINE: HOW TO?

- How to synthesise output from empathizing stage?
- Create a wall of information: collate findings into one place: space, saturate and group into:
  - Empathy Maps
  - Personas
  - Points of View
  - User Needs Statements

USER NEEDS: REPRESENTATIONS

Users:

- Personas
- Empathy Maps

Tasks:

- Activity / Task Analysis

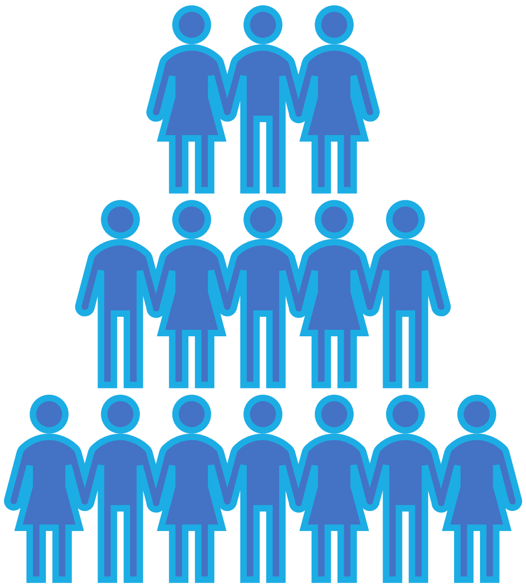
Users & Tasks:

- User Needs Statements
- User Stories
- Use Cases, Scenarios
- Storyboards
- Prototypes

USERS: PERSONAS

- Diversity of humans - abilities, backgrounds, motivations & personalities - design challenge
- "*Average*" or "*typical*" user?
- How to design to accommodate this diversity?

- **Personas:**
  - Concrete example of a user and their motivation, behaviours, abilities
  - Helps keep designers consistent over time
  - Increases empathy
  - Helps innovation

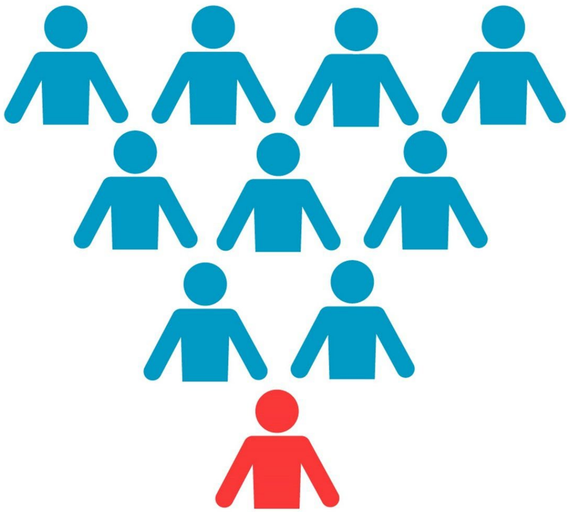


PERSONAS


openmoko
The Greenhorn
The Casual User
The Texter
The Business User
The Power User
The Hacker
JOHN
EMILY
AKIKO
STEPHAN
ROBERTO
RICKY
Profile
- Probably the single biggest segment of mobile users.
- Want simple: turn on their mobile, dial a number and talk to their intended party.
- Don't care about anything other than the mobile being able to be used as a phone, and possibly contacts.
Scenario
I didn't get my first phone until 2001. My daughter bought it for me. I didn't feel it was necessary but since then, I have it with my all the time and use it more than my home phone.
Profile
- Take advantage of most phones features, but not all.
- Use the phone to make calls, use the contacts, send text messages, and take pictures.
- Their mobile is always with them.
Scenario
My phone has to look cool. I personalize it with decals, charms, and ring tones. I talk on it everywhere, so my phone style is everything. Of course, it has to work too. I usually talk on the phone, but recently started taking pictures and recording video. My phone is my favorite accessory.
Profile
- Texting is far more popular than calling.
- Will send and receive thousands of text messages per month.
- Rarely use their phones for calling.
- Want a clean texting interface with the fastest possible input.
Scenario
I prefer texting than calling because it's more fun and creative. My friends and I probably text each other around 40 times a day. We'll even text to order food. It's far more interesting and less intrusive. I don't have to worry about disturbing people on the train with my talking. I love it.
Profile
- Wants a phone that is simple, but functions as an integrated smart device.
- Want to read email and call back the sender with the least amount of effort.
- Needs "Popular" mail server integration, including Blackberry and Exchange.
Scenario
My mobi is my life. Without it my business would suffer. I take conference calls while driving down the M25. If someone text me, I need to ring them without taking my eyes off the road. And since I use my mobi everywhere, it needs to be durable. The last thing I need is for it to break after one drop.
Profile
- Will use almost all of the built-in functionality.
- Will also extend their phones functionality with additional software.
- Will flip through every menu options and changing settings.
Scenario
I'm addicted to new toys. I get the latest gadgets as soon as they arrive on the market. I upgrade my phone every 6 months. I guess you can say this is almost a sport for me. Or an addiction? I just love to explore the latest and how it can make life fun.
Profile
- Care more about customization.
- Want to make changes to every aspect of the phone.
- Belong to mailing lists and forums about hacking the phone.
- Contribute to the open source community.
Scenario
As soon as I found out about an open source phone, I jumped on it. I created two apps for the phone and am working on the texting solution. I probably should spend more time at my day job, but this is far more fun. Of course, I use my phone for calls and texting too.

EXTREME PERSONA

- To avoid “cliches” and bias in user populations
- Focus on specific characteristics of rare or specialist groups
  - Multi minority: physical
  - Hard lifer: emotional
  - Toxic behaviours: behavioural
- Include an extreme persona as part of target user group



EMPATHY MAP

- Aggregated empathy maps summarize qualitative data
- An empathy map can be used to communicate a persona, instead of the traditional ‘business card’ approach

TASKS & ACTIVITIES

- Activity Analysis
- Hierarchical Task Analysis
- Card Sorting
- Affinity Diagrams

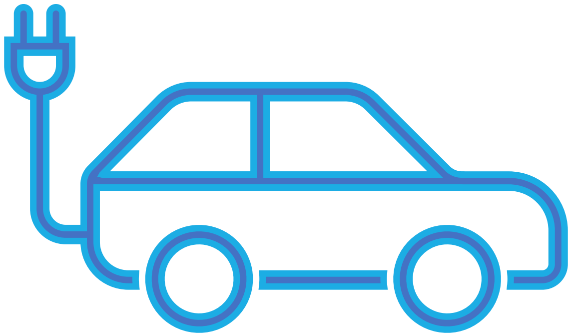
ACTIVITY ANALYSIS

- Activity: narrow / broad (e.g. starting a car, making coffee)
- Often done implicitly in design: explicit
- Activity Analysis Outcomes (not a design):
  - What are steps involved?
  - What artifacts are used?
  - What are goals? How to measure success?
  - What are pain points? Workarounds, breakdowns

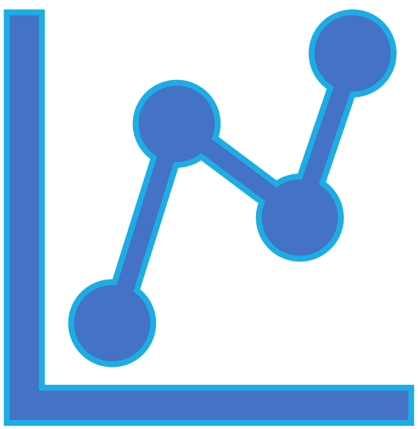
ACTIVITY ANALYSIS EXAMPLE

- Activity: Starting a car
- Narrow / Broad?
  - Unlock driver's door
  - Take a seat behind the wheel
  - Insert key in ignition switch
  - Turn key fully clockwise
  - When engine starts, release the key

- Opportunity for redesign?
  - Artifacts?
  - Goals: important to point of view as designer: narrow / broad pain points?
  - Creating new things - metaphors

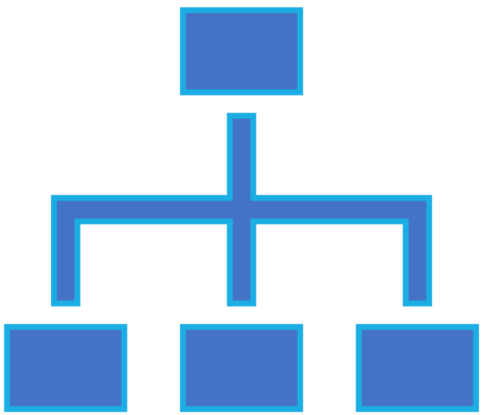


TASK REQUIREMENTS: ANALYSIS



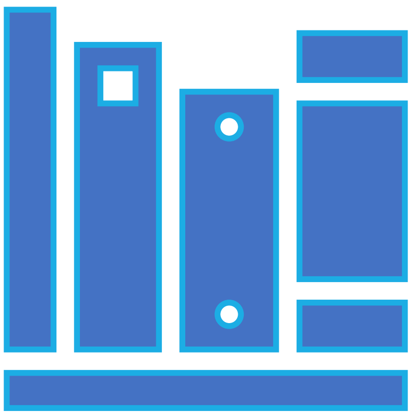
- Analyse how users perform tasks
- The things they do, they act on and they need to know
- Task analysis techniques such as HTA help to investigate existing systems and practices
- Three different approaches to task analysis, each with a different emphasis:
  - **Task decomposition**: task is split into subtasks
  - **Object / ER** based analysis: the actors, objects & relationships
  - **Knowledge-based techniques**: what users need to know, ontologies

TASK ANALYSIS METHODS

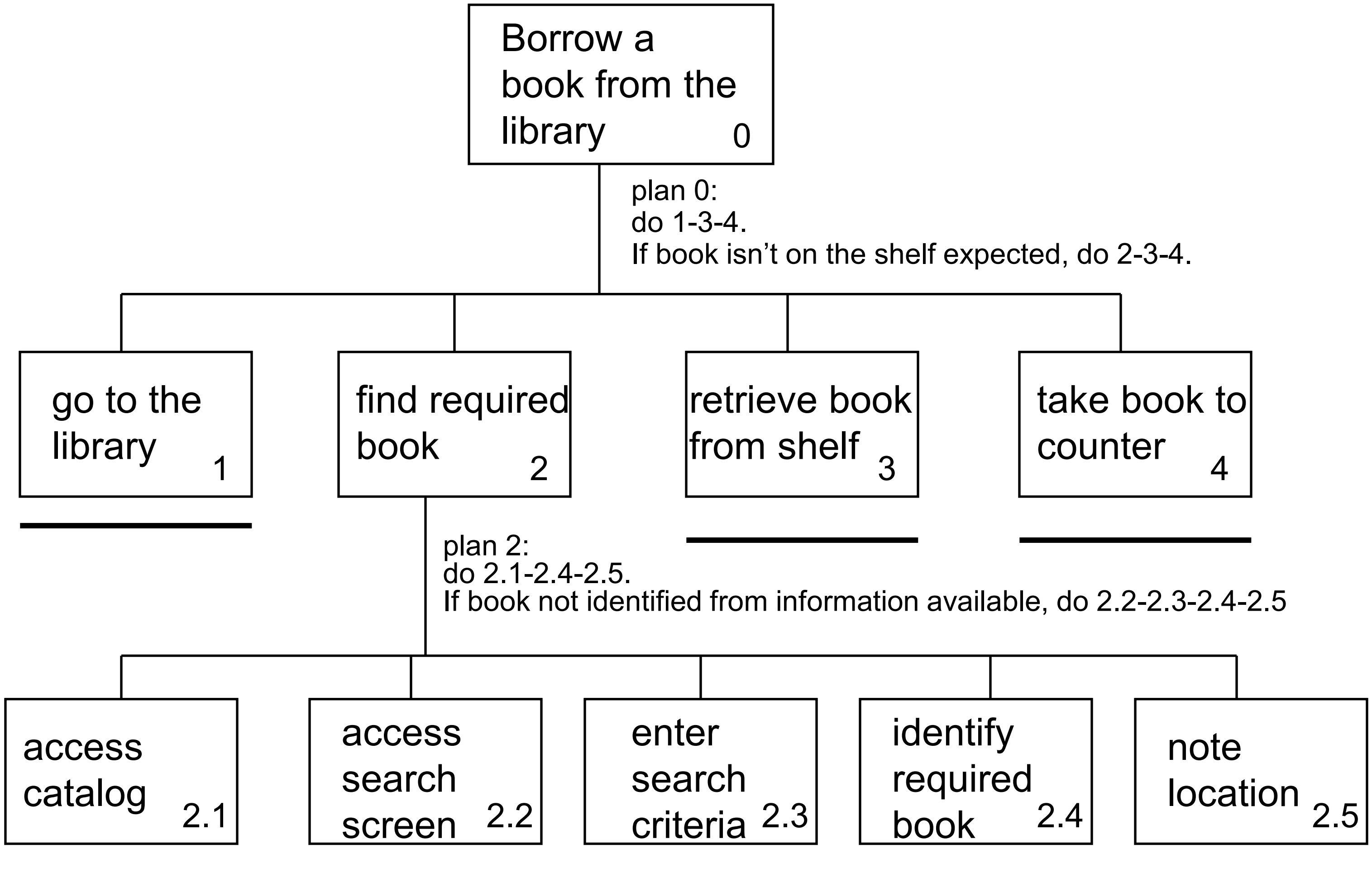


- **Task Decomposition:**
- *Hierarchical Task Analysis* (*HTA*) outputs a hierarchy of tasks and subtasks in the order they are performed
- Iteration & when to stop: P * C rule
- Represented diagrammatically and textually
- Example: Task of vacuum cleaning; making coffee
- **Example:** Borrow a book from library?

HIERARCHICAL TASK ANALYSIS (HTA)

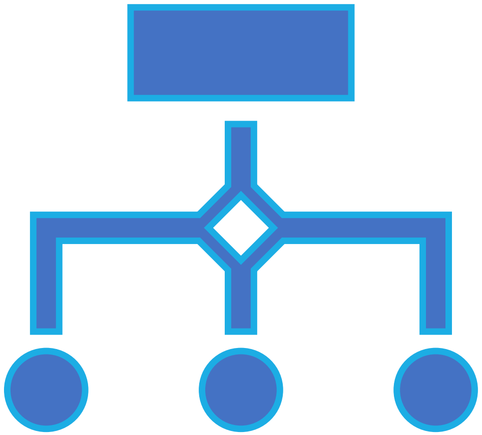


- 0: Borrow a book from the library:
  - 1. go to the library
  - 2. find the required book
    - 2.1 access library catalogue
    - 2.2 access the search screen
    - 2.3 enter search criteria
    - 2.4 identify required book
    - 2.5 note location
  - 3. go to correct shelf and retrieve book
  - 4. Take book to checkout
- Or 2 first? Then 1,3,4?


Borrow a book from the library 0
plan 0:
do 1-3-4.
If book isn't on the shelf expected, do 2-3-4.
go to the library 1
find required book 2
retrieve book from shelf 3
take book to counter 4
plan 2:
do 2.1-2.4-2.5.
If book not identified from information available, do 2.2-2.3-2.4-2.5
access catalog 2.1
access search screen 2.2
enter search criteria 2.3
identify required book 2.4
note location 2.5

TASK ANALYSIS USES

- Output is some breakdown of tasks people perform and the objects, plans, sequences of actions etc.
- This material can be used for many purposes:
  - Production of tutorials and support material
  - Requirements capture and high-level systems design
  - Assignment of tasks to human or computer: who provides data, who does task? (e.g. currency converter)
  - Detailed interface design
- TA does not scale very well, given complexity of real tasks (size, overlapping, parallel, interruptions)



DATA GATHERING: CARD SORTING

- Card sorting: web search akin to looking for a scissors in someone else's kitchen! (Benyon)
- Understanding how people classify and categorise things: information architecture / ontology

AFFINITY DIAGRAMS

- Group information & find relations between groups
- Post-Its on large surfaces
  - haptic UI
  - immersive
  - persistent
  - brainstorming

USERS & TASKS

Describing sequence of actions undertaken by users:

- **User Needs Statements (PoV)**
- **User Stories**: specific, and communicate the value of the experience to its users
- **Storyboards**: generic / specific; visual
- **Scenarios:** specific; visual / textual

USER NEEDS STATEMENTS

- Actionable problem statements
- Summarise:
  - Who a particular user is
  - The user's need
  - Why the need is important to the user
- Define what you want to solve, before solving it
- Advance presumptive solutions towards deeper problem insights

USER NEEDS STATEMENTS

- Align different points of view before progressing to **ideate** stage
- Captures **what** (from empathic insights) rather than **how** (predetermined solutions): what is important to user not UI buttons
- **Verbs** (user goals) rather than **nouns** (UI solutions): *choices* not *dropdown*; *digest varied information* not *dashboard*
- User needs: goals (service provided) not preferences (what they like stylistically)
- **Format: user – need – goal**
- (User) needs a way to (address this need) so that they (accomplish their goal)

USER NEEDS STATEMENTS: EXAMPLES

"Users don't need another food delivery platform; they just need a way to look for food in their area and have it delivered whenever they want

Your users do not require a shopping cart; instead, they require an overview of the products and the total cost in order to finalize their purchase

The goal of your designs is not to build a checkout page, button, or pricing table; instead, it should be to understand the user's demands and provide a solution"

Kaushik, 2021, UXPlanet

- Users do not need to login!

USER NEEDS STATEMENTS: EXAMPLES

- As a renter, I need to know how much my utility bills will be so I can budget appropriately
- As a homeowner, I need to know how much property / council tax I have to pay so I am tax compliant
- As a car owner, I need to know where I can find the cheapest fuel so I save money
- As a student, I need to know where I can study so I don't waste valuable study time searching for a free space
- *"As a householder living near a proposed fracking site I want to know what effect fracking has on nearby households So that I can make a decision about moving home"* (UKGov)

USER NEEDS STATEMENTS

Point of View Template – Example

User	Need	Insight
An adult person who lives in a city	To use a car for 10-60 minute trips 1-4 times per week	The user would not want to own his own car as it would be too expensive compared to his needs. He would like to share a car with others who have similar needs, however, there are no easy and affordable solutions for him. It's important for the user to think and live green and to not own more than he truly needs.

User Need

As a [User Type] I need/ want [User Need] so that [User Goal] .

User Problem

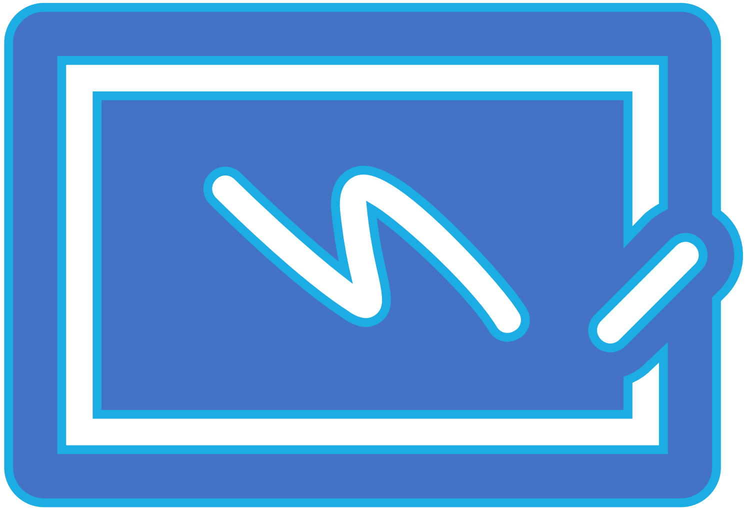
[Situation] is challenging for [User Type] because [Cause/ Problem] .

USER STORIES

- Using storytelling in UX design: Account of events from user's perspective: well crafted from user insights, empathic
- Shared vocabulary, focus on common goal, ignite imagination and persuade stakeholders: compelling
- Current (as-is) or Future
- User & user goals are building blocks upon which empathy, context, plot and insight are built
- User, User's goal & motivation, Context, Plot, Insight, Spectacle

STORYBOARDS

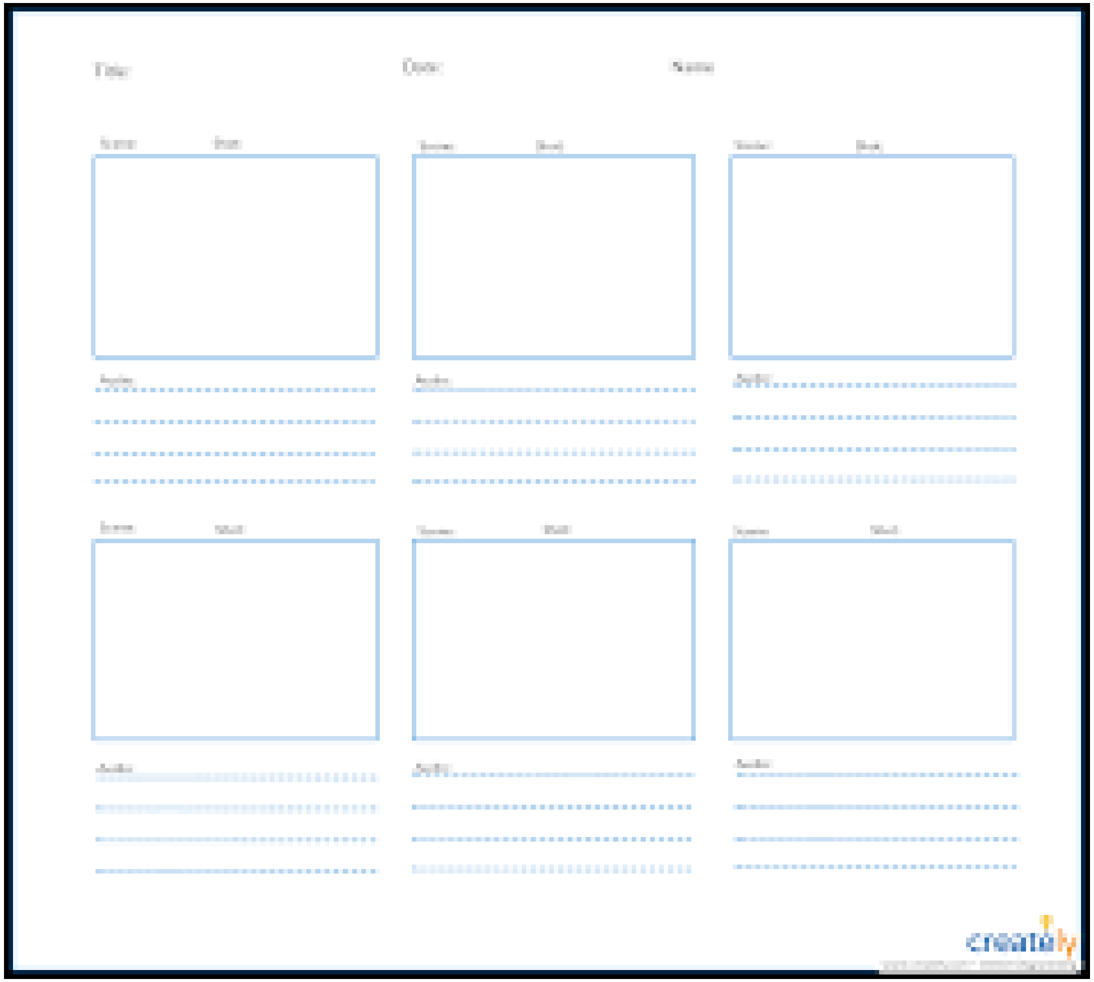
- Storyboard: visual communication of ideas
- "Communicates a story through images displayed in a sequence of panels that chronologically map the story's main events." NNG
- Provide additional context
- Images make the story quick to understand at first glance and easy to remember: informal
- Storyboards consist of:
  - A specific scenario
  - Visuals: define fidelity
  - Corresponding captions



STORYBOARDS

- **Tasks** & **activities** you want to support (not UI)
- Holistic focus: no commitment to particular UI
- In a few panels capture what user will accomplish
- Will have person in it
- Communicate flow & ideas: key points in time
- Extremely harsh time limits: 10 minutes
- Three key components:
  - Setting: people, environment, task
  - Sequence: steps
  - Satisfaction: user motivation

STORYBOARD TEMPLATE

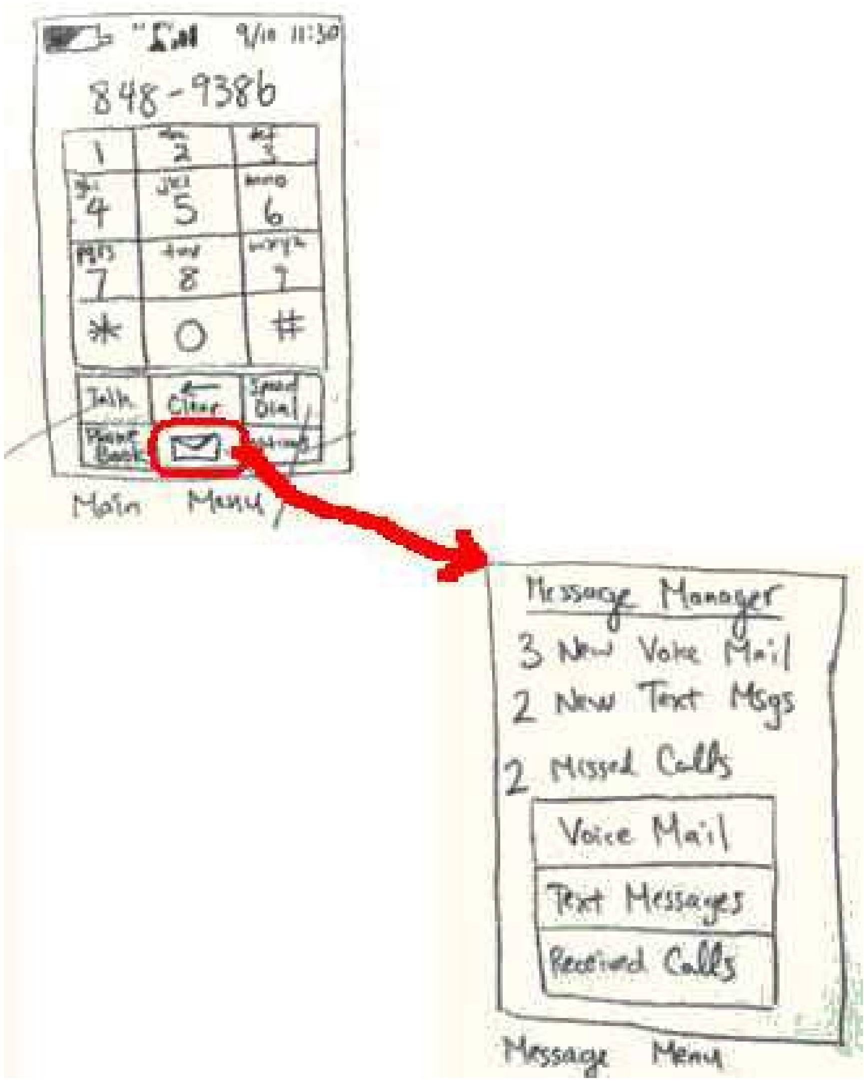


SCENARIOS

- An informal narrative story, simple, 'natural', personal, - not generalisable
- Illustrate using storyboards: sequences of sketches showing screens & transitions
- Good to demonstrate to management, marketing and customers
- Can replace much textual specification

SCENARIOS

- Scenarios are *design specific*, tasks aren't
- Scenarios force us to
  - show how various features will work together
  - settle design arguments by seeing examples
    - only examples -> need to look beyond
- Show users storyboards
  - sequences of sketches showing screens
  - actions users can take
  - get feedback

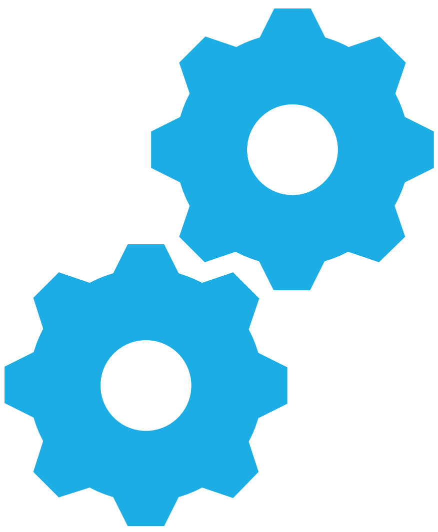


PACT FRAMEWORK

- **PACT**: People, Activities, Contexts and Technologies *(Preece et al, Interaction Design book)*
- ***People*** use ***technologies*** to undertake ***activities*** in ***contexts***
- Variety of these elements that makes designing interactive systems such a challenge
- Aim: best possible mix of technologies to support the activities being undertaken by people in different contexts
- PACT analysis useful for analysis and design
- Good Project Framework

REQUIREMENTS TO DESIGN

- Design begins after set of requirements established: Ideation & Design
- Define **what** product will do before you design **how** the product will do it!
- Brainstorm different design solutions
- Two stages of design:
  - **Conceptual**: what the product will do & how it will behave: ***knowledge*** about system
  - **Physical**: details such as screen structure, icons, graphics: system ***actions***



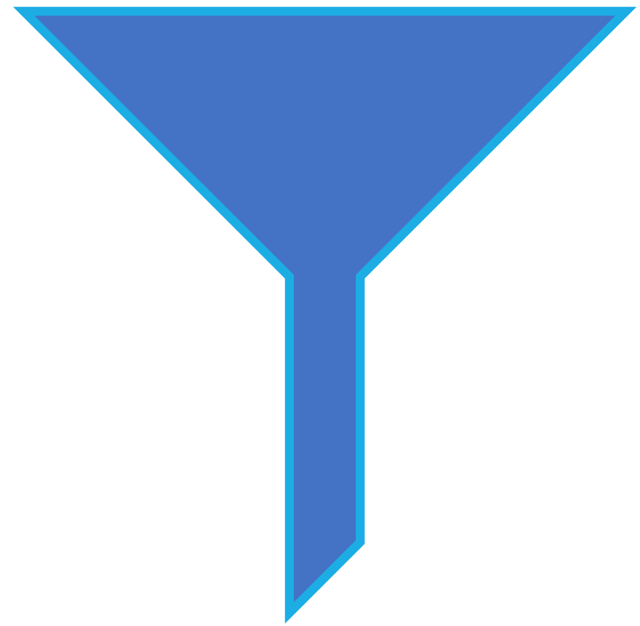
CT318 LECTURE 5 REVIEW

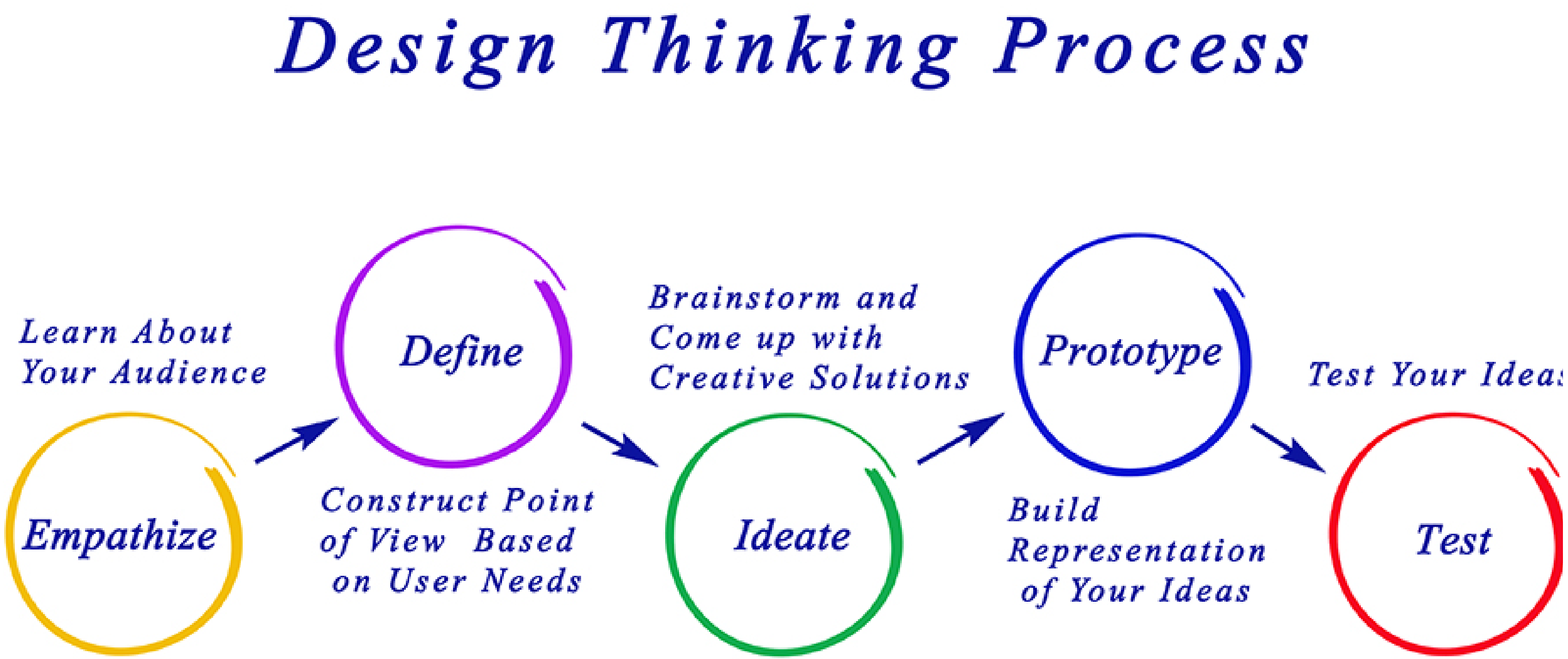
Design Thinking 2:

- Design Projects
- Design Thinking Step 2: Define
- Problem Statements
- Represent Requirements: Task & User Needs
- PACT (Preece et al)

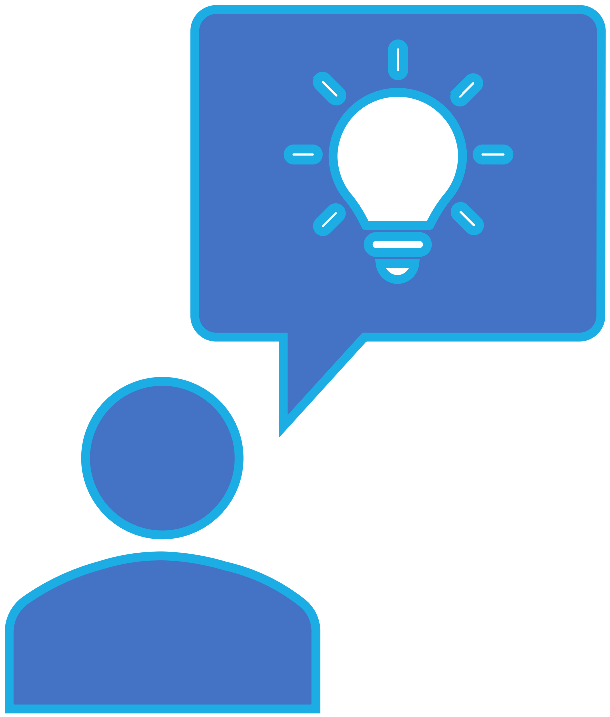
HCI: LECTURE 6 OVERVIEW

- **Design Thinking 3: Ideation**
  - Ideation
  - Design Funnel (Laseau)
  - Functional Fixedness
  - Conceptual Design




Design Thinking Process
Learn About Your Audience
Empathize
Define
Construct Point of View Based on User Needs
Brainstorm and Come up with Creative Solutions
Ideate
Prototype
Build Representation of Your Ideas
Test Your Idea
Test

DESIGN THINKING: IDEATION



KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY 2023-2024

IDEATION

- Starting point: understanding users' needs: ground ideas in these needs, not in novel design trends or convenient technical solutions
- The focus of ideation is improving the user experience, without any real-world constraints (e.g. technical feasibility or business viability)
- Open minds to generate innovation & insights
- Generate Alternatives: precedes any design creations
- Parallel design activities: explore more of design space; not satisficing
- No idea is too farfetched: "*much easier to scale back a crazy idea that addresses a true user need, than to try to make a mundane idea desirable.*" (NNG)

IDEATION

- Quantity instead of quality; the more ideas the better:

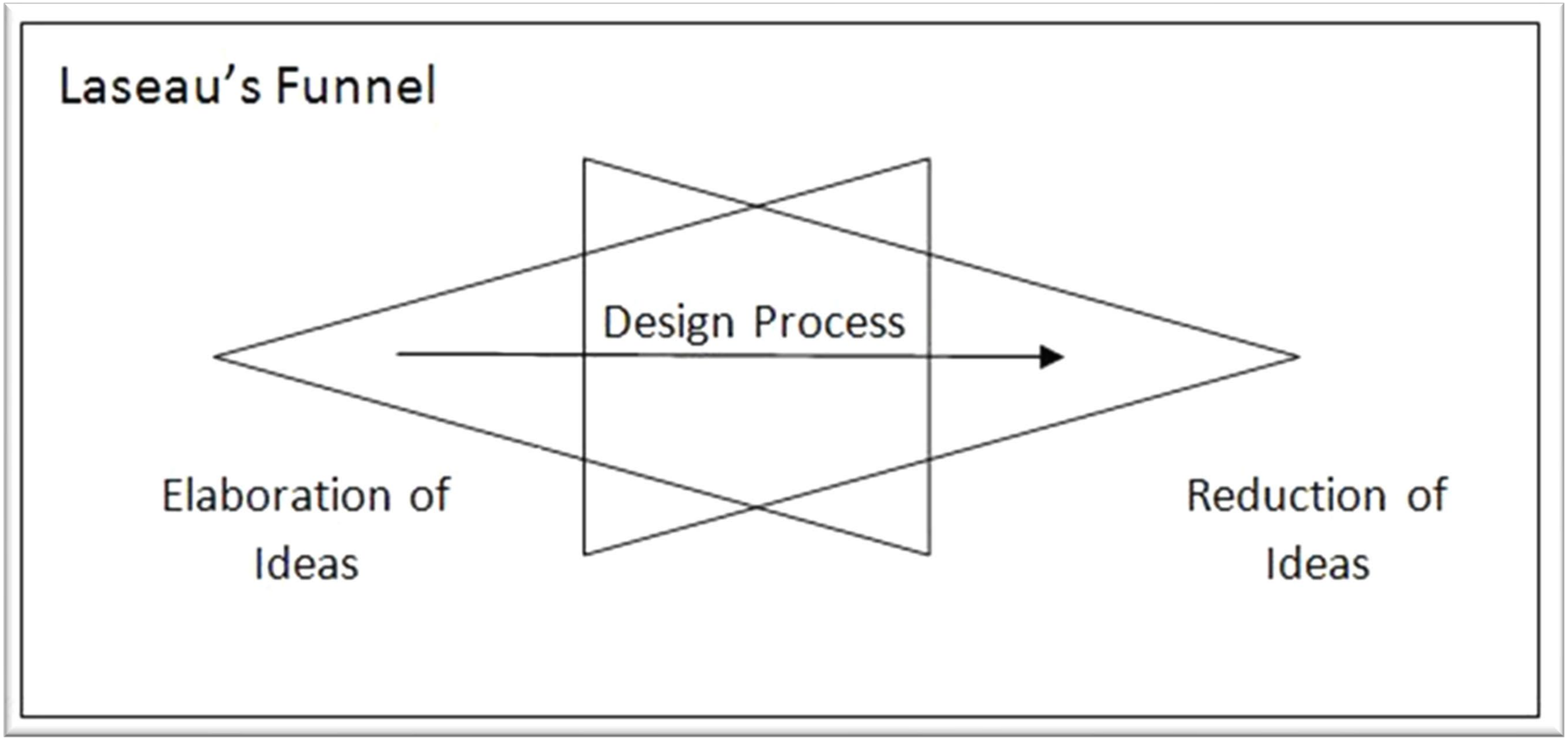
"The best way to have a good idea is to have a lot of ideas. Most of them will be wrong, and what you have to learn is which ones to throw away."

Linus Pauling (1995)

- Three Characteristics:
  - Ideas are not evaluated
  - Ideas are recorded and documented
  - Collaboration spurs diverse ideas: "Yes and…."

IDEATION: HOW?

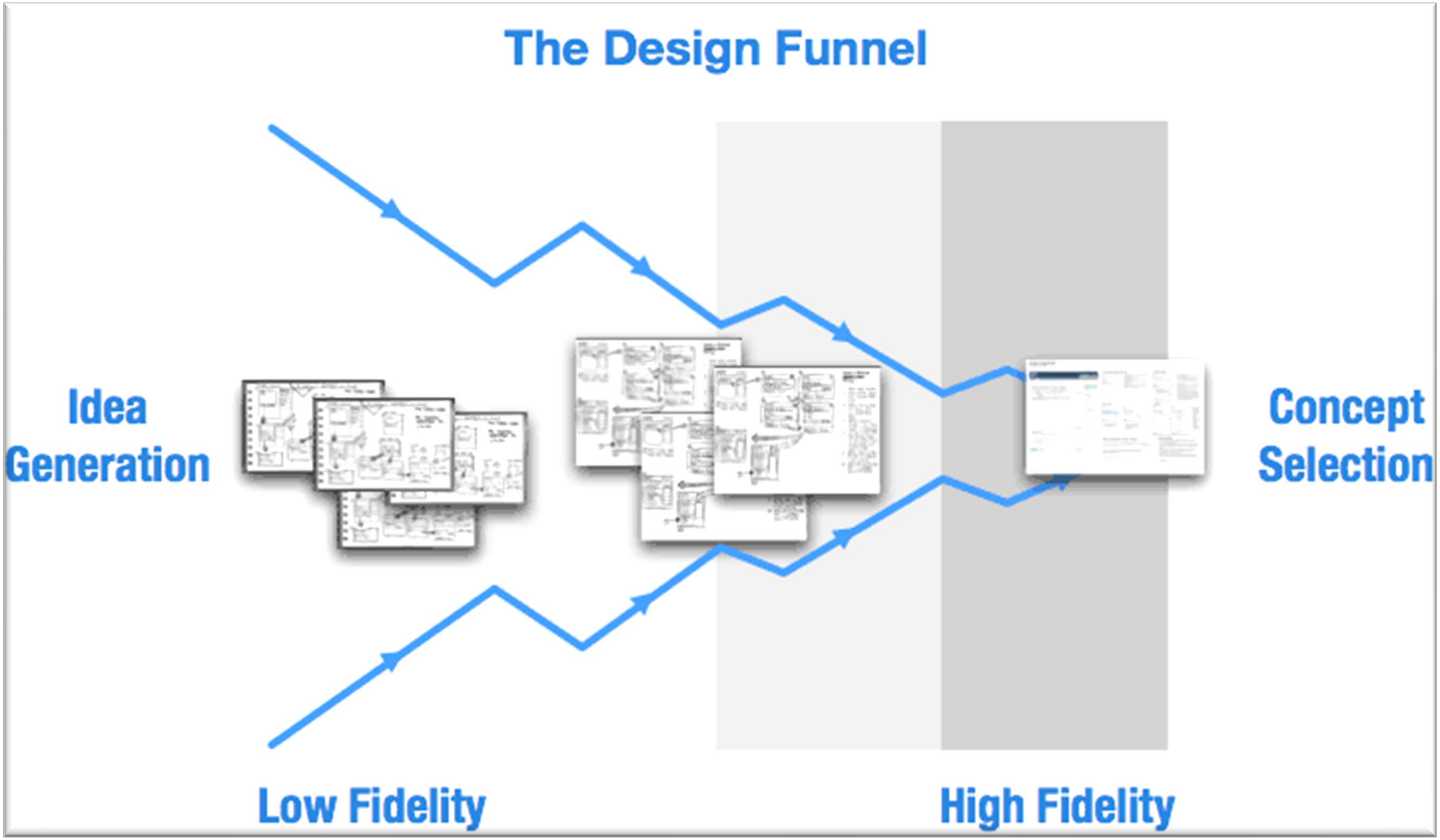
- Problem abstraction: related sources of inspiration
- Looking at different domains entirely: cross-fertilization of ideas
- Designer flair and creativity: envisionment
- Design Alternatives
- Involving different stakeholders in the design process
- How Might We?
- Sketching



DESIGN FUNNEL

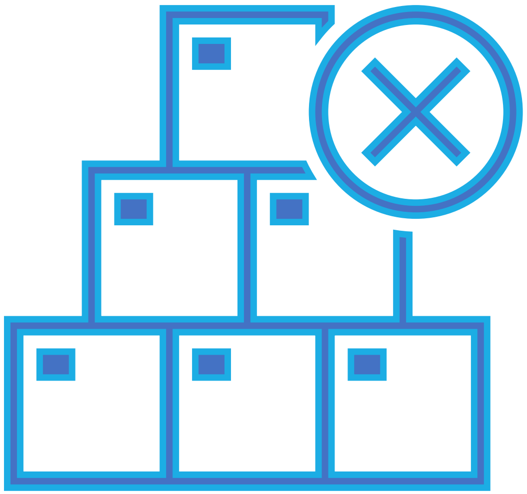
CONVERGENT & DIVERGENT DESIGN

- Convergent Vs. Divergent Design Thinking: Harvard Professional Development https://www.youtube.com/watch?v=xjE2RV6IQzo
- The companies that want to see the most models in the least time are the most design-sensitive (*divergent*); the companies that want that one perfect model are the least design sensitive (*convergent*)


The Design Funnel
Idea Generation
Concept Selection
Low Fidelity
High Fidelity

FUNCTIONAL FIXEDNESS

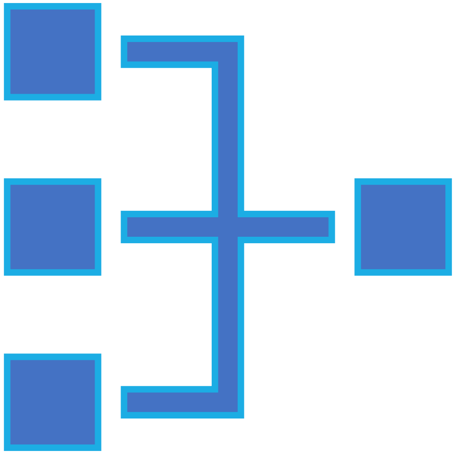
- Functional fixedness is a cognitive bias that drives people to use objects in traditional, standard ways
- "Stuck in a box / rut" thinking: strengthens over time
- Candle, box of tacks, matches
- Overlooking alternate approaches and functions hinders problem-solving
- Different perspectives: group ideating
- Abstract the problem & identify potential sources of inspiration
- How else might this work? How might we?



FUNCTIONAL FIXEDNESS

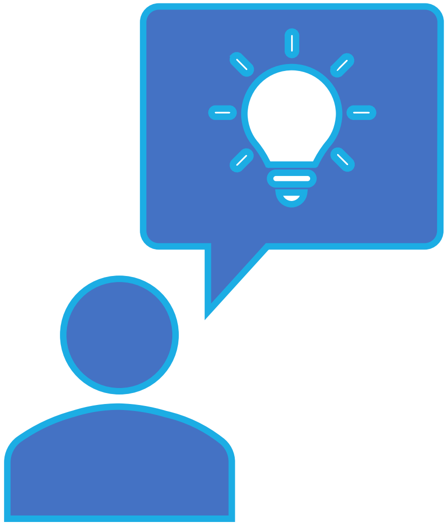
Three steps to avoid functional fixedness:

1. Abstract the problem: distill the problem down to the basics
2. Identify alternative fields of expertise that could help solve the problem
3. Draw inspiration from these distant domains, no concept is too crazy: delay judgment and branch out as far as possible to generate creative potential solutions



IDEATION: ENVISIONMENT

- Envisionment is a visual exploration & presentation of key features of design
- Aids generation, communication and evaluation of ideas for different people at different stages of development
- Allows for feedback from users and clients
- All aspects can & should be envisioned: **concepts, functions, structure, interaction** methods go from sketches ('back of the envelope') to full computer prototypes

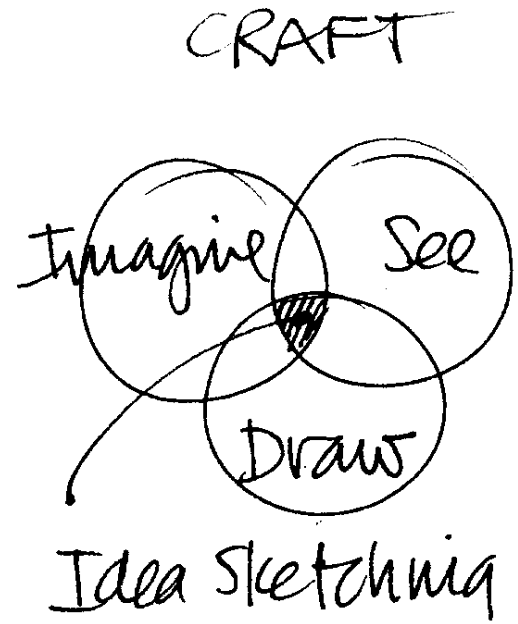


DESIGN: PROTOTYPING & IDEATION

"*Sketches* and *prototypes* are both instantiations of the design concept. However they serve different purposes, and therefore are concentrated at different stages of the design process. Sketches dominate the early ideation stages, whereas prototypes are more concentrated at the later stages where things are converging within the design funnel."
Bill buxton, *sketching user experiences*

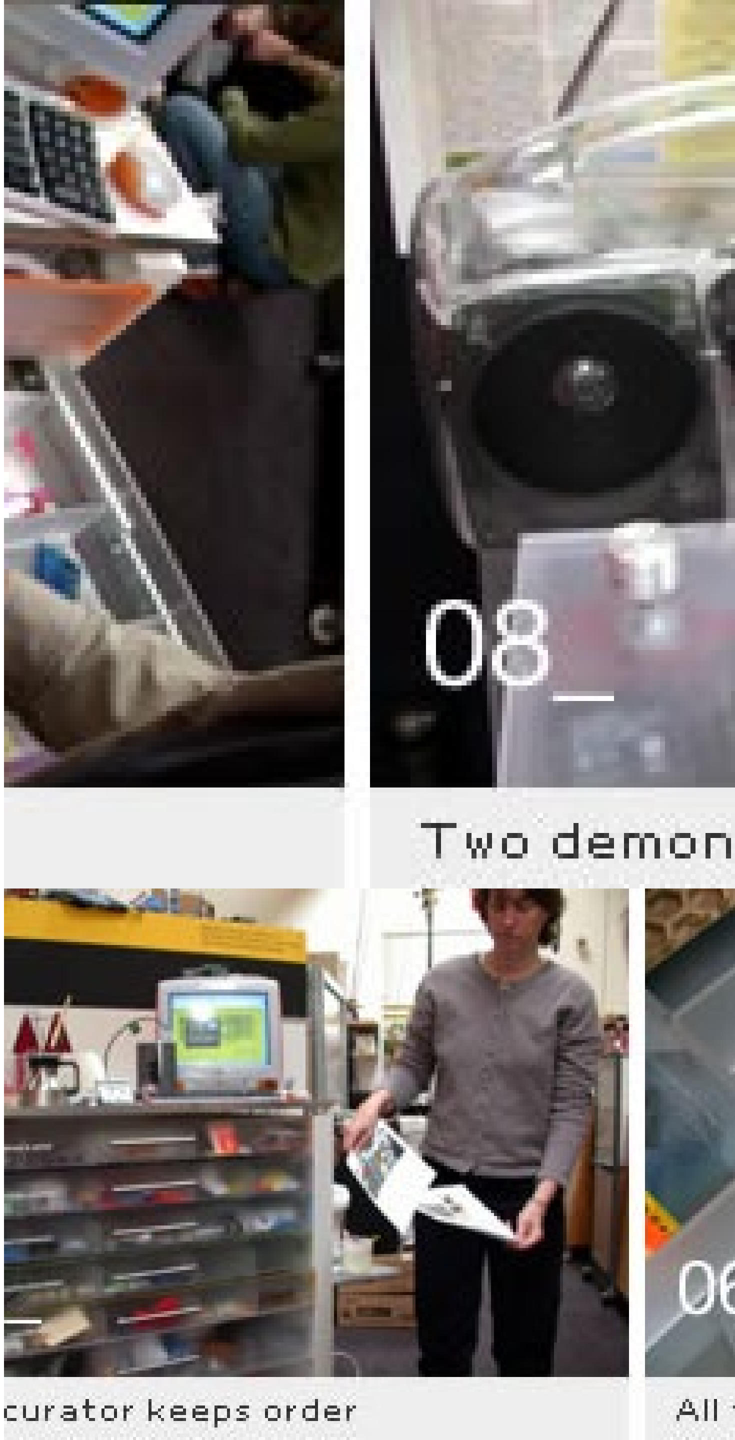
SKETCHING: VISUAL THINKING

- Robert McKim: *Experiences in Visual Thinking*: seeing feeds drawing which improves seeing
- Rapid visualisation (idea sketching) is the craft of imagining, seeing, and drawing at the same time
- Sketches: essential designer's tool for capturing preliminary observations and ideas
- Can be concrete or abstract, representational or Symbolic



DESIGN ALTERNATIVES?

- Humans stick to what they know works
- Considering alternatives is important to ‘break out of the box’
- Designers are trained to consider alternatives, software people generally are not
- How do you generate alternatives?
  - ‘Flair and creativity’: research & synthesis
  - Seek inspiration: look at similar products or look at very different products



HOW MIGHT WE?

- "*A challenge well framed is half solved*" Dam & Siang, IDF
- Meaningful actionable problem statements focus on users' needs for ideation sessions
- Reframe problem statement as a question instead of "we need to design X or Y"
- How Might We (HMW)? Questions are the best way to open up to new ideas & innovations in a collaborative way
- HMW: not prescriptive - don't have answer; all possibilities are valid; collaborative
- *Embrace Warmer* for neonatal hypothermia

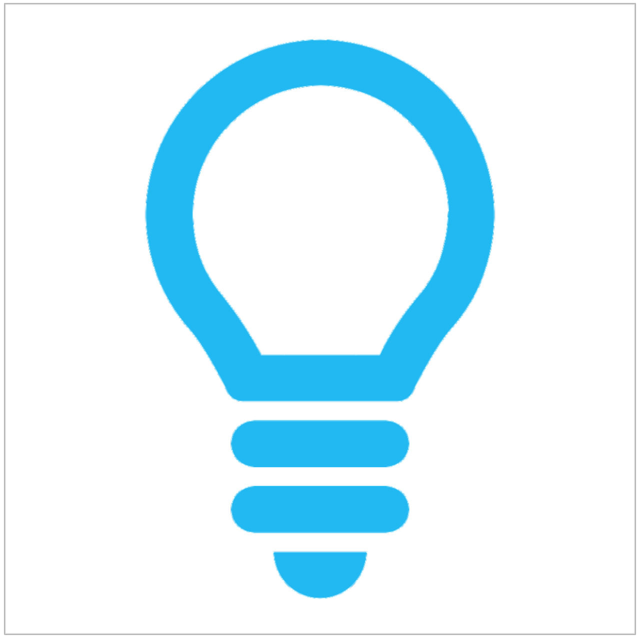
HOW MIGHT WE?

Problem: Users aren't aware of full product offerings

- **HMW:** How might we increase awareness of the full product offerings?

Problem: Users often call us because they're unsure about the application process.

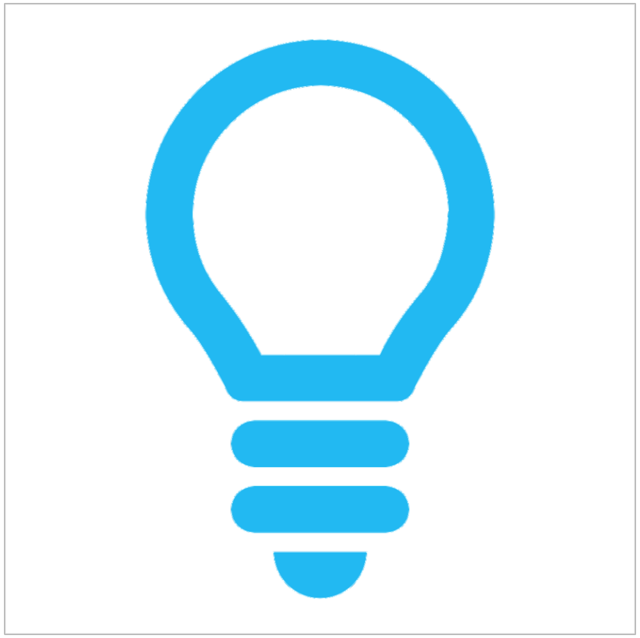
- **HMW:** How might we stop users from calling us?
- **HMW:** How might we make users feel confident they have all the information they need?



HOW MIGHT WE?

Problem: "Teenagers need… to eat nutritious food… in order to thrive and grow in a healthy way."

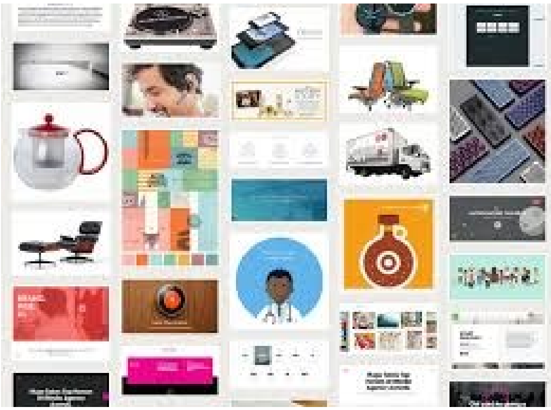
- **HMW**: How Might We make healthy eating appealing to young people?
- **HMW**: How Might We inspire teenagers towards healthier eating options?
- **HMW**: How Might We make healthy eating something, which teenagers aspire towards?
- **HMW**: How Might We make nutritious food more affordable?



HOW MIGHT WE?

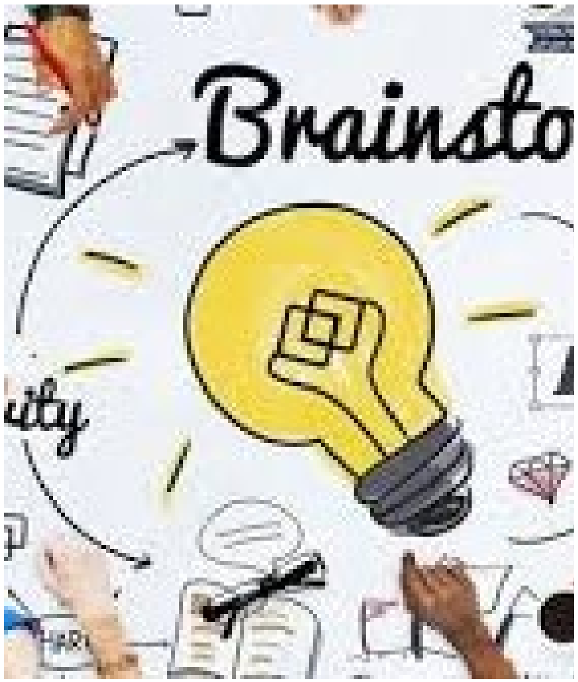
To frame the design challenge on the right design problems:

1. Start with problems / insights
2. Avoid suggesting solutions
3. Keep HMW's as broad as possible
4. Focus on desired outcome: focus on root problem not symptoms
5. Phrase questions positively



MOODBOARDS

REMOTE IDEATION



Multidisciplinary engagement

Synchronous: remote meetings at a shared time

- Suits quick idea generation & complex problems
- Fast exchange of ideas; Focused attention; Teambuilding
- Scheduling difficulties; Tools selection; Awkward

Asynchronous: message thread (slack channel), shared document; physical bulletin board

- Longer timeline, multiple timezones, busy schedules
- Freedom to contribute; Time for ideas to incubate
- Lacks: teambuilding, focus;
- Time to catch up

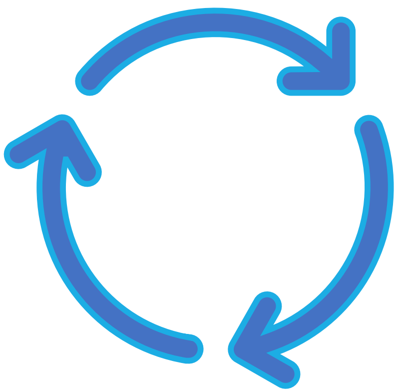
IDEATION: EVALUATING OUTCOMES

- Step away after generating alternatives, take a break
- Break up ideation session and signal move to next phase
- All ideas must be "heard"
- Prioritization of ideas: critique, voting
- Top Three: which concepts resonate with group

IDEATION TO DESIGN?

- After ideation? - Design
- Design activity follows a progression from divergent (conceptual) to convergent (physical) activity:
  - **Conceptual**: what the product will do & how it will behave, how users will ***understand*** it: knowledge about system
  - **Physical**: details such as screen structure, icons, graphics: how users will ***use*** it

CONCEPTUAL DESIGN



- The development of a **conceptual model** precedes all other design space activity
- A conceptual model is:

  "a high-level description of how a system is organized and operates"

  (Johnson and Henderson, 2002, p. 26)

CONCEPTUAL MODEL

"The result of an interaction design is displays and controls and the behaviours that connect them (mappings). In order to create a coherent implementation, there must be both a task analysis of the step-by-step interactions as well as an over-all conceptual model that organizes the behaviour (modes) both for implementers and for users. The invention of an interaction involves not only one compelling scenario and a unifying metaphor but consideration of a variety of scenarios and a wide exploration of alternative and mixed metaphors."

- Bill Verplank

MENTAL MODELS

- Mental model: internal representation of how users understand a system: based on belief rather than facts, what users know or think they know about a system
- Ovens?

MENTAL MODELS

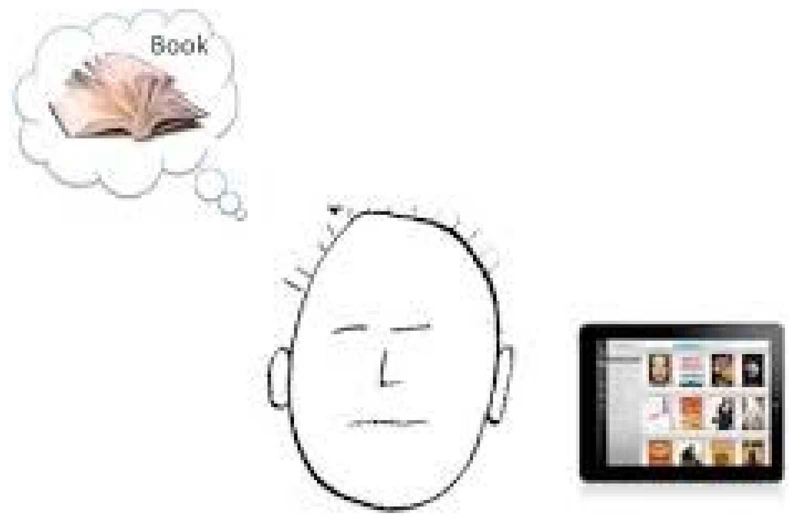
"A mental model represents a person's thought process for how something works (i.e., a person's understanding of the surrounding world). Mental models are based on incomplete facts, past experiences, and even intuitive perceptions. They help shape actions and behavior, influence what people pay attention to in complicated situations, and define how people approach and solve problems."

Susan Carey (1986): *Cognitive Science and Science Education*

MENTAL & CONCEPTUAL MODELS

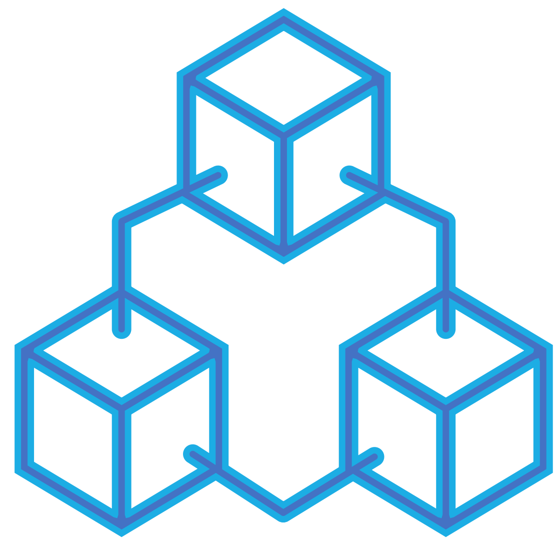
"Everything we do in the field of user experience is, ultimately, about the match, or mismatch, between the users' mental models and the product's conceptual model."

(Susan Weinschenk)



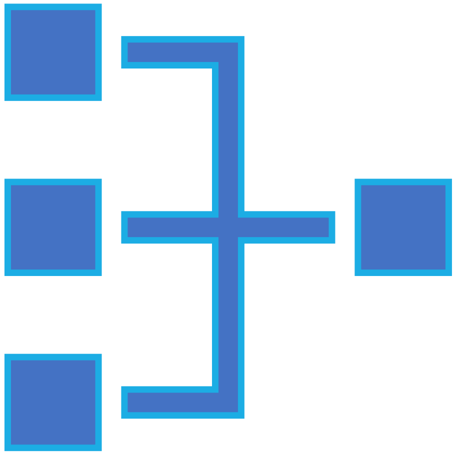
MENTAL MODELS

*"Design is a quest to find the best possible match between the user's **mental** model that they have in their mind, and the **conceptual** model that you're presenting to them with your product.*
These two models run through all resolutions of design — everything from developing a product system to crafting a single button. Understanding how they work together will help you design products that users can easily understand."
Brajdic, 2019 (UX Collective)



MENTAL MODELS

- Software development incorporates three different models:
  - *Implementation* (or System) Model
  - User's *Mental* Model
  - *Represented* (or Designer's) Model
- Close alignment between the *Represented* and *Mental* models leads to more usable systems
- Close alignment between *Represented* and *Implementation* models reduces usability of system: leads to errors



MENTAL MODELS

- Main advantage of computers: putting a simple face on complex processes and situations
- EG: Adobe photoshop *Variations* feature
- Much easier to design software that reflects its implementation model: ***component home theatre system***
- EG: Windows UI *Move* and *Copy*

Cognitive Dissonance: inconsistency of computer response to two similar user actions

MENTAL MODELS: COGNITIVE DISSONANCE

"Inconsistency of computer response to two seemingly similar user actions has the potential to create ***cognitive dissonance*** *(confusion resulting from two contradictory images of reality), for users, making even a simple interaction difficult to learn. If you drag a file between dirs on the same hard drive, the programme interprets this as a MOVE (moving the file from old dir and adding it to the new dir – following the mental model. However, if you drag a file from hard drive C to hard drive D, the action is interpreted as a COPY. This behaviour is rooted in the implementation model: the way the file system actually works: when the OS moves a file on the same drive, it merely relocates the file's entry in the disk's toc. It never erases and rewrites the file. But when moving it to another physical drive, it physically copies the data onto the new drive. To match the user's MM, it should then erase the original (thus "moving" the file, even though this contradicts the implementation model)."*

(About Face 3: Cooper at al, 2012)

MENTAL MODELS

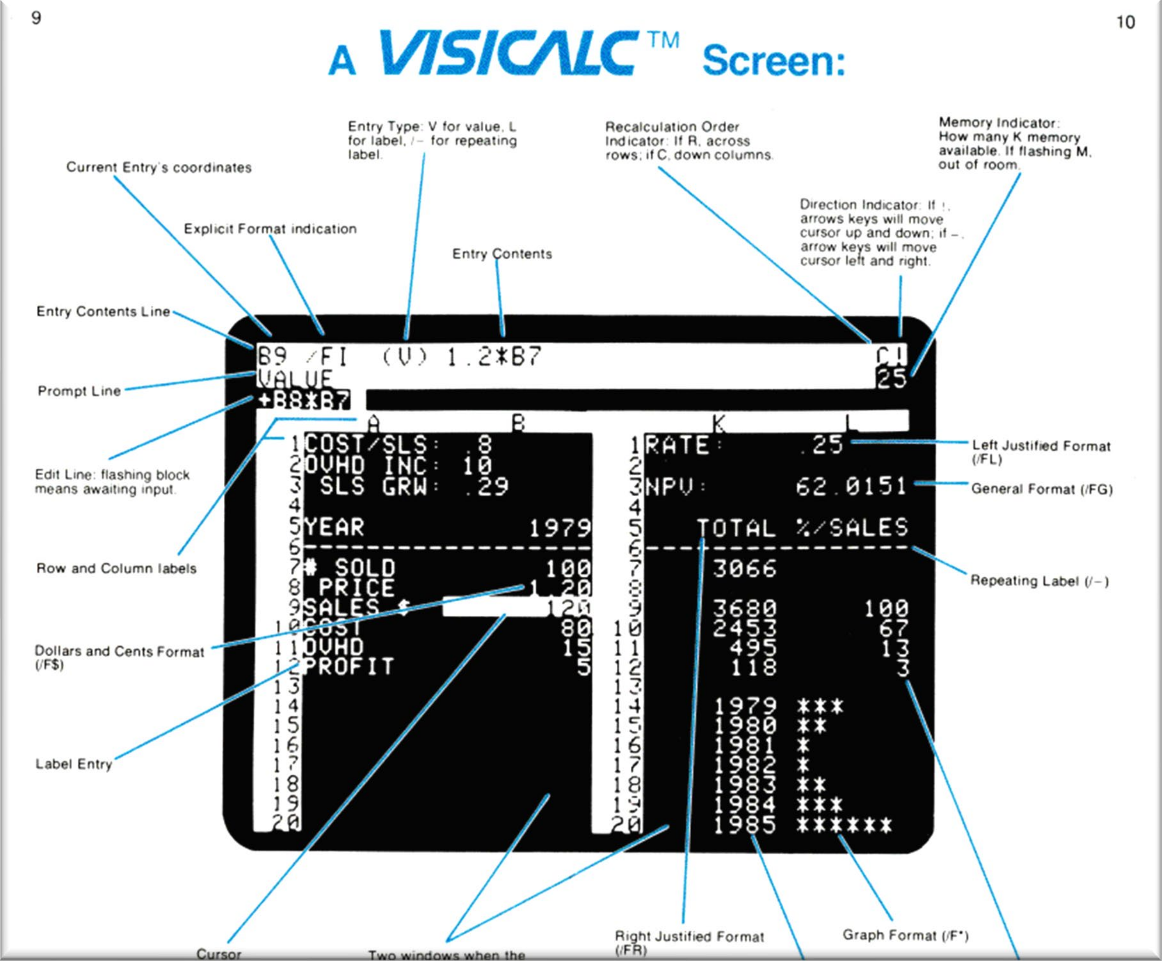
- Mental Models in Design: create a beacon
- Users transfer knowledge of world around them to their use of computers
- Successful system: enables users to readily learn and use it effectively
- How to find MM: task analysis, observation, user feedback, usability testing

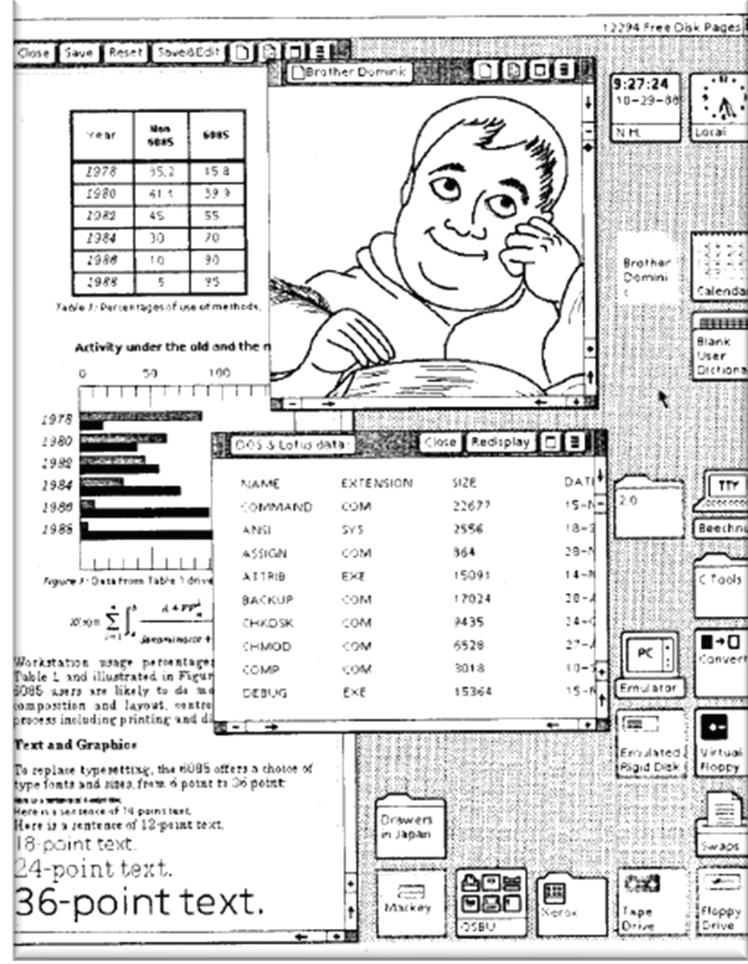
CONCEPTUAL MODEL

- Software products are based on conceptual models, often ones that are well-established (e.g., shopping websites)
- Abstraction outlining what people can do with a product and what concepts are needed to interact with it
- Core components:
  - *Metaphors and analogies to illustrate what a product is used for and how it is used (e.g., browsing, bookmarking)*
  - *Concepts people are exposed to through use, including domain objects, attributes and operations (e.g., saving, organizing)*
  - *Relationships between concepts*
  - *Mappings between concepts and intended user experience*

INTERACTION DESIGN FRAMEWORK

Do	Feel	Know
How do you do? What sort of ways do you affect the world: poke it, manipulate it, sit on it? (Buttons – discrete, automatic vs Handles – continuous)	How do you feel? What do you sense of the world and what are the sensory qualities that shape media? (Print - exact vs Cartoon - fuzzy, more participation)	How do you know? What are the ways that you learn and plan (or perhaps, how we want you to think)? (Paths vs Maps)

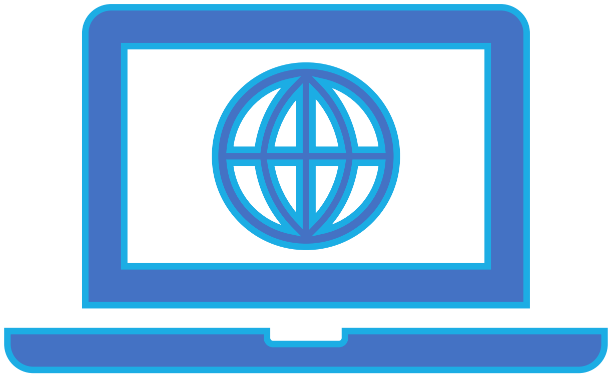




CLASSIC CONCEPTUAL MODELS

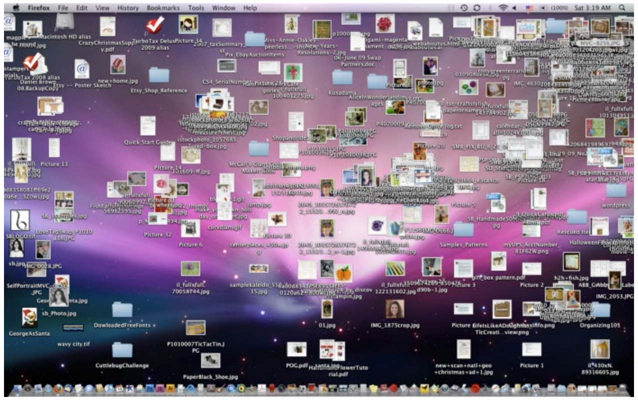
INTERFACE METAPHORS

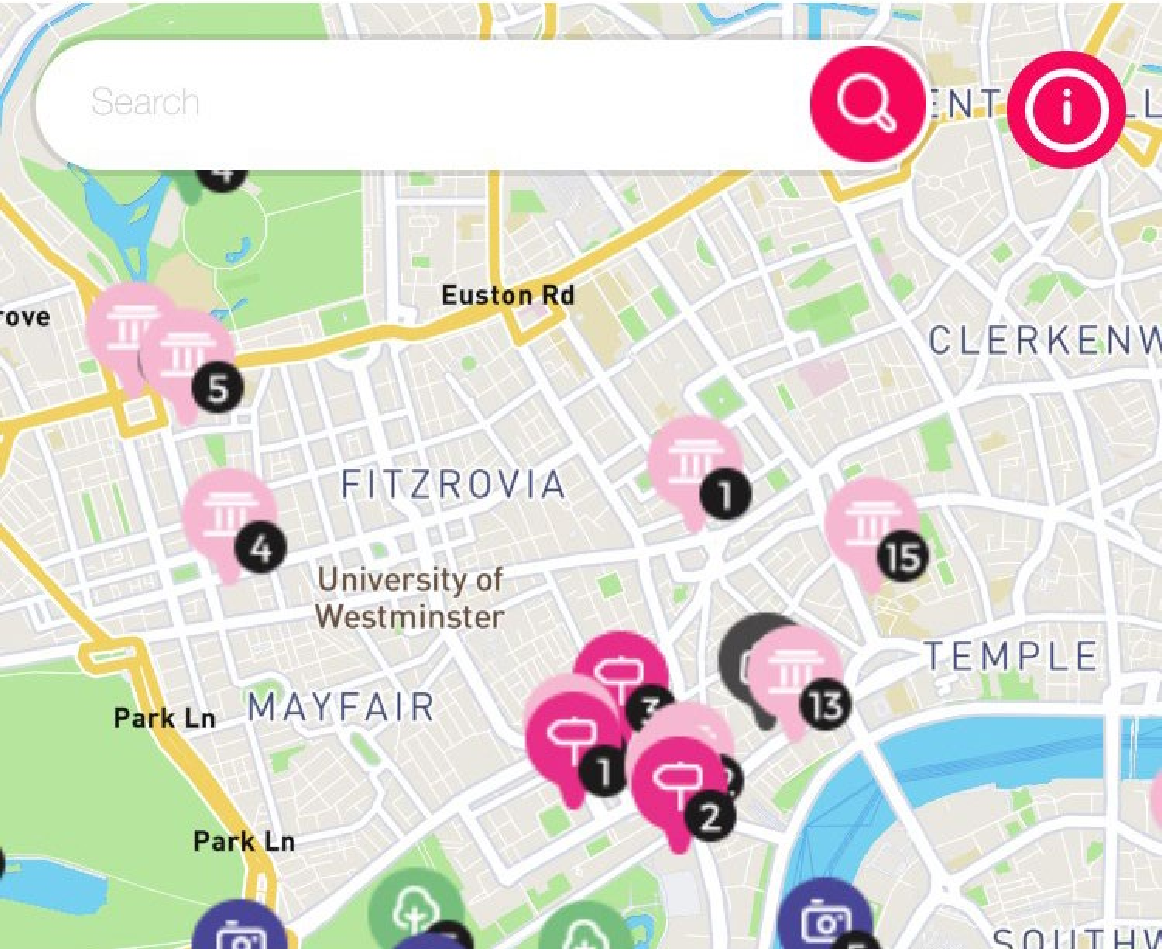
- Exploit users' familiar knowledge, helping them to understand 'the unfamiliar'
- People find it easier to learn and talk about what they are doing at the UI in terms familiar to them
- Direct Manipulation leverages real world metaphors: interface's physical form discloses its use, e.g. desktop, search engine

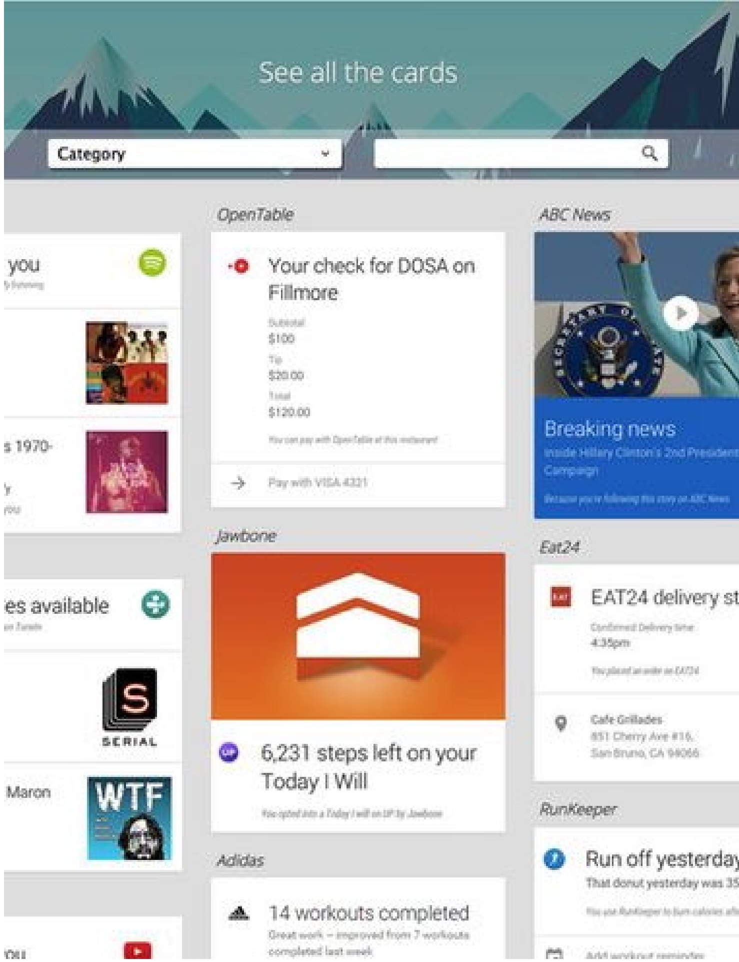


CLASSIC INTERFACE METAPHORS?

- Desktop Metaphor
- Map Metaphor
- Card Metaphor







INTERFACE METAPHORS

INTERFACE METAPHORS: PROBLEMS?

"If technology is to provide an advantage, the correspondence to the real world must break down at some point"

Jonathan Grudin.

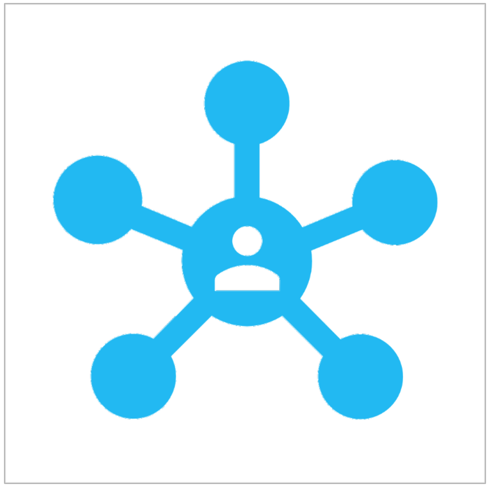
INTERFACE METAPHORS

- Can constrain designers in the way they conceptualise a problem space
- Over reliance on mechanical age representations over information age
- May limit designers' imagination in coming up with new conceptual models
- Designers can inadvertently use bad existing designs and transfer the bad parts over
- Can break conventional and cultural rules
  - e.g., recycle bin placed on desktop

CONCEPTUAL MODEL COMPONENTS

How to build a strong conceptual model?

- Iterate, Test
- Explain things better; make UI more transparent
- Anchor it in current experience: language, patterns
- New Conceptual Model: leverage existing knowledge, affordances, onboarding
- Unknown Conceptual Model (e.g. driverless cars): customer journey



CONCEPTUALISING INTERACTION

Why are conceptual models of interaction important?

- Abstract away from product details to product purpose
- Encourage thinking more broadly about potential solutions
- Focus on the user and user experience Supports collaboration through common understanding
- Support communication as a tool that can be shared

INTERACTION DESIGN

Conceptual Design:

Develop Product Concept

Define Interaction Paradigm

Design Alternative User Interfaces: Prototyping

Physical Design:

Detailed design of UI

Construct the user interface

Validate the user interface

Provide rollout support

HCI LECTURE 6 REVIEW

- **Design Thinking 3: Ideation**
  - Ideation
  - Design Funnel
  - Functional Fixedness
  - Conceptual Design

- **Lecture 7: Design Thinking 4: Prototyping**

CT318 LECTURE 7

Design Thinking 4: Prototype

- Conceptualising Interaction:
  - Interaction Paradigms
  - Interaction Styles
- Prototyping

CONCEPTUALISING INTERACTION

- A conceptual model is an abstraction for thinking about the design space of an interaction that focuses on the user experience and what it is for
- Components: metaphors for how a product will be used; the kinds of objects, attributes and operations that are involved in the interaction
- Core interaction types can help thinking about the design space: instructing, conversing, exploring, manipulating, responding

INTERACTION DESIGN FRAMEWORK

Do	Feel	Know
How do you do? What sort of ways do you affect the world: poke it, manipulate it, sit on it? (Buttons – discrete, automatic vs Handles – continuous)	How do you feel? What do you sense of the world and what are the sensory qualities that shape media? (Print - exact vs Cartoon - fuzzy, more participation)	How do you know? What are the ways that you learn and plan (or perhaps, how we want you to think)? (Paths vs Maps)

INTERACTION TYPES / PARADIGMS

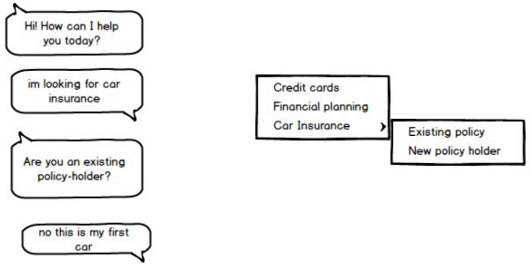
- **How do I do?**
- Five basic metaphors for our interaction with things:
  - *Instructing:* command
  - *Conversing:* languages
  - *Manipulating*: hands: desktop, notebook
  - *Exploring / navigating*: feet/locations and travelling: web, 3D worlds
  - *Responding*

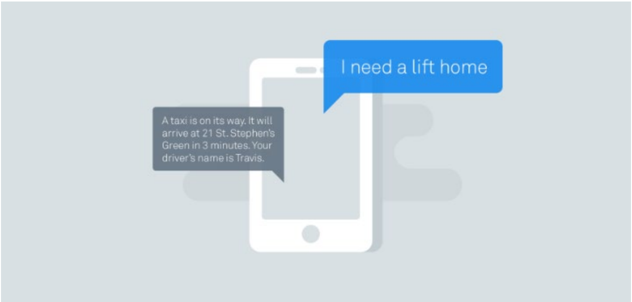
INTERACTION PARADIGM: INSTRUCTION

- Users carry out tasks by telling product what to do
- Command-response sequential model
- Examples: “list the files in my current directory” “show me my account balance”
- Invoked through pressing buttons, typing text, clicking menu item, speaking commands, etc.
- Advantages: quick and efficient; good for frequent repetitive actions

INTERACTION PARADIGM: CONVERSATION

- Conversational metaphor: conversation between people
- Used primarily for scenarios of finding out or providing information
- Driven by advances in speech recognition
- Advisory systems, help facilities, chatbots, robots
  - Concierge services (Path Talk, Magic): via text message; banks of support agents
  - AI applications: chatbots





INTERACTION PARADIGM: MANIPULATION

- Interaction through handling, controlling and influencing objects
- Benefits from user’s knowledge of analogous manipulation in the physical world, e.g., moving, selecting, opening, rotating
- Extends physical world analogies: e.g. zooming, stretching, shrinking
- Human actions can be imitated by physical controllers or gestures

Microsoft.com

INTERACTION PARADIGM: EXPLORATION

- Exploring – moving through – physical or virtual environments

INTERACTION PARADIGM: RESPONDING

- System proactively interacts with the user to alert, describe, or show them something
- Disadvantages: becomes tiresome and frustrating; distracting
- Design: Need to understand when a user can be interrupted or when information is useful

INTERACTION STYLES

- **How do I do?**
- Interaction styles represent alternative design strategies for the entry of information at the user interface - first choice in UID: type of interface and interaction it implies
- Three basic metaphors for our interaction with things:
  - *Manipulation*: hands: desktop, notebook
  - *Navigation*: feet/locations and travelling: web, 3D worlds
  - *Conversation* / Instruction: languages: command, conversation

INTERACTION STYLES

- GUI Interaction Styles:

  1. **Direct Manipulation:** WIMP, GUI & Icons

  2. **Task-related Organisation:** menus, forms
- Function Key Interaction
- Touch, Gestural, Haptic Interaction
- **Linguistic:** command line, natural

- Choice of Interaction Style?

INTERACTION STYLES: DM

- Information is displayed in the form of graphical objects, which the user can query and manipulate graphically with a pointing device
- Example: Xerox Star; Apple Macintosh; MS Windows; Video games
- Direct involvement with world of objects
- **Usability**: high for error-reduction and ease of exploratory learning; slower interaction times
- **Advantage** is the directness of the interaction: e.g. driving a car
- **Disadvantage** is lack of step-by-step guide for learning

INTERACTION STYLES: DM

- Problems in visual form? Appropriate representations of reality?
- DM: comprehensible, rapid, simple, reversible actions
- Anxiety recedes and user's sense of control increases
- Common communicative units, interface widgets, including: icons, buttons, check boxes, radio buttons
- These can be grouped into menubars, toolbars, palettes
- Difficulties:
  - Visual representation may be misleading
  - Good icon design is difficult: culture, context

INTERACTION STYLES: DM: WIMP

Windows

could be scrolled, stretched, overlapped, opened, closed, and moved around the screen using the mouse

Icons

represented applications, objects, commands, and tools that were opened when clicked on

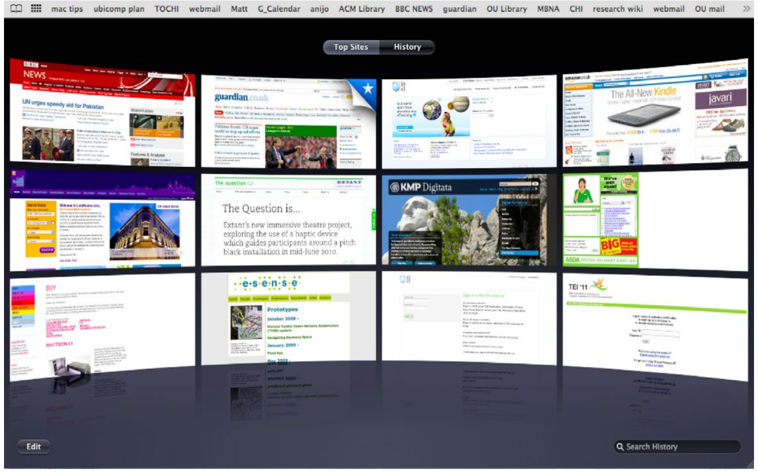
Menus

offering lists of options that could be scrolled through and selected

Pointing device

a mouse controlling the cursor as a point of entry to the windows, menus, and icons on the screen

GUI & WIMP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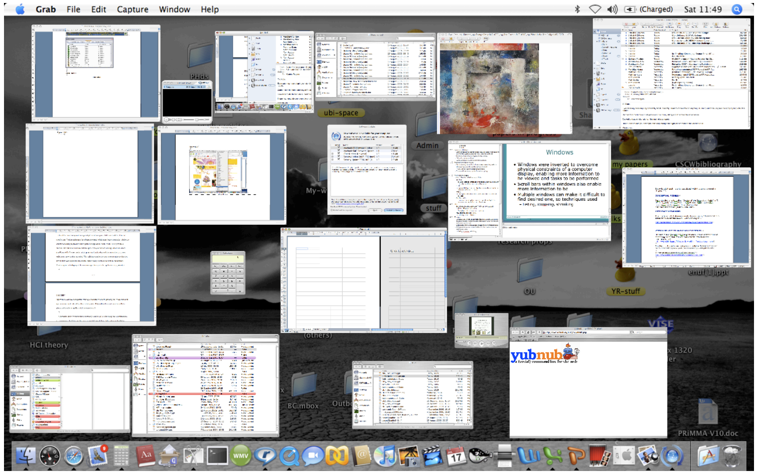
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INTERACTION STYLES: TASKS

Primary goal is to create a sensible and convenient organisation relevant to users' tasks

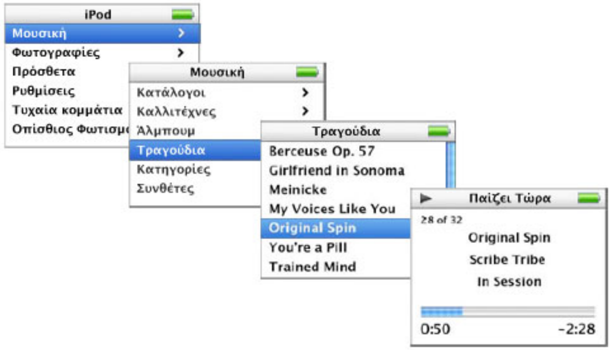
- Menu Selection
- Form Fill-in
- Q & A
- Function-Key Interaction

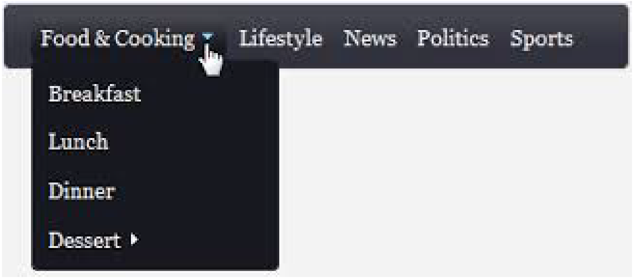
INTERACTION STYLES: MENUS

- User is presented with a display of options to suit circumstances
- Make selection by pointing, touching target on-screen or pressing a button alongside the option
- Used in systems for walk-up use: e.g. ATMs, ticket machines
- Supports easy system navigation
- Usability is good for first-time users; irritating for frequent users as can be time-consuming
- Weak on support for complex actions with many operands

INTERACTION STYLES: MENUS

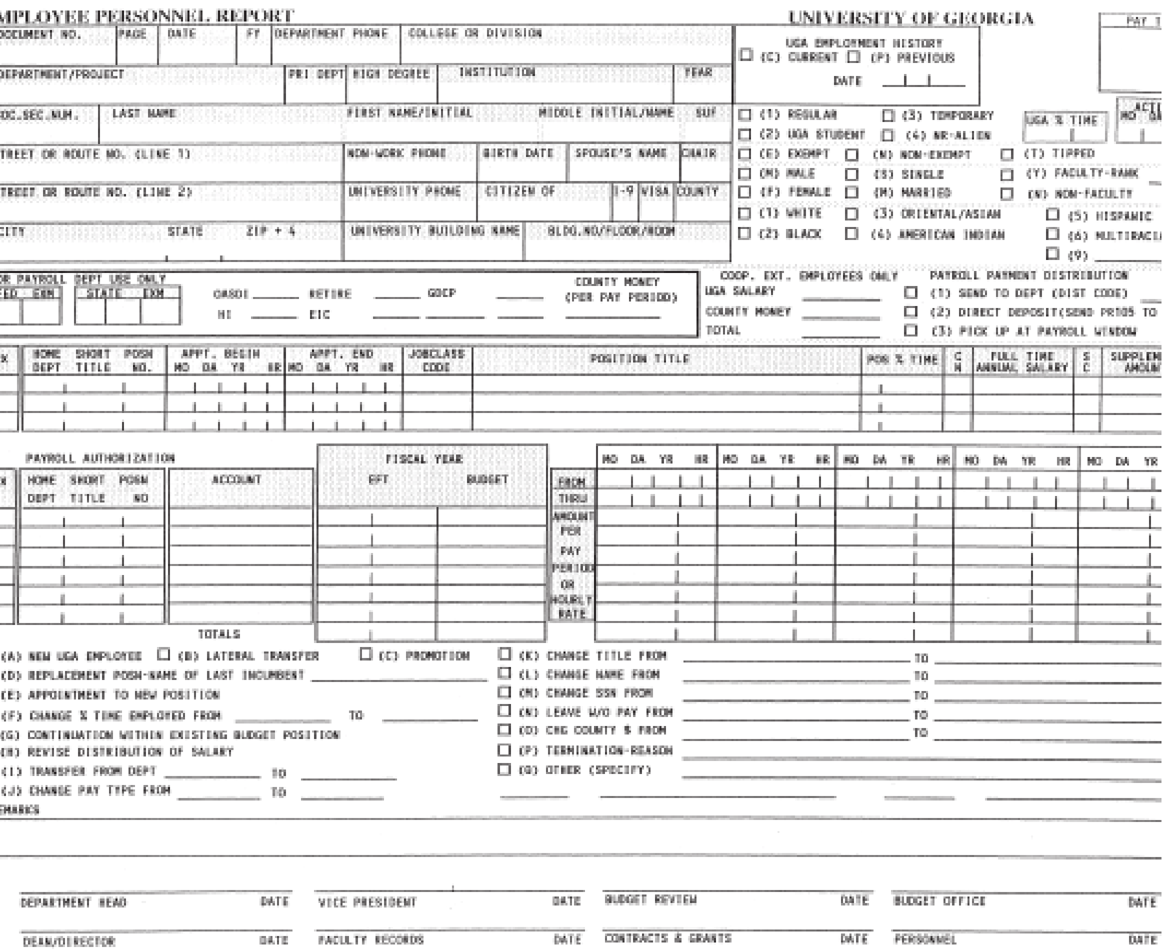
- Menu types:
  - Single, Binary and Multiple selection menus
  - Pull-down and pop-up menus
  - Scrolling and 2D menus
  - Embedded links
  - Iconic menus, toolbars or palettes
  - Tree structured menus: depth vs. breadth
- Item presentation sequence and phrasing

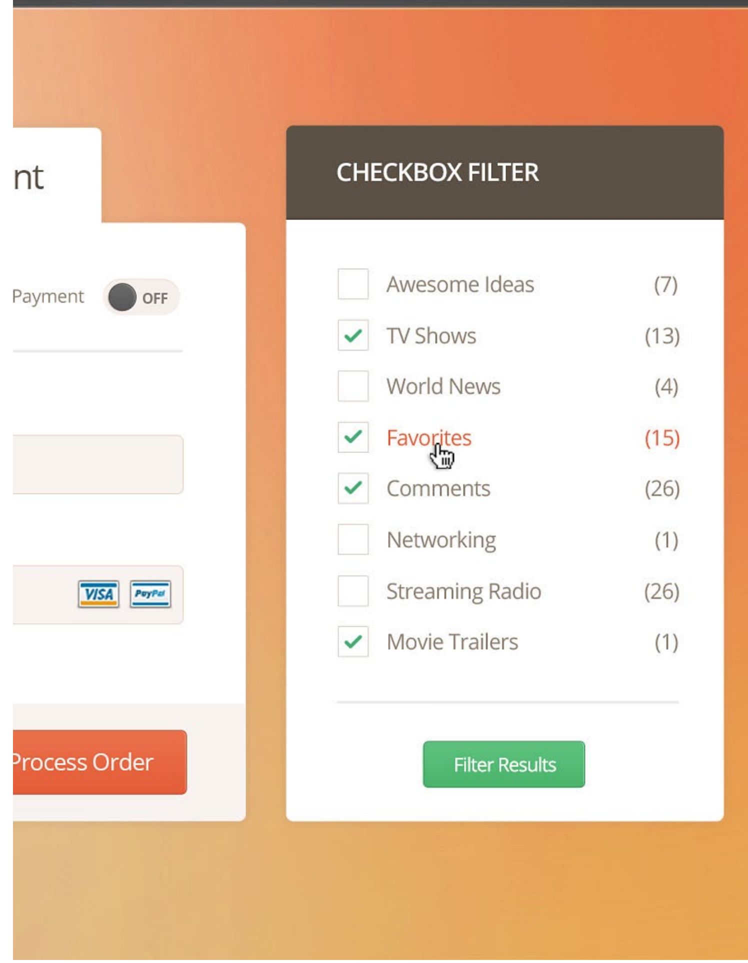




INTERACTION STYLES: FORMS FILL-IN

- Provides a means of both entering and retrieving data
- Supports the editing of existing entries in fields
- Restricted to textual data
- Tends to limit the range of supported tasks: each task requires a pre-defined form
- User needs to be able to type and may need training in use of forms and templates
- Well suited to the support of work activities





INTERACTION STYLES: FORMS FILL-IN

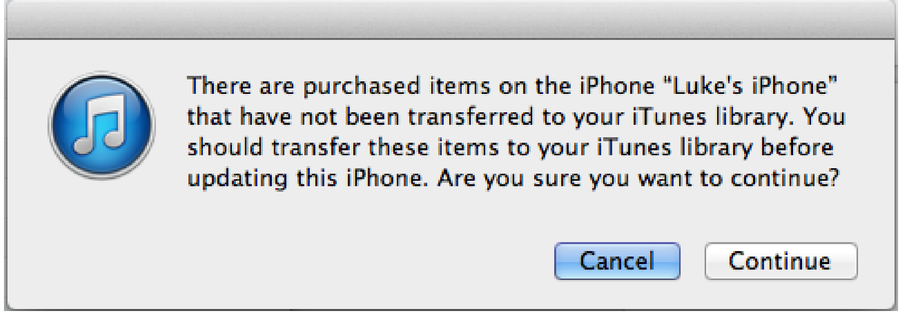
KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY, 2023-2024

INTERACTION STYLES: FORMS FILL-IN

- Form Fill-in Design:
  - Meaningful title
  - Comprehensible instructions
  - Logical grouping and sequencing of fields
  - Visually appealing layout
  - Familiar field labels
  - Visible space and boundaries for data-entry fields
  - Error handling: prevention, correction, messaging
  - Explanatory messages for fields

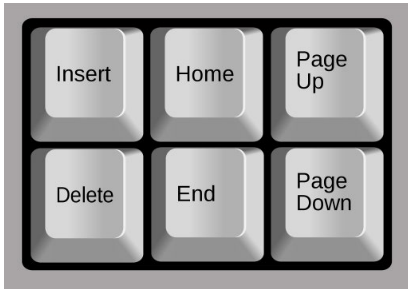
INTERACTION STYLES: Q & A

- User is presented with a series of textual questions, enters answers via keyboard: dialogue between user & computer
- Often best choice for data-entry tasks by unskilled users
- Emphasis on simple data capture: one element at a time
- Poor usability in terms of error correction, feedback, and can ask unnecessary questions



INTERACTION STYLES: FUNCTION-KEY

- Often used in public places - relies less on user keyboard skills
- Can incorporate many interaction devices: numeric keypads, credit-card readers, ID badge detectors etc.
- Usually must be operated in strict sequence: requires mapping of the activation of devices (e.g. VCR, digital watch etc.)



INTERACTION STYLES: LINGUISTIC

- User inputs made on an alpha-numeric keyboard using a particular language
- Command-Line Interaction:
  - user types a command; results are displayed
  - efficient, precise & fast
  - user must know the syntax and semantics of the language: inconsistent abbreviation strategies
  - good for complex functionality and speedy interaction
  - “Know what you are about to Do, for there is no Undo”
  - Poor relationship to user’s mental model: Large overhead to learning set of commands **C:\>-**

INTERACTION STYLES: LINGUISTIC

- Text-based Natural Language:
  - User enters information as words and phrases in natural language; train system to understand user's language
  - Makes interface more approachable; lowers initial learning
  - Later learning required for information structure, repertoire of functions, informal syntax etc.
  - Advantage over graphical styles unclear

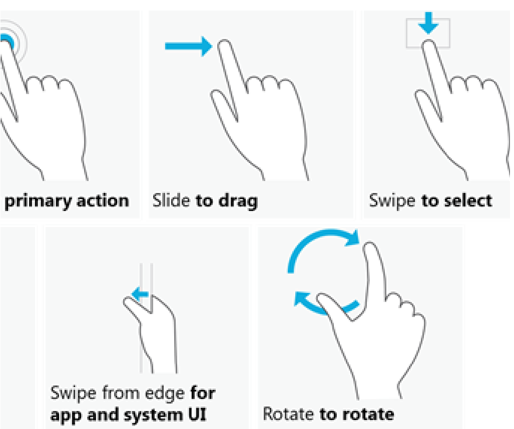
INTERACTION STYLES: SPEECH

- Voice Interaction: hands-free, eyes-free interaction
  - Siri, Google Now: mobile OS; Amazon Echo – stationary device
  - Activation phrase results in execution of user instructions: Echo monitoring every word: privacy vs efficiency
  - Error prevention: detection of activation phrase; background noise; making tasks faster and easier?
  - Semantic processing: default to web search (Siri, Now) vs. Echo's more focused functionality
  - Task efficiency: Echo's shopping list!
  - Visual output? Supporting recognition over recall?

INTERACTION STYLES: TOUCH

- Touch screens, such as walk-up kiosks, detect the presence and location of a person's touch on the display
- Now used for many kinds of displays, such as Smartphones, iPods, tablets and tabletops
- MS Touch UI libraries
- Multi-touch support a range of more dynamic finger tip actions, e.g. swiping, flicking, pinching, pushing and tapping
- More fluid and direct; faster but more error-prone

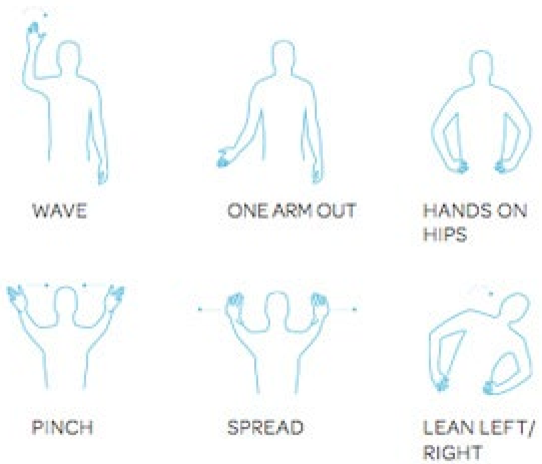
INTERACTION STYLES: TOUCH

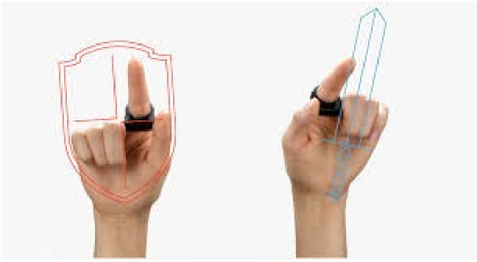


INTERACTION STYLES: GESTURE

- Uses camera recognition, sensor and computer vision techniques: universal appeal
  - can recognise people's body, arm and hand gestures in a room
  - systems include Kinect and EyeToy
- Movements are mapped onto a variety of gaming motions, such as swinging, bowling, hitting and punching
- Players represented on the screen as avatars doing same actions

Interaction Styles: Gesture





INTERACTION STYLES: GESTURE

- Gestural Interaction: visibility, feedback, consistency?
- Recall over Recognition
  - Low affordance
  - Low discoverability
  - Low memorability
- Touch: leverages our understanding of physical world
- Touch, multi-touch and gesture to perform commands and replace DM: inconsistency in how user actions are mapped to system commands
- How natural are NUI's?

INTERACTION STYLES: GESTURE

"But the lack of consistency, inability to discover operations, coupled with the ease of accidentally triggering actions from which there is no recovery threatens the viability of these systems.
We urgently need to return to our basics, developing usability guidelines for these systems that are based upon solid principles of interaction design, not on the whims of the company human interface guidelines and arbitrary ideas of developers."
Nielsen & Norman (2010)

INTERACTION STYLES: HAPTIC

- Tactile feedback
- Can enrich user experience or nudge them to correct error
- Can also be used to simulate the sense of touch between remote people who want to communicate

INTERACTION STYLES: CHOICE?

- One of most important interface decisions
- Provides interface architecture
- Choice is based on functional & usability requirements, as well as cost targets for hardware & software
- Data entry requirements
- Much detailed design work required to achieve a satisfactory interface using selected style(s)
- Combining two or more styles in one UI: consistency

INTERACTION STYLES: CHOICE?

- Choose an appropriate interaction style for each of the following systems:
  - Tourist information kiosk application sited at an airport arrivals area
  - E-mail client: can set colour scheme preferences, incoming mail preferences (alerts, display, download etc.)
  - Mobile phone gaming
  - Account management system
  - Music website

PROTOTYPE

WHAT IS PROTOTYPING?

- Prototyping quickly, and frequently, is the best way to test your assumptions, learn about users, and improve on your ideas.
- *"Prototyping is about bringing conceptual or theoretical ideas to life and exploring their real-world impact before finally executing them. All too often, design teams arrive at ideas without enough research or validation and expedite them to final execution before there is any certainty about their viability or possible effect on the target group."*

IDF

- Why Prototype? Alan Dix:

https://www.interaction-design.org/literature/topics/prototyping

WHAT IS A PROTOTYPE?

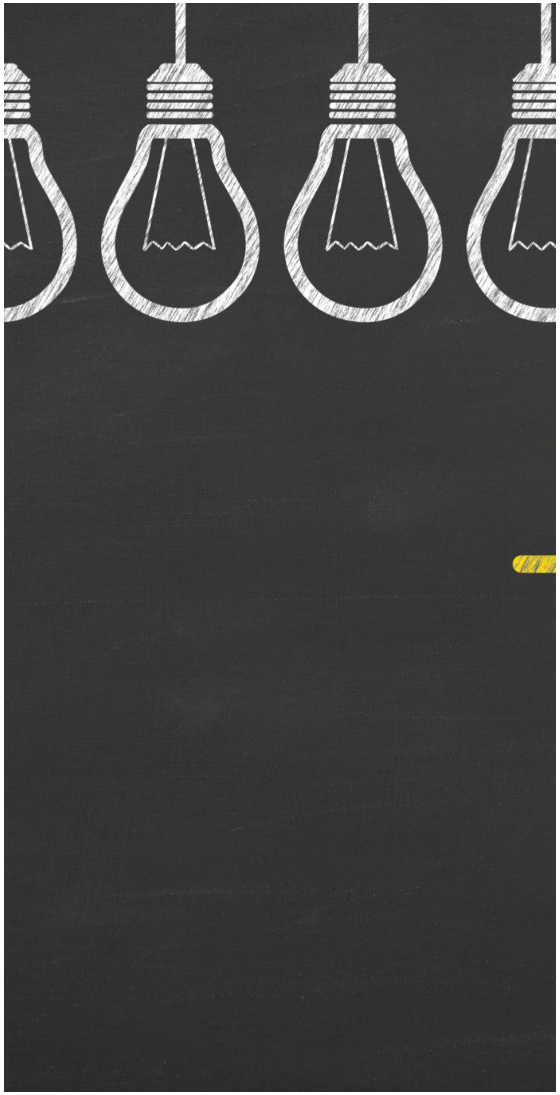
A **prototype** is

- An implementation of ideas in tangible forms to test concept on users

- A simple experimental model of a proposed solution

- Of varying degrees of fidelity, from paper to digital

- Anything from sketches on a napkin to role-playing



PROTOTYPING

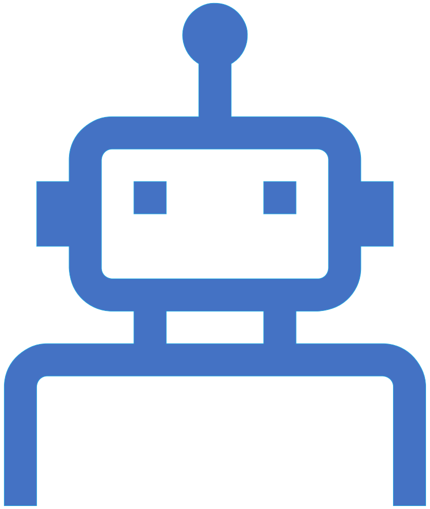
"Prototypes should command only as much time, effort, and investment as is necessary to generate useful feedback and drive an idea forward"

Tim Brown

(Change By Design)

PROTOTYPING ADVANTAGES

- Solid foundation from which to ideate towards improvements: clear picture of the potential benefits, risks and costs associated
- Can adapt changes early, avoiding commitment to a single, falsely-ideal version
- Can experiment with associated parts of the users' needs: insights into less-obvious areas of the users' world
- Iterative user research tool



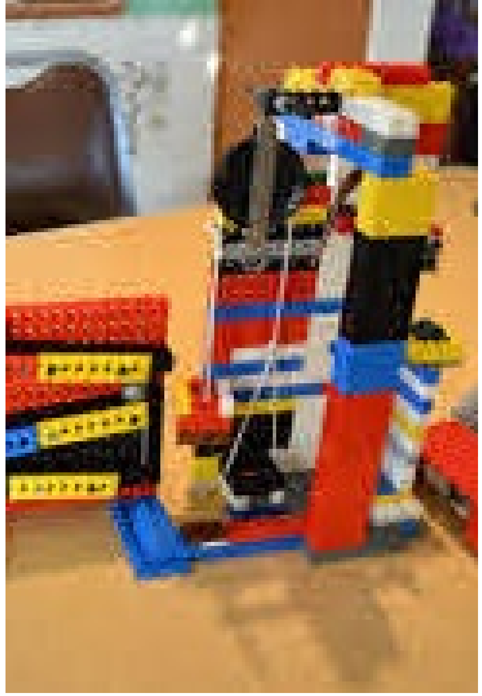
PROTOTYPING BENEFITS

PROTOTYPING: TYPES

Horizontal: gives a wide view of the entire system or subsystem (e.g. a website)

Vertical: gives a detailed view of just one feature (e.g., a checkout process)

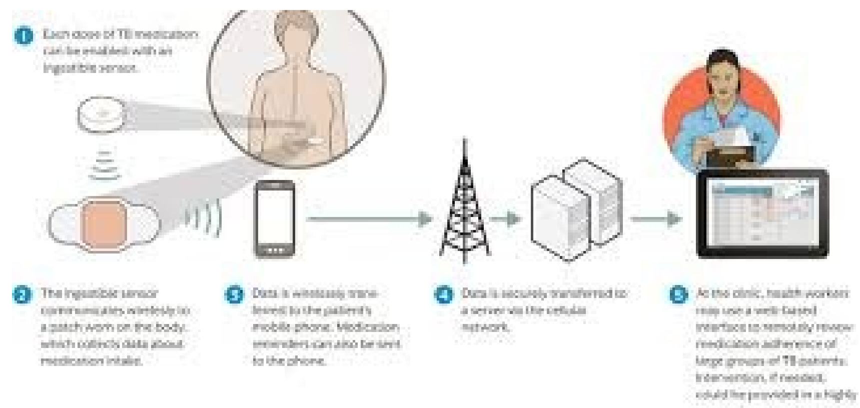
Fidelity: the level of detail and functionality in your prototype: low or high. Depends on product development stage



PROTOTYPES

- Sketches
- Paper prototypes
- Wizard of Oz
- Video
- Lego
- Physical
- 3D Printing
- Landing Pages
- User Driven (empathise)

“***Proteus Discover*** is comprised of ingestible sensors, a small wearable sensor patch, an application on a mobile device and a provider portal. Once activated, Proteus Discover unlocks never-before-seen insight into patient health patterns and medication treatment effectiveness, leading to more informed healthcare decisions for everyone involved.”

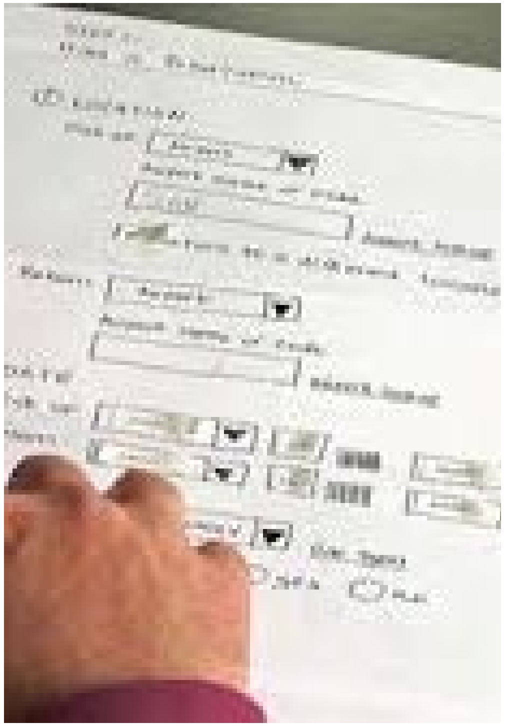


LOW FIDELITY PROTOTYPING

- Uses a medium unlike the final medium, e.g. Paper, cardboard
- Used early in design to explore alternative ideas
- Good for exploring issues of content and structure
- Quick, cheap and easily changed

Examples:
- Sketches of screens, task sequences
- Storyboards

LOW FIDELITY PROTOTYPING



Disadvantages:

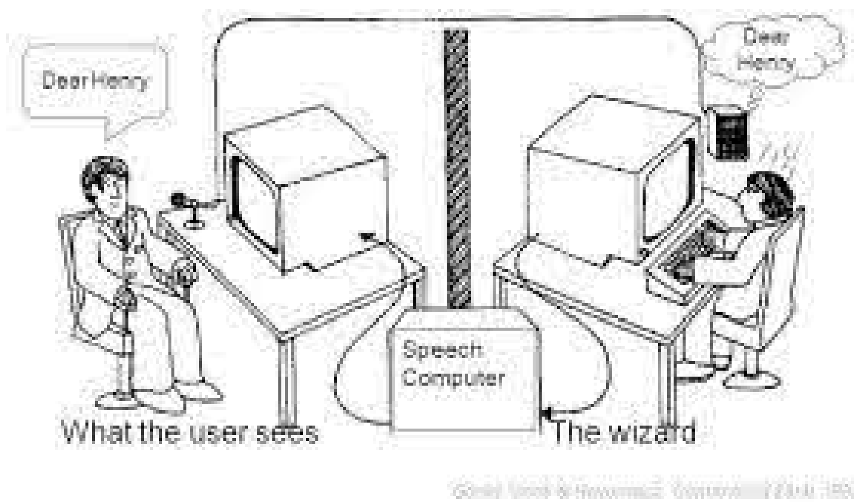
- Lack of realism:
    - Users must imagine how they would use the product
    - Difficult for users to give feedback
- Hard to apply results; may be too basic to reflect the user experience of the finished product
- Lack of interactivity deprives users of direct control
- Can oversimplify complex issues

PAPER PROTOTYPING

- Paper mockup of UI
- Work quickly: fast & fun
- Reduces time and relieves perfectionism: easy to change
- Stick postits on device itself: mockup
- Can mix fidelities
- Test multiple prototypes to get most value: by trying things out and learning, can improve
- Everybody can be involved: give users a pen

WIZARD OF OZ PROTOTYPING

- The user thinks they are interacting with a computer
- More real than paper prototyping
- Works well with forward looking / futuristic UI’s
- Problems?



WIZARD OF OZ: IBM

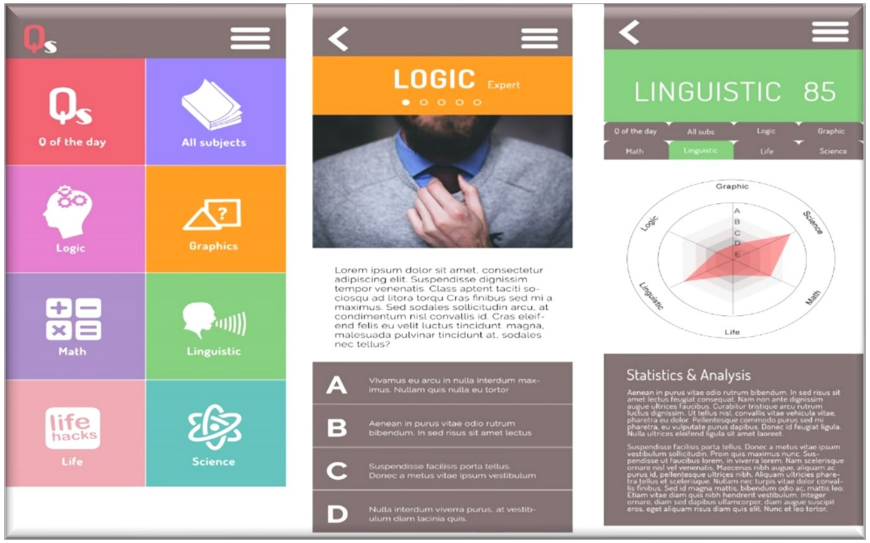
Another example: **IBM** using the 'Wizard of Oz' experimentation method to test whether people would be interested in a program that could transcribe what people were saying. They invited participants into a room with a projector and interviewed them, under the pretense of testing this transcribing program. Whatever the participant was saying would be then projected on the screen. Unbeknownst to the participant, however, the transcribing was not the work of a machine, but a human, typing furiously away, hidden behind a curtain the next room over. IBM just needed to replicate the experience to get fast, relevant feedback.

IBM Speech to Text experiment (1980s)

See IBM Watson Speech Recognition Program: https://www.ibm.com/ibm/history/ibm100/us/en/icons/speechreco/

HIGH FIDELITY PROTOTYPING

- Uses materials that would be in the final product: digital mockup
- Prototype looks more like the final system
- Provides interactive functionality; more engaging
- Useful as a marketing tool
- Common environments are prototyping tools & implementation technology UI libraries



HIGH FIDELITY PROTOTYPING

Disadvantages:

- Can take a long time to build & more expensive
- Danger that users think they have a full system
- Users are more likely to comment on superficial details than on content
- After all the work, you the designer are likely to dislike the idea of making changes

VIDEO PROTOTYPING

- Create a video showing how you envision use of your system
- Can be any fidelity: low to high
- Really useful early in design cycle: using paper prototypes as design to be elaborated
- Proliferation of video devices: cheap & fast
- Good communication tool
- What goes in a video prototype?
  - Storyboard: whole task, motivation & success, establishing shots and narrative help
  - Tasks: orients interface design to tasks
  - Informs design decisions: shows context of use

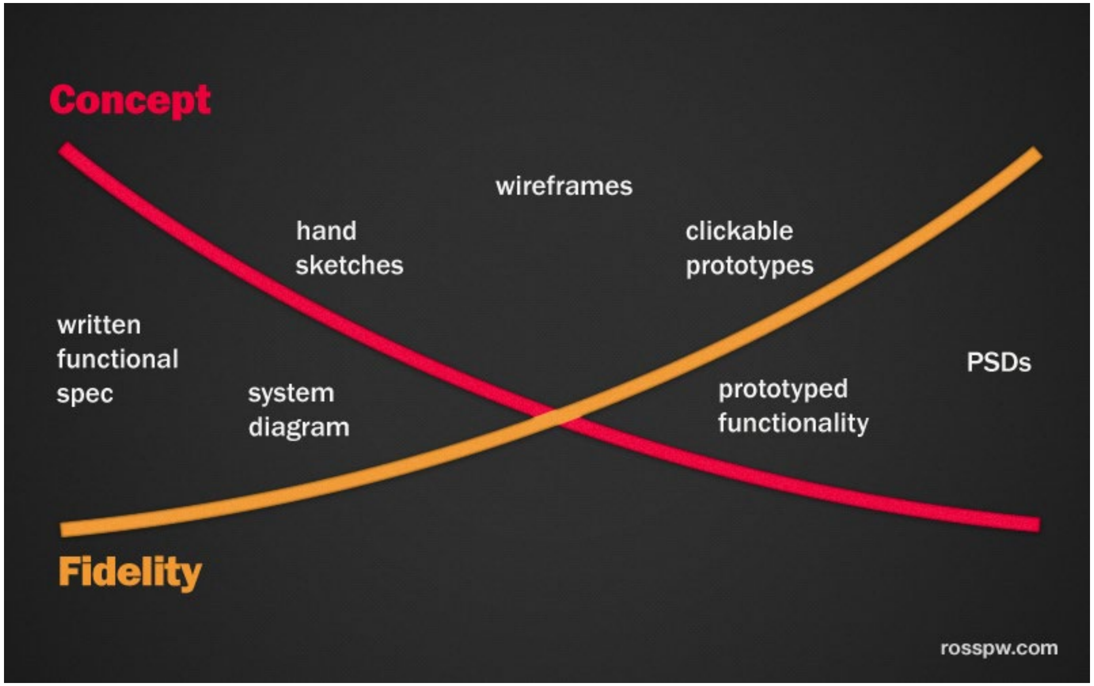
VIDEO PROTOTYPING

- How to?
  - Start with outline storyboards
  - Equipment: phone, people, location
  - Pause editing is most efficient (don't waste time on medium)
  - Focus on message: goal (not high production values)
  - Interface can be paper/mockups: can show success & failure

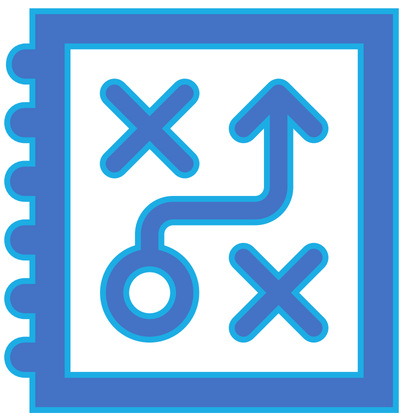
PROTOTYPING TOOLS

- Prototyping tools:
  - Disposable: paper & pen
  - Pen and paper simulators
  - Visual reality: slice and dice: photoshop, HTML, dreamweaver
  - Presentation software: powerpoint, visio, omnigraffle (APAD)
  - Interactive Software: platform specific
  - Generic prototyping tools

PROTOTYPING TOOLS



PROTOTYPING PITFALLS



- Focus on the deliverable, not on the learning
- Too much converging, not enough diverging
- Working in the wrong fidelity
- Too little evaluating
- Fixating on a single prototyping tool

(Jared M. Spool)

CT318 LECTURE 7: REVIEW

Design Thinking 4: Prototype

- Interaction Types
- Interaction Styles
- Prototyping

Week 8: DT 4 Prototype

- Physical Design: Visual Design

CT318 LECTURE 8

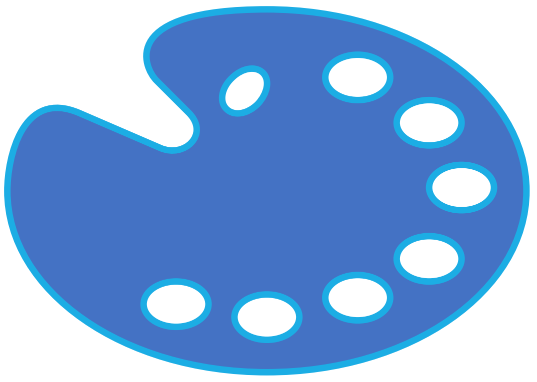
Design Thinking 4: Prototype

- Visual Design
- Icon Design
- Group Project:
  - User Research Feedback

WHY VISUAL DESIGN?

VISUAL DESIGN?

- **V**isual design engages users by drawing the eye to the correct functionality and prioritizing tasks on a page (Uxbooth)
- “**S**trategic implementation of images, colors, fonts, and other elements to enhance a design or interaction and engage users” (Usability.gov)
- **T**he aesthetics of a design and its related materials (IDF)



5 Visual-Design Principles in UX

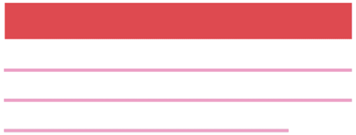
Visual-design principles inform us how design elements go together to create well-rounded and thoughtful visuals. Graphics that take advantage of the principles of good visual design can drive engagement and increase usability.

SCALE

The principle of scale refers to using relative size to signal importance and rank in a composition.

VISUAL HIERARCHY

The principle of visual hierarchy refers to guiding the eye on the page so that it attends to design elements in the order of their importance.

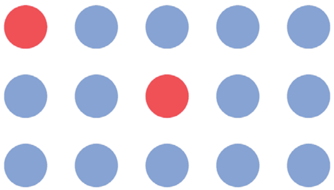


BALANCE

Balance occurs when there is an equally distributed amount of visual signal on both sides of an imaginary axis.

CONTRAST

The principle of contrast refers to the juxtaposition of visually dissimilar elements in order to convey the fact that these elements are different.



GESTALT PRINCIPLES

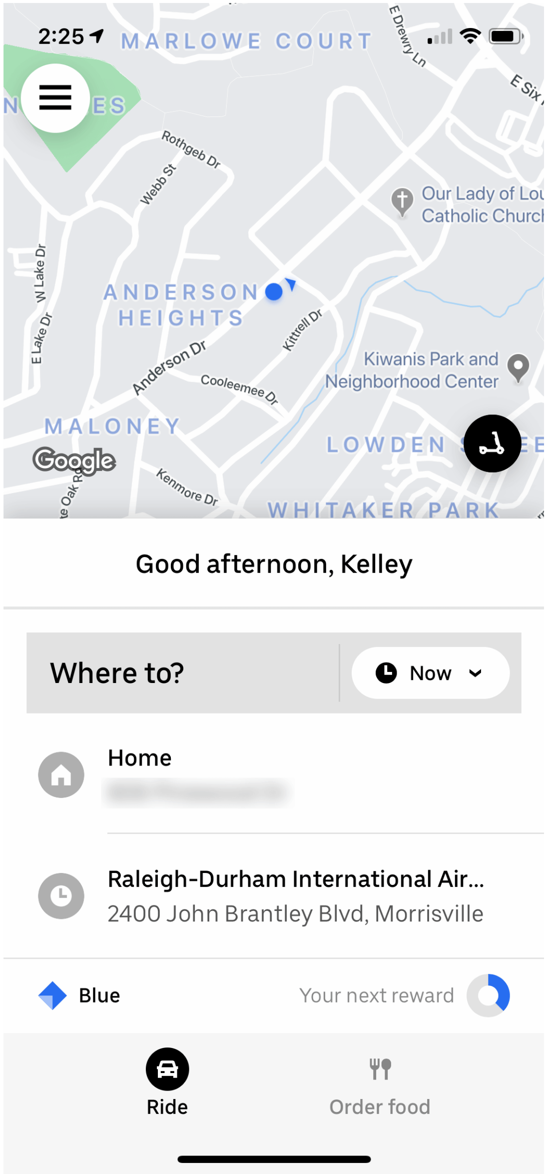
Gestalt principles capture our tendency to perceive the whole as opposed to the individual elements.

NNGROUP.COM NN/g

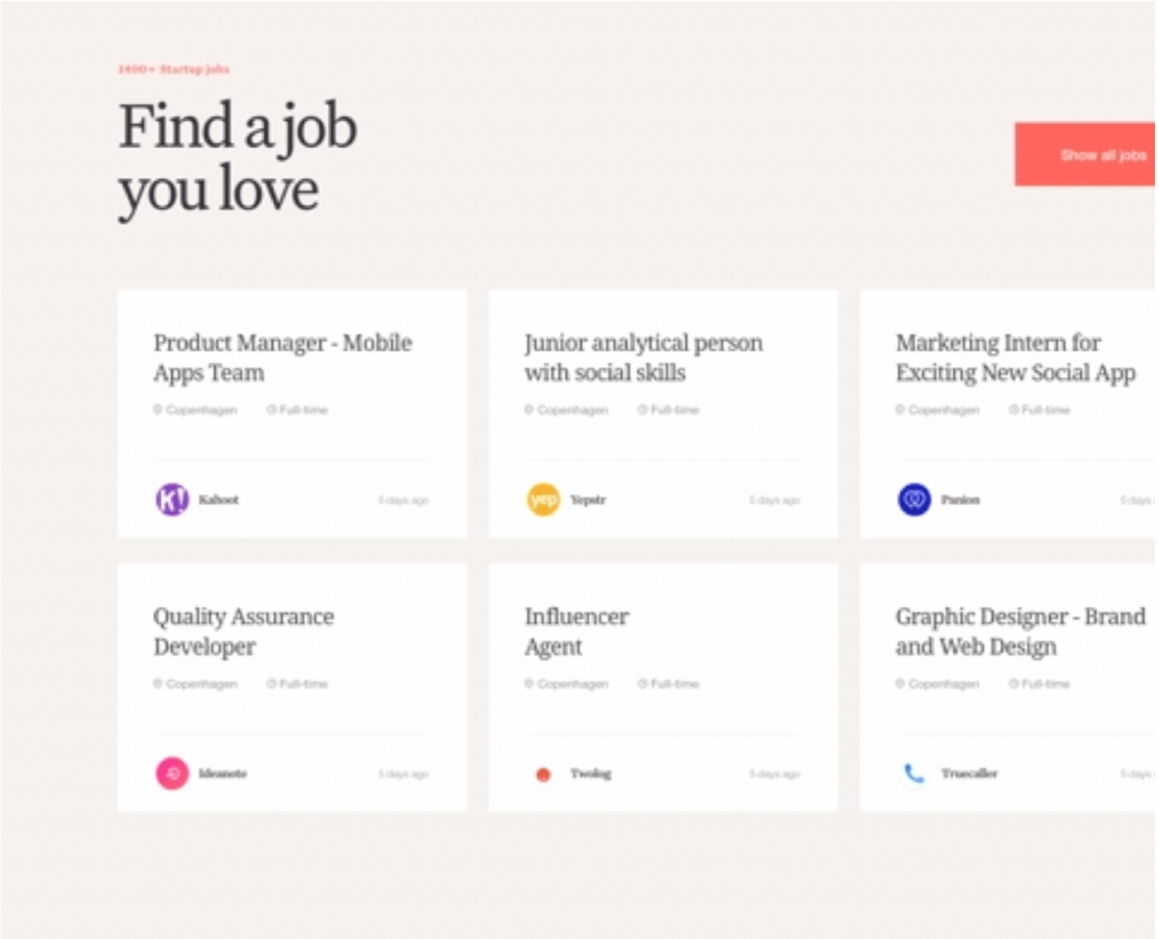
Nngroup.com

SCALE

VISUAL HIERARCHY



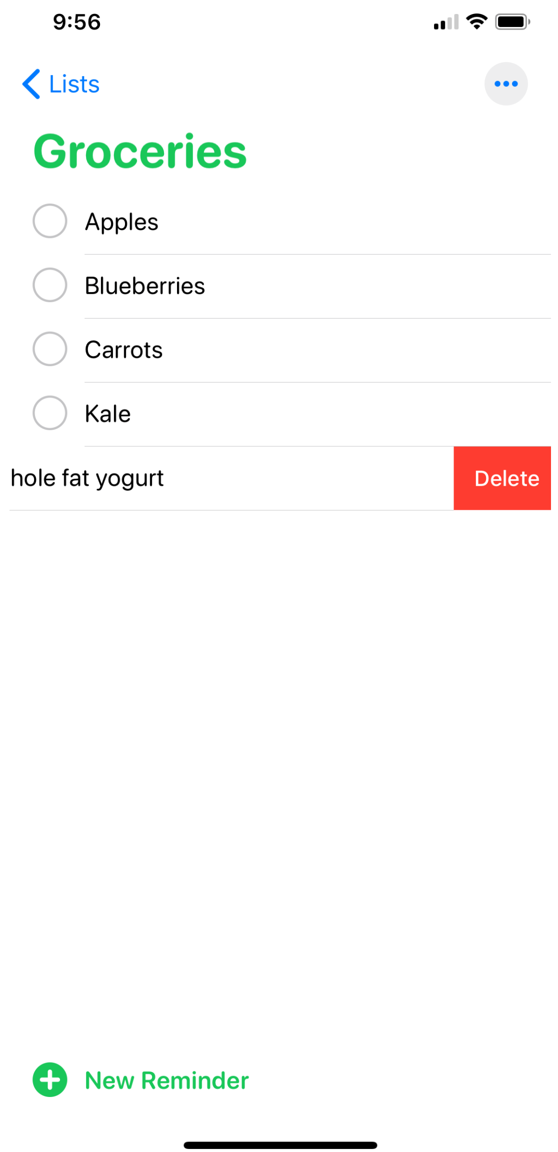
Nngroup.com


Find a job
you love
Show all jobs
Product Manager - Mobile Apps Team
Copenhagen
Full-time
Kahoot
Junior analytical person with social skills
Copenhagen
Full-time
Marketing Intern for Exciting New Social App
Copenhagen
Full-time
Quality Assurance Developer
Copenhagen
Full-time
Influencer Agent
Copenhagen
Full-time
Twolog
Graphic Designer - Brand and Web Design
Copenhagen
Full-time
Truecaller


THE VORTEX

BALANCE

CONTRAST



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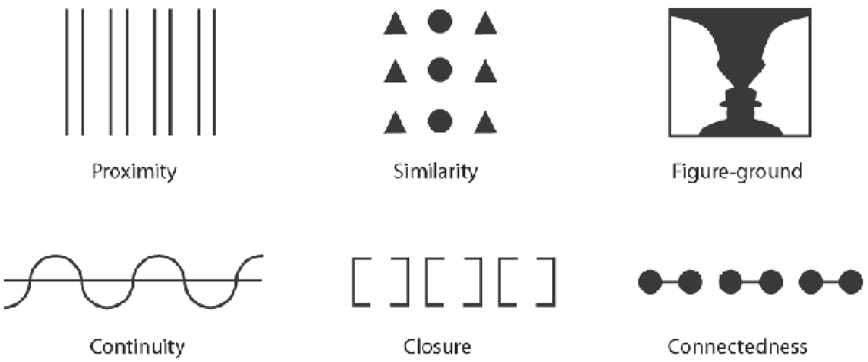
GESTALT

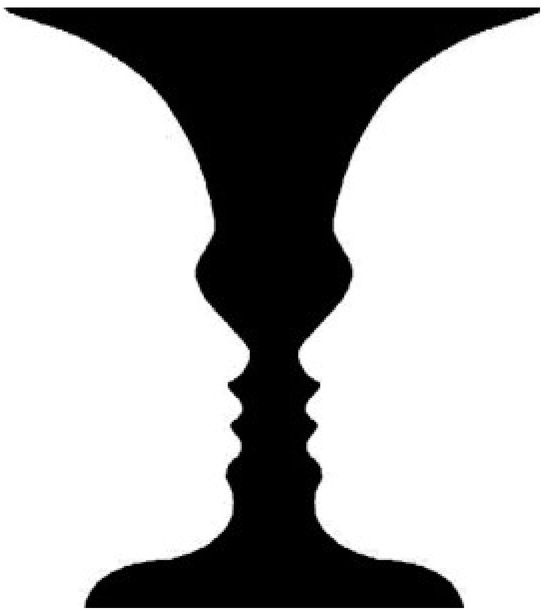
Nngroup.com

VISUAL PERCEPTION: GESTALT PRINCIPLES

- Law of Proximity
- Law of Similarity
- Law of Pragnanz: Figure (the element in focus) or Ground (background)
- Law of Symmetry
- Law of Closure



Gestalt Perception: Figure / Ground



CLOSURE

Visual Design

- Visual design aims to shape and improve the user experience through consideration of **images**, **typography**, **space**, **layouts**, and **colour** (visual design tools)
- Successful visual design:
  - communication not self expression
  - content remains central to the page or function and engages users

UI VISUAL DESIGN: TOOLS

- Images
- Typography
- Colour
- Space
- Layout

IMAGES

TYPOGRAPHY

- Letter forms: perceptual balance as opposed to actual
  - Typeface: point/font size; varies with typeface
  - Leading: spacing between lines
  - X-height: height of lowercase letters
  - Ascenders & Descenders
  - Weight: light / regular / bold
  - Serifs: serif for body text; sans serif for headers: heuristic
- Which typeface to use? It depends!

UI VISUAL DESIGN: TYPOGRAPHY

- These letters are in a **serif** font:

  A E F G H L M N Z

- These letters are in a **non-serif** font:

  A E F G H L M N Z

- Times New Roman is a serif font
  Arial is a non-serif font

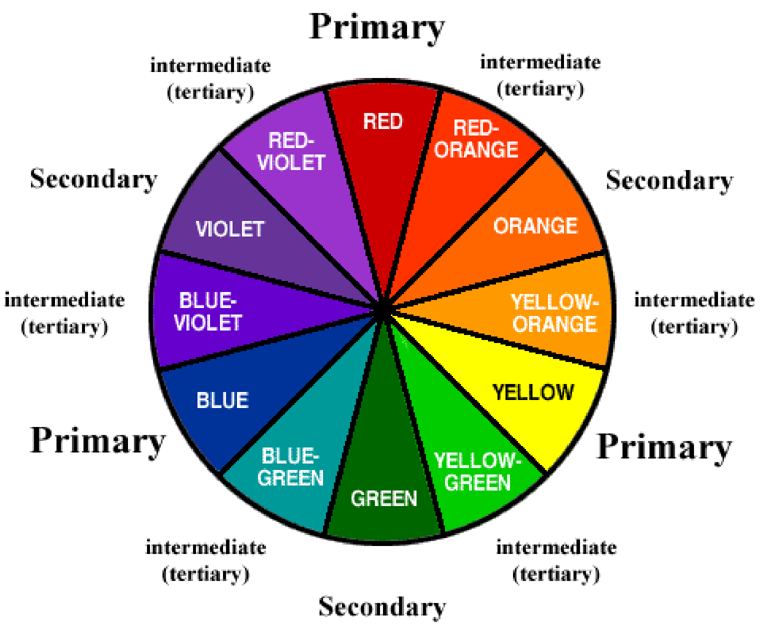
TYPOGRAPHY

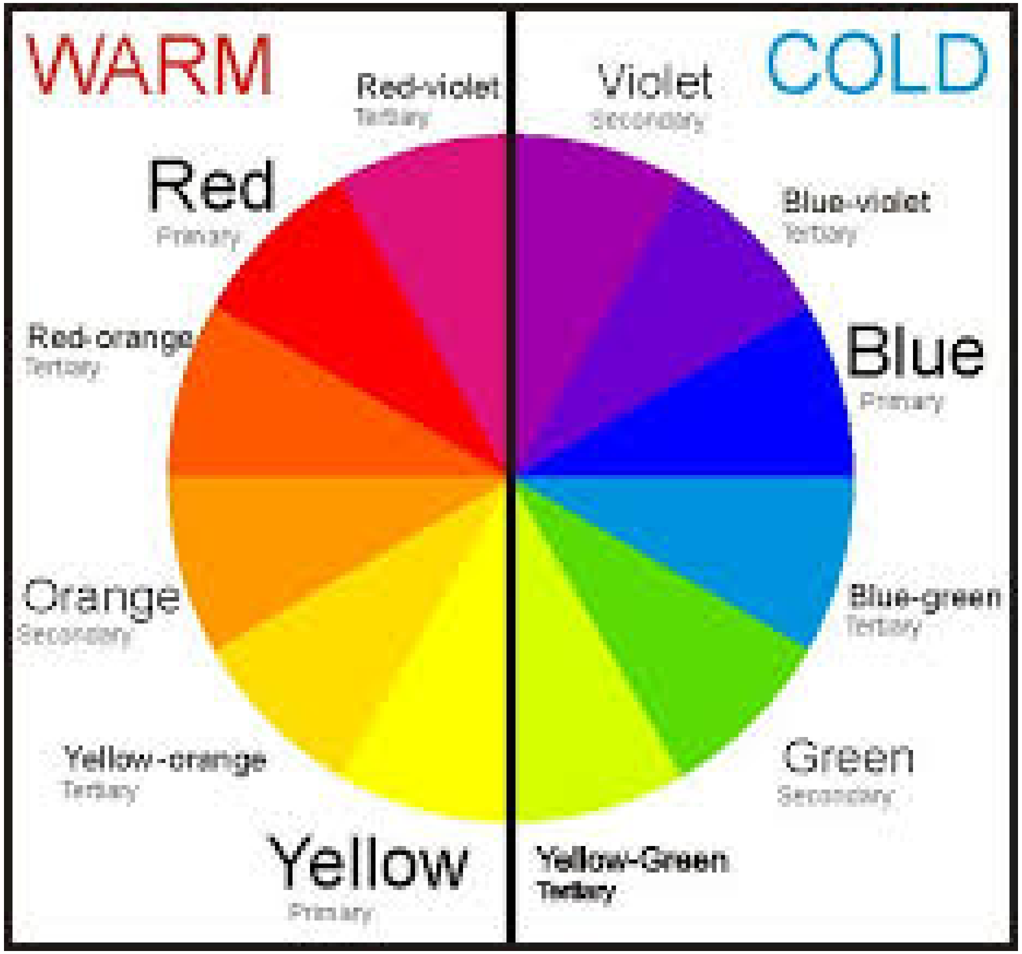
- Typography Guidelines:
  - Choose a typeface that works well in various sizes (e.g Avenir, Univers)
  - Choose a typeface with easily distinguishable letter forms (Clear Sans better than Lato)
  - Treat text as UI (e.g. Medium)
  - Consider the job to be done (Instapaper web and mobile apps)
- Type plays a vital role in UI: enabling or impeding users

COLOUR

COLOUR WHEEL

- Colour Wheel: shows the relationship between colours
- Based on the RYB content of each colour; developed by Sir Isaac Newton 1666
- Bleicher (2011) colour wheel into three types of colors based on combination of base colors used to create the final colour:
  - **Primary**: red, yellow, blue
  - **Secondary**: orange, green and purple (mix 2 primary)
  - **Intermediate**: mix primary & secondary colours: a hybrid

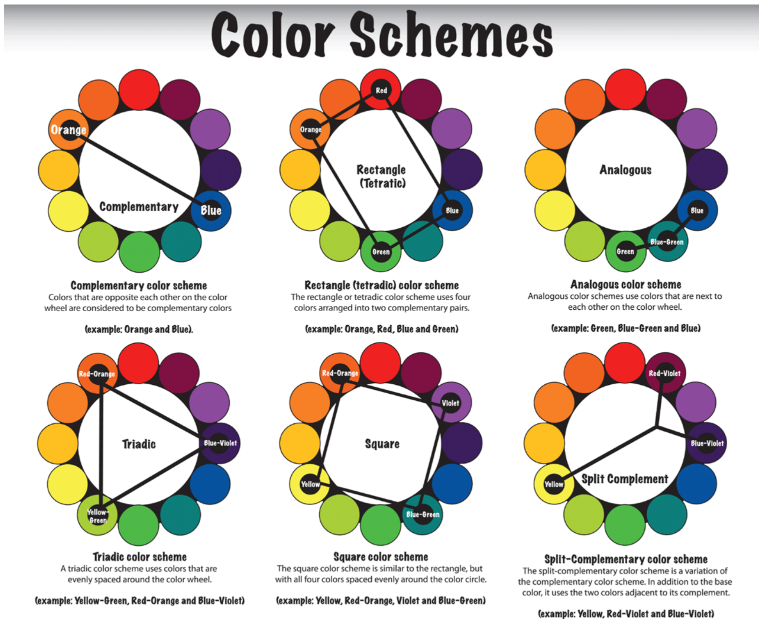



WARM
COLD
Red-violet
Tertiary
Violet
Secondary
Red
Primary
Blue-violet
Tertiary
Red-orange
Tertiary
Blue
Primary
Orange
Secondary
Blue-green
Tertiary
Yellow-orange
Tertiary
Green
Secondary
Yellow
Primary
Yellow-Green
Tertiary

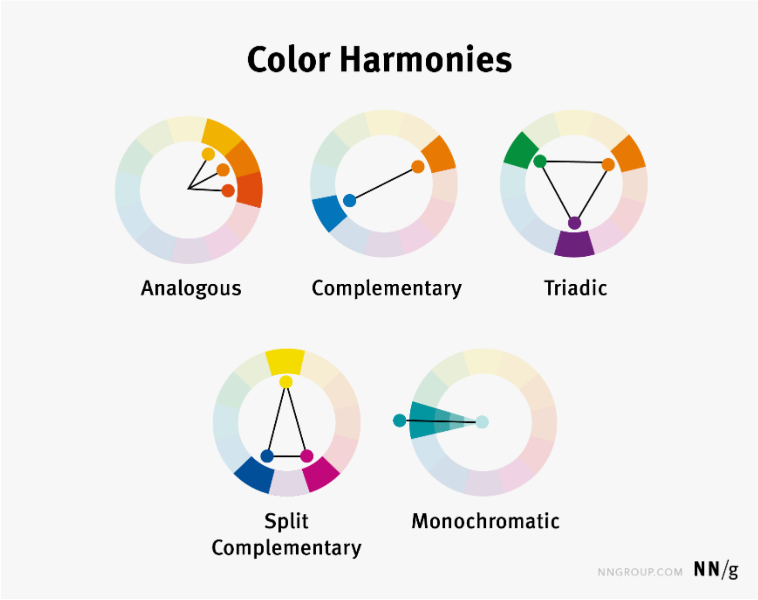
COLOUR SCHEMES

Different colour schemes based on the colour circle. These are helpful when designing your visualisations and interfaces:

1. Complementary Scheme
2. Analogous Scheme
3. Triadic Scheme
4. Split-Complementary Scheme
5. Rectangle Scheme
6. Square Scheme



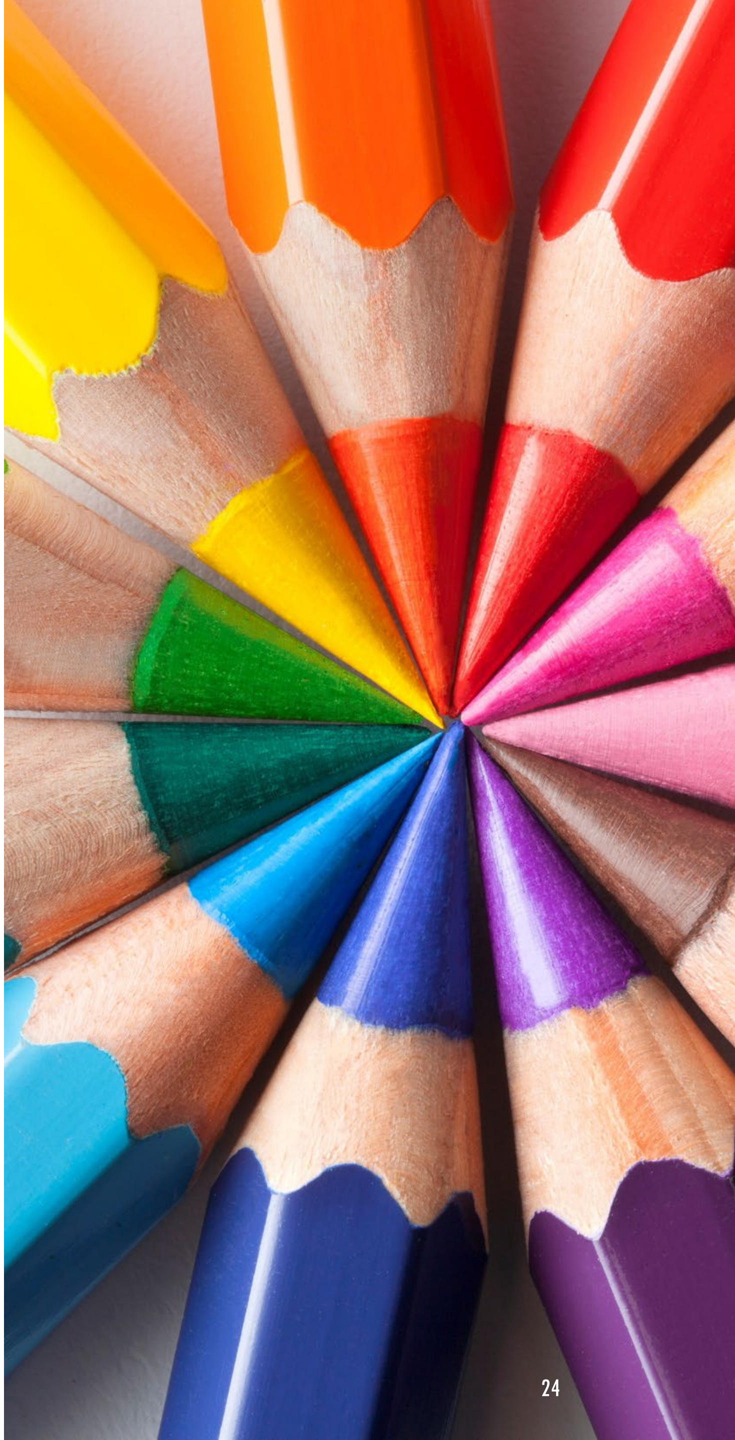
Color Schemes
Orange
Complementary
Blue
Complementary color scheme
Colors that are opposite each other on the color wheel are considered to be complementary colors
(example: Orange and Blue).
Red
Orange
Rectangle (Tetratic)
Blue
Green
Rectangle (tetradic) color scheme
The rectangle or tetradic color scheme uses four colors arranged into two complementary pairs.
(example: Orange, Red, Blue and Green)
Analogous
Blue
Blue-Green
Green
Analogous color scheme
Analogous color schemes use colors that are next to each other on the color wheel.
(example: Green, Blue-Green and Blue)
Red-Orange
Triadic
Blue-Violet
Yellow-Green
Triadic color scheme
A triadic color scheme uses colors that are evenly spaced around the color wheel.
(example: Yellow-Green, Red-Orange and Blue-Violet)
Red-Orange
Violet
Square
Yellow
Blue-Green
Square color scheme
The square color scheme is similar to the rectangle, but with all four colors spaced evenly around the color circle.
(example: Yellow, Red-Orange, Violet and Blue-Green)
Red-Violet
Blue-Violet
Yellow
Split Complement
Split-Complementary color scheme
The split-complementary color scheme is a variation of the complementary color scheme. In addition to the base color, it uses the two colors adjacent to its complement.
(example: Yellow, Red-Violet and Blue-Violet)

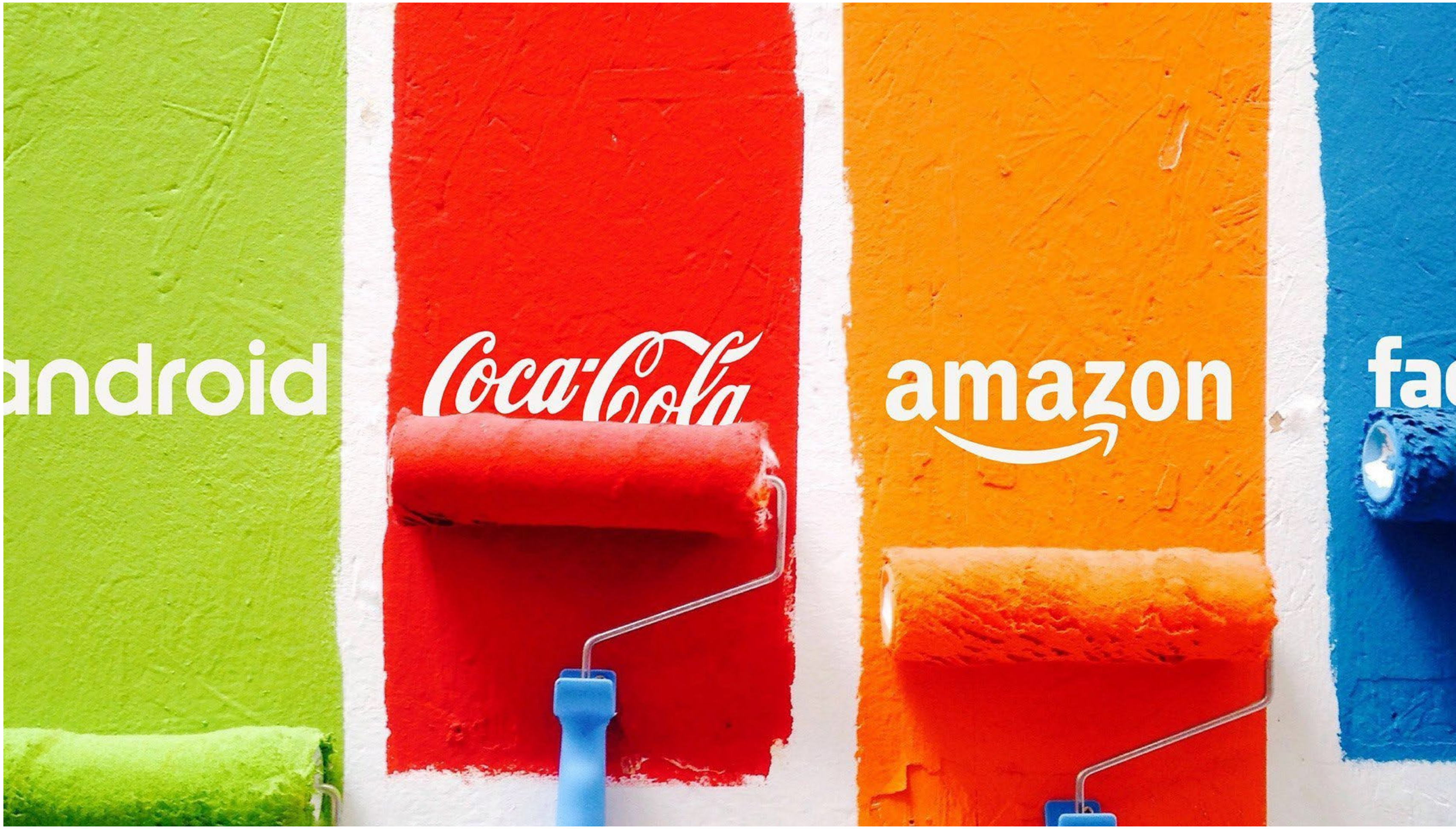


Color Harmonies
Analogous
Complementary
Triadic
Split Complementary
Monochromatic
NNGROUP.COM NN/g

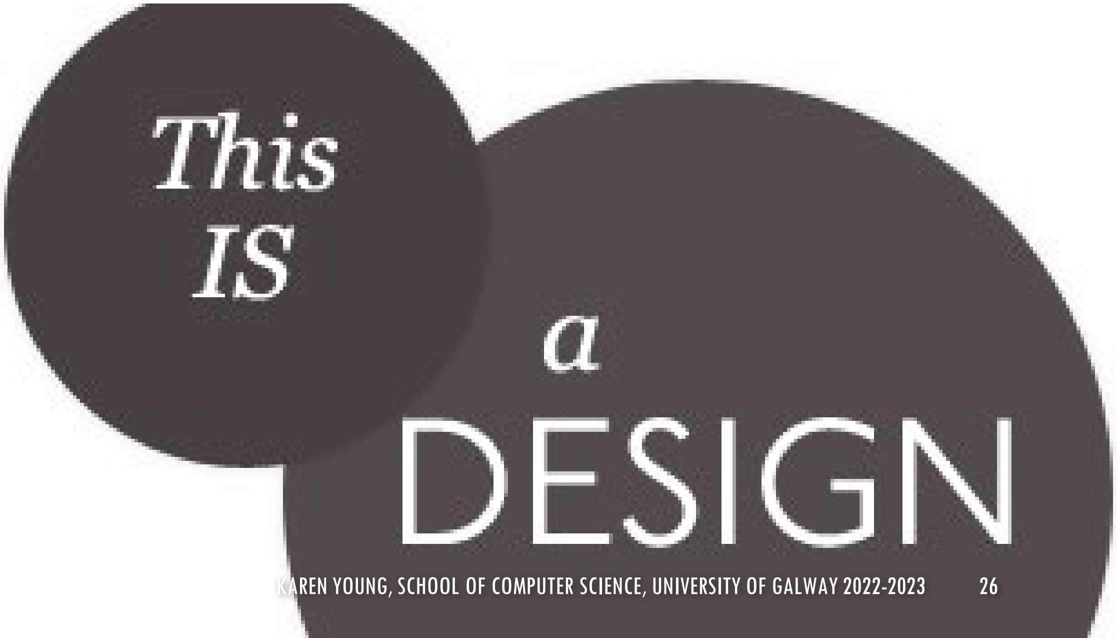
DESIGNING WITH COLOUR

- Choose a colour scheme and iterate on individual colours: Soft / Harsh? Warm / Cool?
- Limit your palette to three colours
- Follow any branding colour guidelines
- Use the 60/30/10 rule
- Apply, then iterate: user testing
- Be consistent throughout




Coca-Cola
amazon

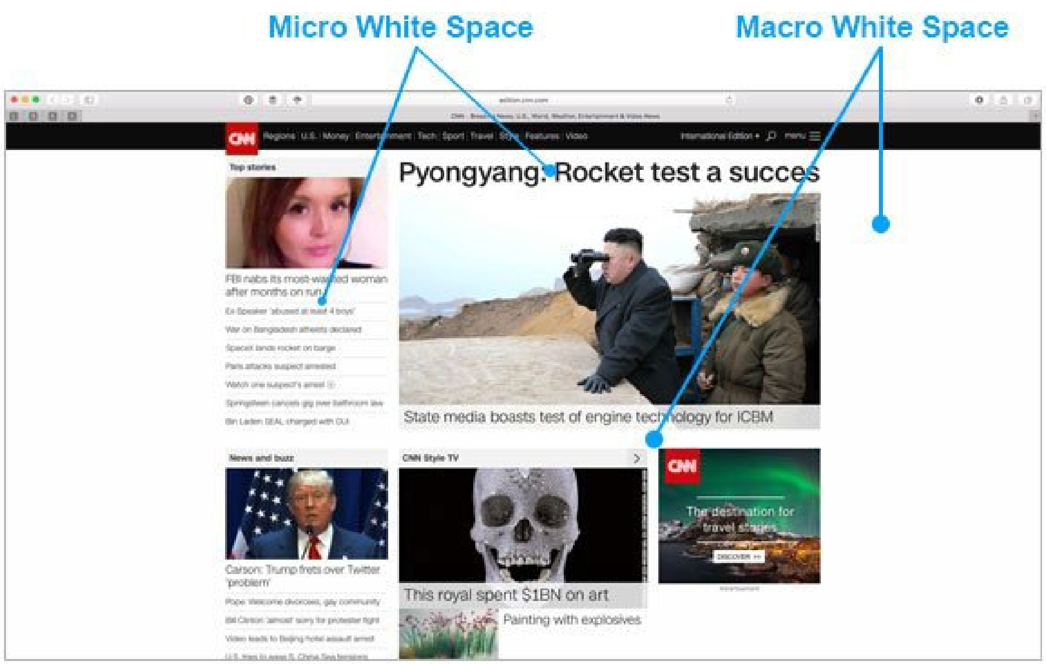
VISUAL DESIGN: WHITE SPACE



VISUAL DESIGN: WHITE SPACE

- White space between typography glyphs, content blocks, or other UI elements enhances user experience
- Classification of White Space:
  - Function: Active / Passive
  - Size: Micro / Macro
- Purpose of White Space:
  - Branding
  - Content
  - Focus
  - Readability

VISUAL DESIGN: WHITE SPACE



LAYOUT

- The arrangement of items on the screen
- Like items are grouped into areas
  - Each area is self-contained
  - Areas should have a natural intuitive flow: West / East
- All areas should be well defined, logically grouped together and easily discernible visually
- Include titles on all interfaces
- Menus should show where the user is and how the user got there

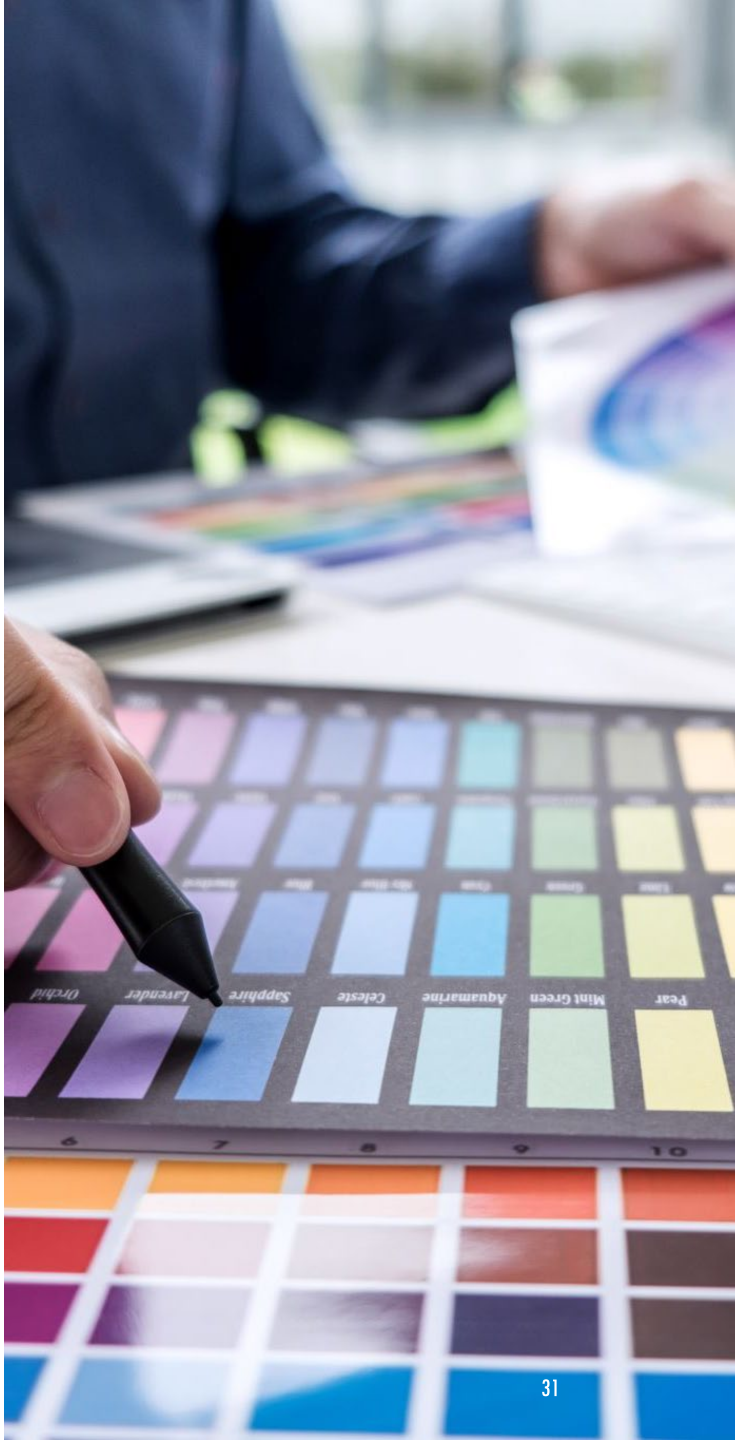

Graphic Design
Web Design
Branding
Mobile applications
HTML5
CSS3
WordPress
START
PREMIUM
BUSINESS
$10.00
$19.00
$30.00
60 GB Bandwidth
100 GB Disk Space
10 Databases
Add to cart
Photoshop
Applications
Social Media
BASIC
PROFESSIONAL
PREMIUM
PREMIUM
Free
$3.99
$5.99
$9.99
Try now
Buy now


SECURITY
FREE
WEATHER
VIDEO
MUSIC
SETTINGS
NOTEBOOK
SOCIAL NETWORKS
EMAIL
CLOUDS

VISUAL DESIGN STRATEGY

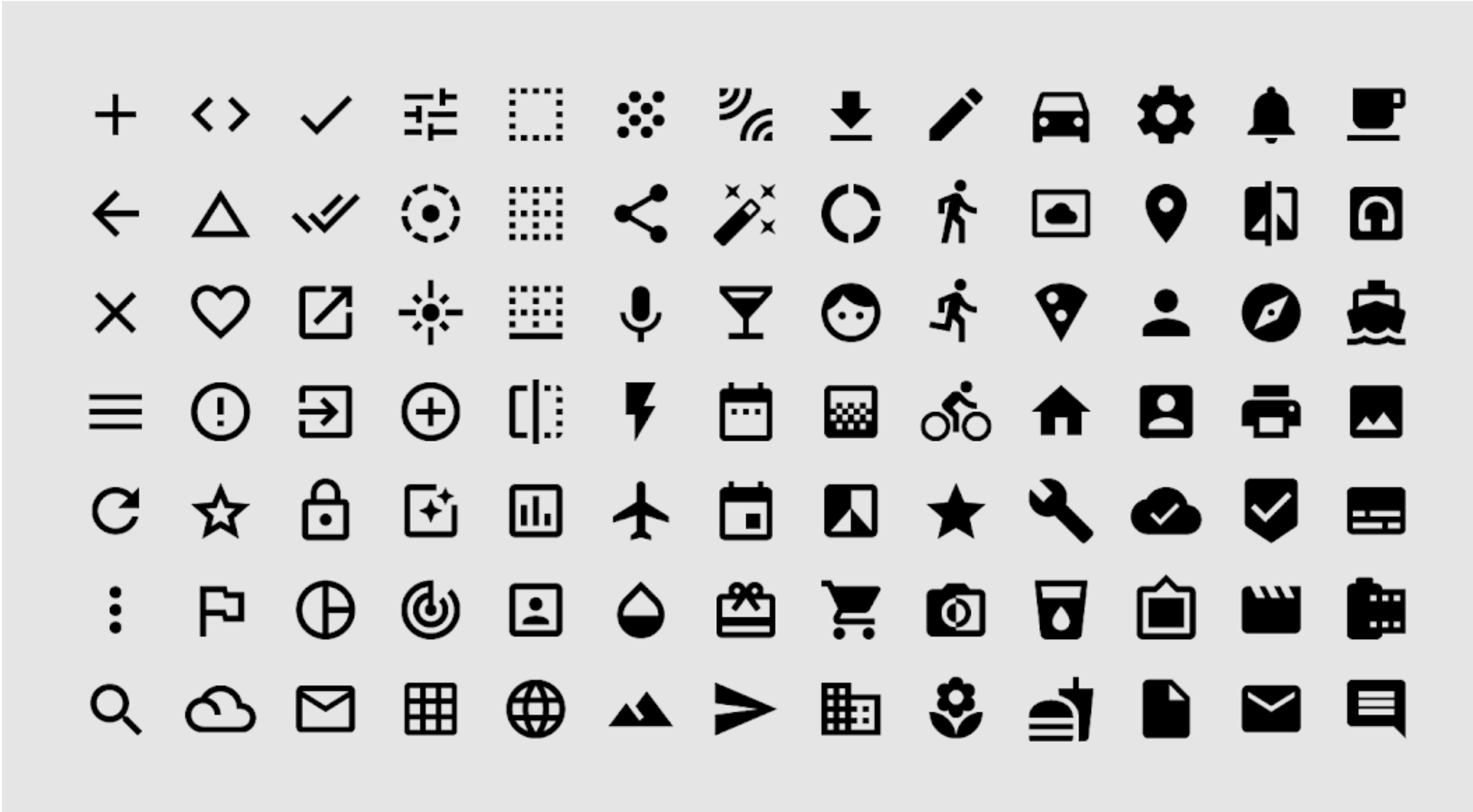
Visme Visual Design Principles: (video)

- Establish focal point
- Use Contrast
- Use Patterns
- Simplify to improve focus
- Create Interactivity

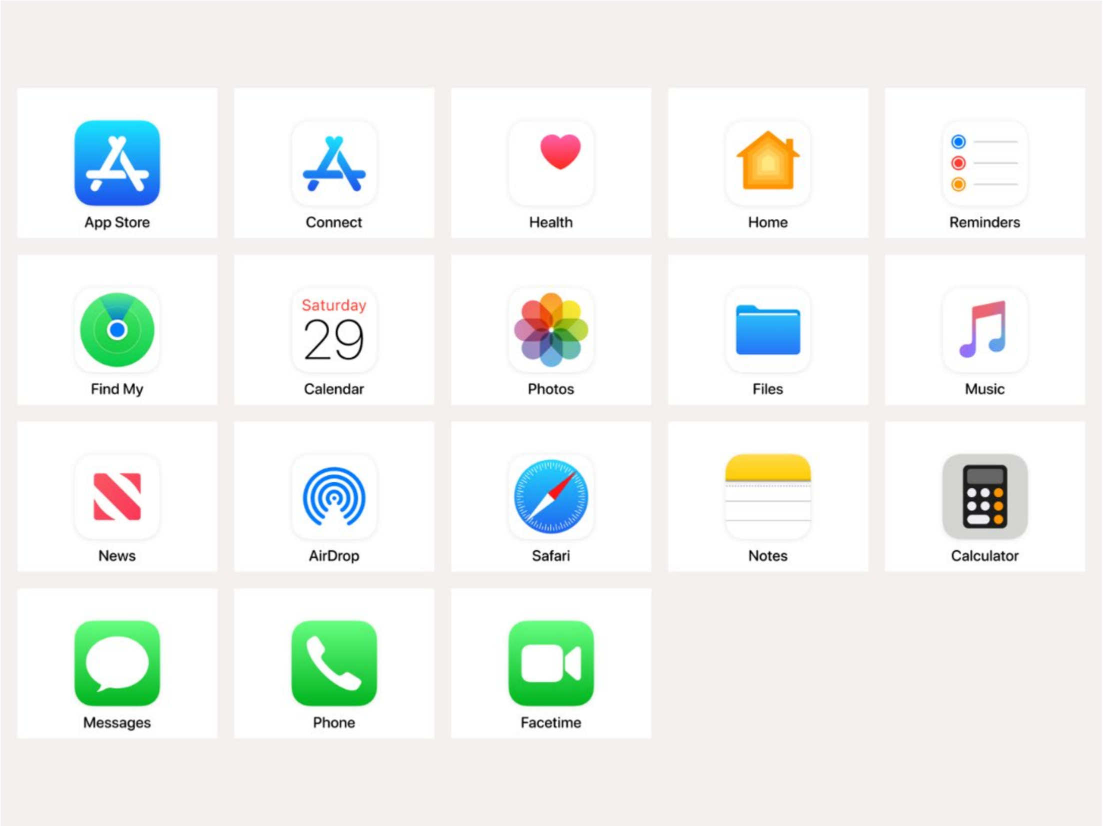


ICON DESIGN:

- Challenges of Icon Design:
  - Identifiability
  - Consistency
  - Distinguishability: colour
  - Sizing
- Universal / Accessible Icon Design



GOOGLE ICONS


App Store
Connect
Health
Home
Reminders
Saturday
29
Find My
Calendar
Photos
Files
Music
News
AirDrop
Safari
Notes
Calculator
Messages
Phone
Facetime

APPLE ICONS

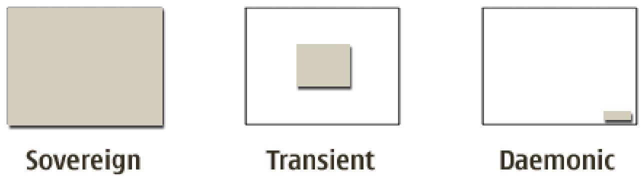
Interaction Design: Posture

PHYSICAL DESIGN: POSTURE

- Behavioural stance: the way it presents to users
- Appearance and behaviour consistent with system purpose: Conflict of *posture* and *purpose*?
- People: soldier, car park attendant, actor, service representative, funeral director
- Programme *posture*: e.g. bold / timid; colourful / drab; automatic / interactive
- Choice of *posture*?
- Consistency of posture: blackberry use during train commute vs. use when late for meeting

POSTURE

- "Desktop": OS, DBs and UI technologies
- Three desktop postures:
  - ***Sovereign***: monopolise users' attention for long periods of time; intermediate users
  - ***Transient***: come and go; single function with constrained set of controls
  - ***Daemonic***: don't normally interact with user – background applications



POSTURE: SOVEREIGN

- ***Sovereign*** Design Rules:
  - Optimise for intermediates: speed and power over initial ease of use
  - Be generous with screen estate: default to maximised
  - Use minimal visual style: long visual exposure
  - Feedback can be visually rich (without clutter)
  - Can exploit rich input

POSTURE: TRANSIENT, DAEMONIC

- ***Transient*** Design Rules:
  - Simple, clear and to the point
  - Bright and clear: orient user quickly
  - Direct, explicit feedback
  - Limit to a single window and view
  - Movable: title bar
  - Give application a memory: size & placement from last time likely to work again
- ***Daemonic*** Design Rules:
  - As above and
  - How to access UI? Given it's normally invisible; Control Panel: consistent place to go and configure daemons
  - Status reports and user interruptions

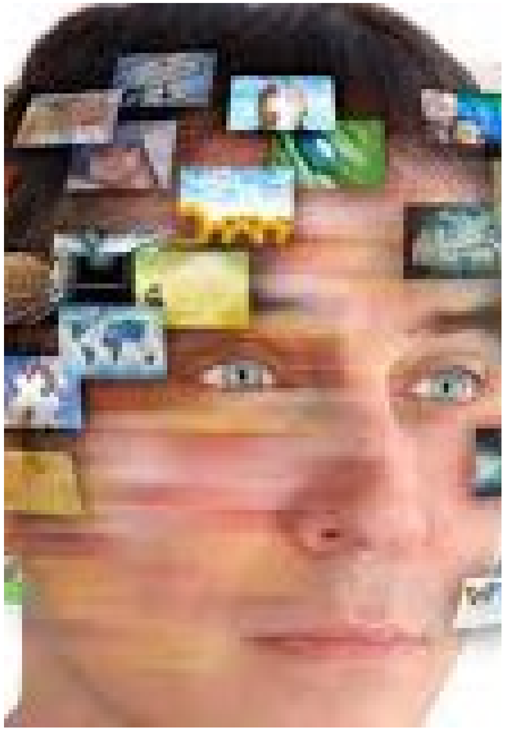
CT318 LECTURE 8: REVIEW

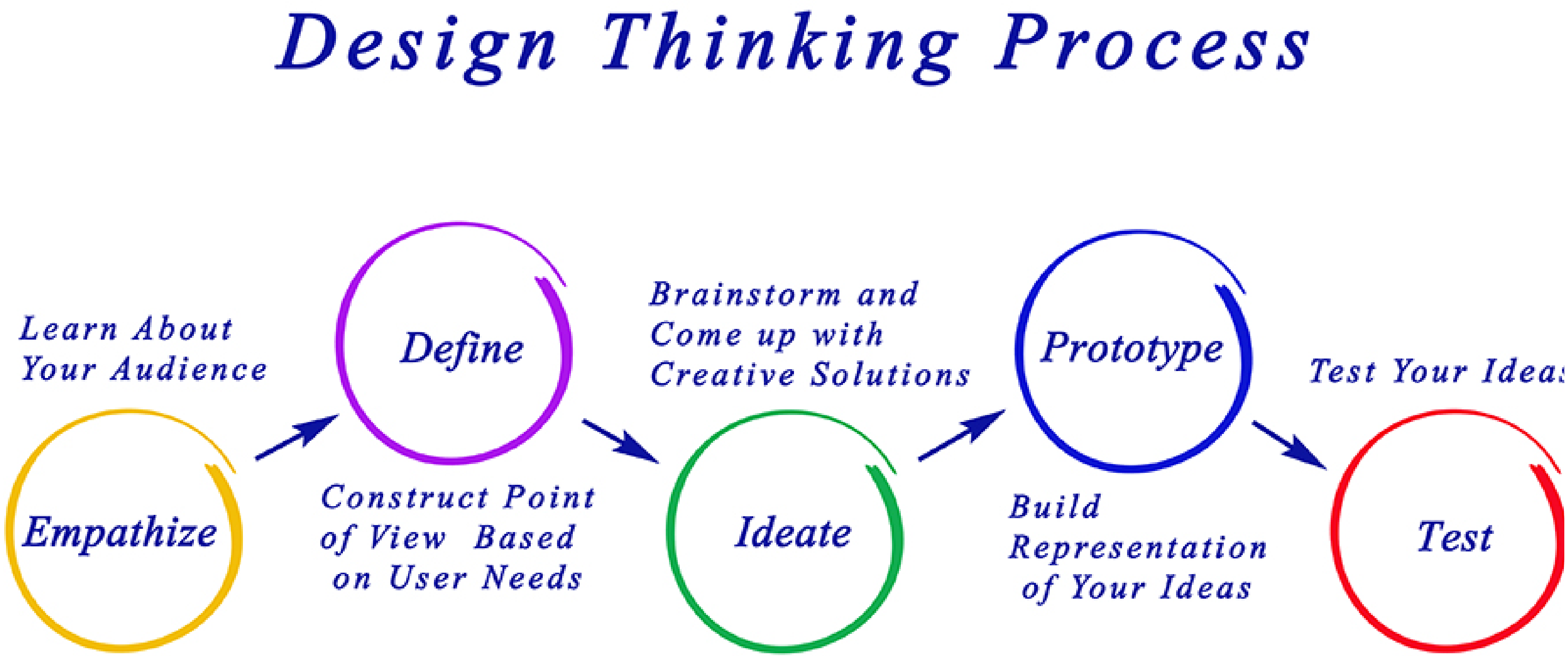
Design Thinking 4: Prototype

- ➢ Visual Design
- ➢ Icon Design
- ➢ Group Project Feedback: User Research

HCI: LECTURE 9 OVERVIEW

- DESIGN THINKING 4: PROTOTYPE (Information Architecture / Design)
  - Information Visualisation
    - Perception: Representation
    - Interpretation: Interaction, Analysis
    - Understanding




Design Thinking Process
Learn About Your Audience
Empathize
Define
Construct Point of View Based on User Needs
Brainstorm and Come up with Creative Solutions
Ideate
Prototype
Build Representation of Your Ideas
Test Your Ideas
Test

INFORMATION ARCHITECTURE

"An information architect is the individual who organizes the patterns inherent in data, making the complex clear."

- (Richard Wurman, *Information Anxiety* 1976)

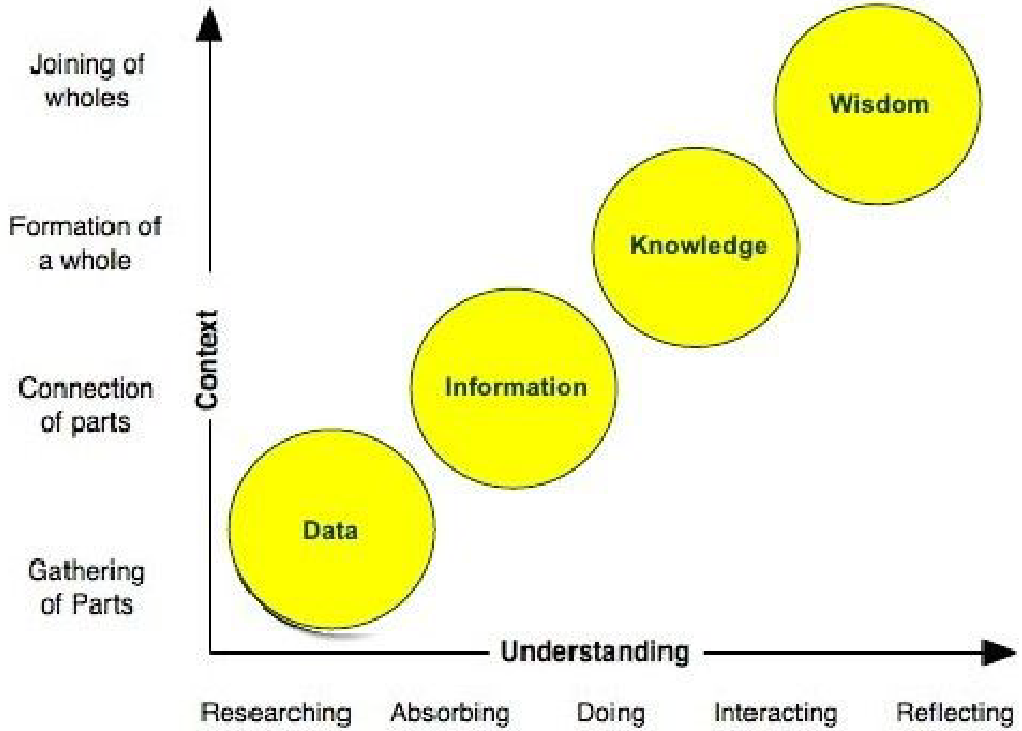
- Information Architects:
  - Label (ontology)
  - Organise (taxonomy) and
  - Present (choreography) content
- According to user goals to minimize cognitive load

INFORMATION DESIGN

- Information Visualisation: Representing data in a way that is easy to ***understand*** and to ***manipulate***, helping us make ***sense*** of information and make it ***useful*** in our lives
- Understand user goals to make effective design decisions
- Help people understand the world better
- Add value by translating raw data into relevant, useful information
- Data – Information – Knowledge – Wisdom: Gathering – Connecting – Formation - Joining

Imperial College London

The Continuum of Understanding



understanding is a continuum (Cleveland, 1982):

USER GOALS

- Understanding users and user goals essential to move from data to information on the continuum of understanding
- Different users with different goals and emotions: alleviates information anxiety
- "*Information anxiety is the black hole between data and knowledge, and it happens when information doesn't tell us what we want or need to know.*"
  Richard Saul Wurman
- Example of Diabetes patients: patient's perspective vs. healthcare professional perspective: what they need to know

INFORMATION VISUALISATION: THREE STAGES OF UNDERSTANDING

1

Perceiving: What does it show? Where is big, medium, small? How do things compare?

Design Choices

2

Interpreting: What does it mean? What is good and bad? Is it meaningful or insignificant? Unusual or expected?

Viewer Capacity

3

Understanding: What does it mean to me? What are the main messages? What have I learnt? Any actions to take?

Depends on Viewer

Data Visualisation: A Handbook, Kirk, 2016

1. PERCEIVING: REPRESENTATION

REPRESENTATION

- How information can and should be encoded and displayed
- "*Design cannot rescue failed content*" Edward R. Tufte
- What is salient? What to attend to?
- **Representation**: Design decisions about what information to encode: only a portion of the information space can be visible in the representation space at any given time
- Representation connects the human mind to the information space (mental model to data model)

INFORMATION REPRESENTATION

Guidelines for good visual information representation (Tufte): (value over beauty / decoration)

1. Graphical Excellence: “the greatest number of ideas, in the shortest time, using the least amount of ink, in the smallest space” – in short, **usability**
2. Visual Integrity: neither distort the data nor create a false impression
3. Maximizing the Data-Ink Ratio: all superfluous elements should be removed (borders, 3D etc.)
4. Aesthetic Elegance: simplicity of design (Minard’s representation of Napoloeon’s march)

INFORMATION READABILITY

Nielsen Usability Research (1997): How people read online

- People look around, interlaced browsing: **don't read**
- Effective Writing Strategy: improve comprehension
  - Concise text: improved by 58%
  - Scannable Layout: improved by 47%
  - Objective language: improved by 27%
  - Combined version: improved by 124%
- Use structure: headings, subheadings & pages
- Information bearing words in links: improves scanning
- Eye catching text elements: bulleted lists, capitals

INFORMATION REPRESENTATION

- Visual Tools for representing complex data:
  - Tables
  - Brackets and Tree diagrams
  - Blueprints, diagrams, schematics: 2-D micro representations of 3-D macro systems
  - Flow charts, Organisation charts
  - Notational systems: chess, music, maths
  - Maps: 2-D figures to represent complex multi-dimensional data

CHARTS

Define the shape, size and layout choices for all components:

- **Size**: small multiples, readable labels
- **Scales**: most meaningful range of values for data?
- **Orientation**: which way is best?
- **Value sorting**: most meaningful? LATCH acronym

INFORMATION DESIGN: "5 HAT RACKS"

How Do Things Compare?

Location: Mapping locations to explore connections

Alphabetic: Organising information following standard alphabetic order

Temporal: Showing trends and activities over time

Categorical: Comparing categories and distributions of quantitative values

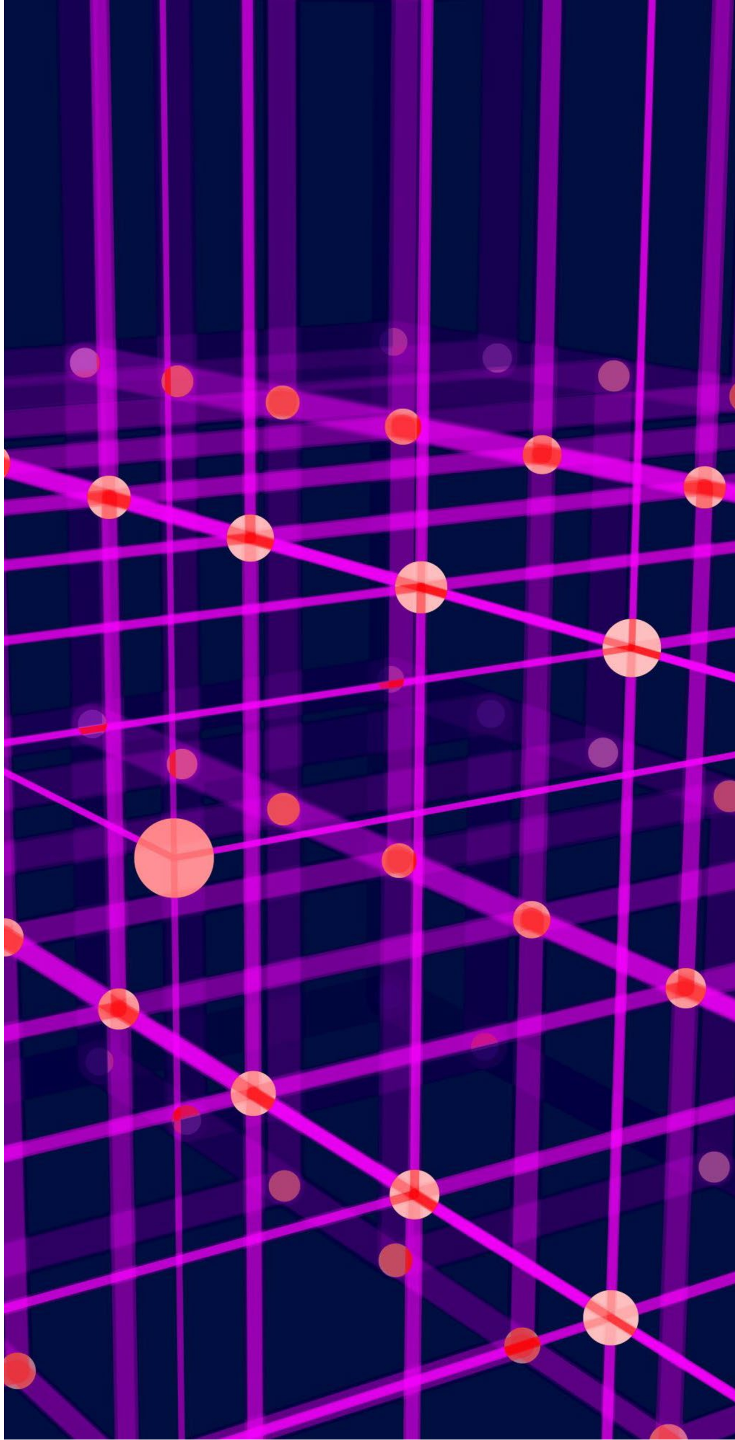
Hierarchical: Charting part-to-whole relationships and hierarchies

LATCH: Saul Wurman (1989)

HOW TO REPRESENT?
HOW & WHAT TO ENCODE?

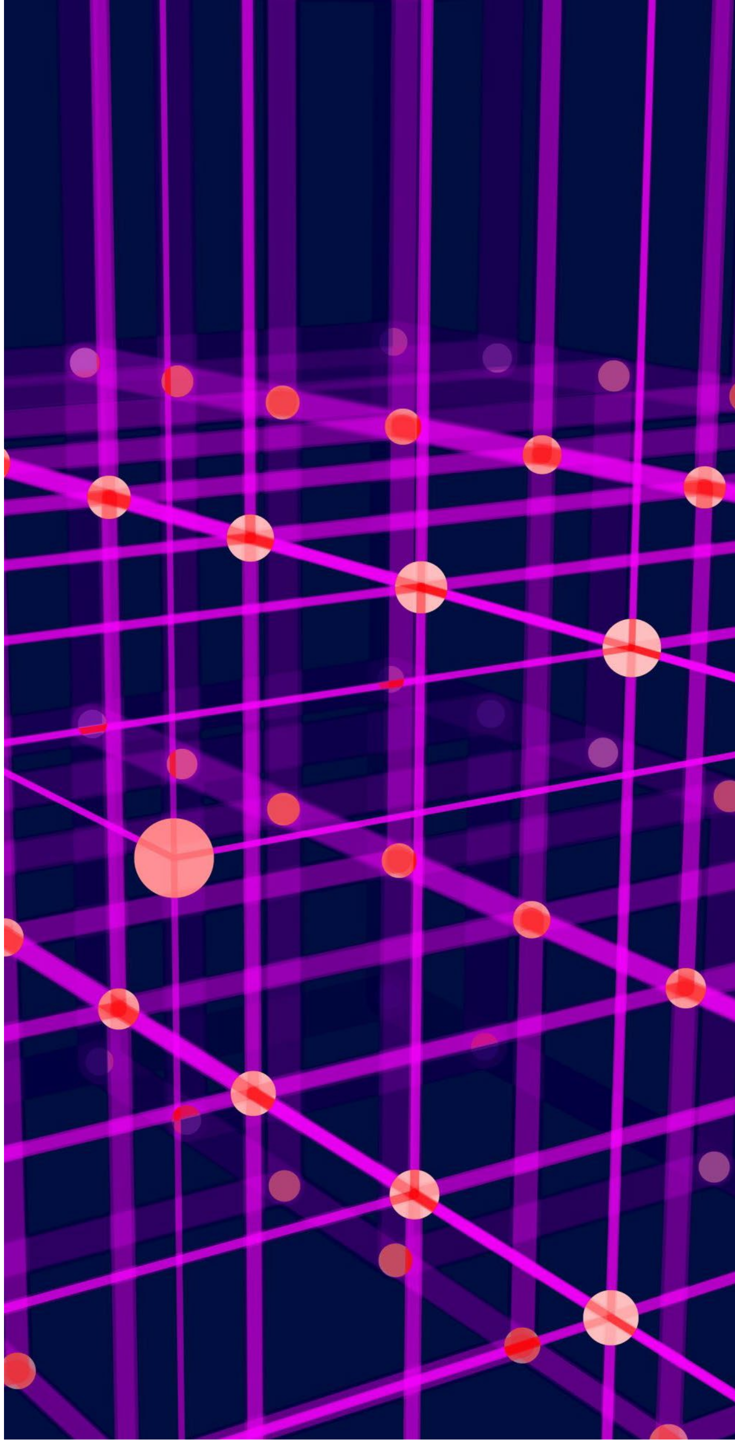
ENCODING

- Three visual mapping elements (Card, Mackinlay and Shneiderman, 1999):
  - The **Spatial Substrate**: 2/3/multi dimensional spaces; data type (quantitative, ordinal, categorical)
  - The **Graphical Elements**: Visual elements that will appear in the spatial substrate: points, lines, surfaces, volumes
  - The **Graphical Properties**: apply to the graphical elements to make them more or less noticeable: size, orientation, colour, texture and shape

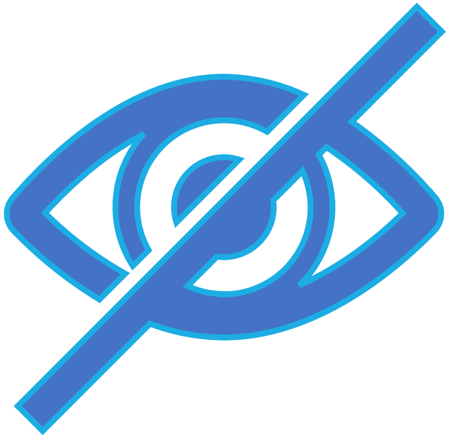


ENCODING

- Encoding comprises two different properties
  - **Marks** (elements) - visible features like dots, lines, areas
  - **Attributes** (properties) - appearance of marks, e.g. colour, size, position
- Objective of Visual Encoding is to find the right blend between marks and attributes that best captures the angle you want to portray
- Marks & Attributes are called Visual Variables

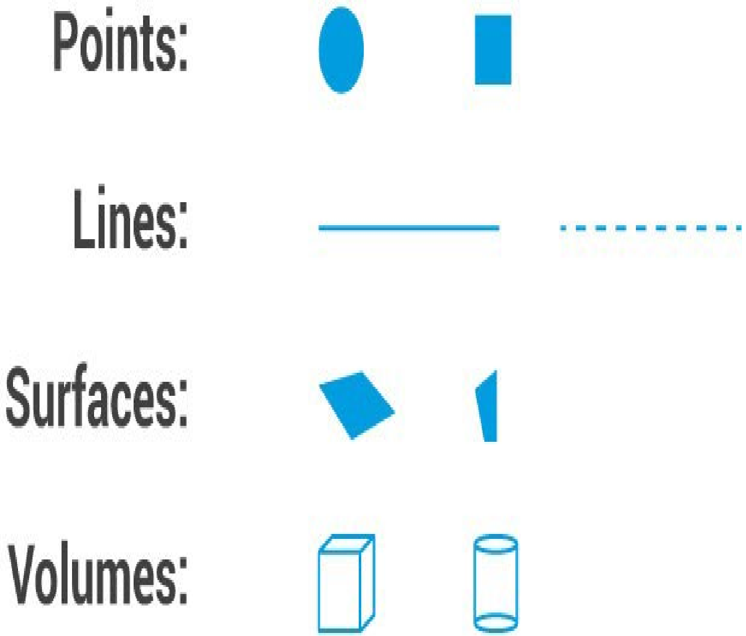


ENCODING



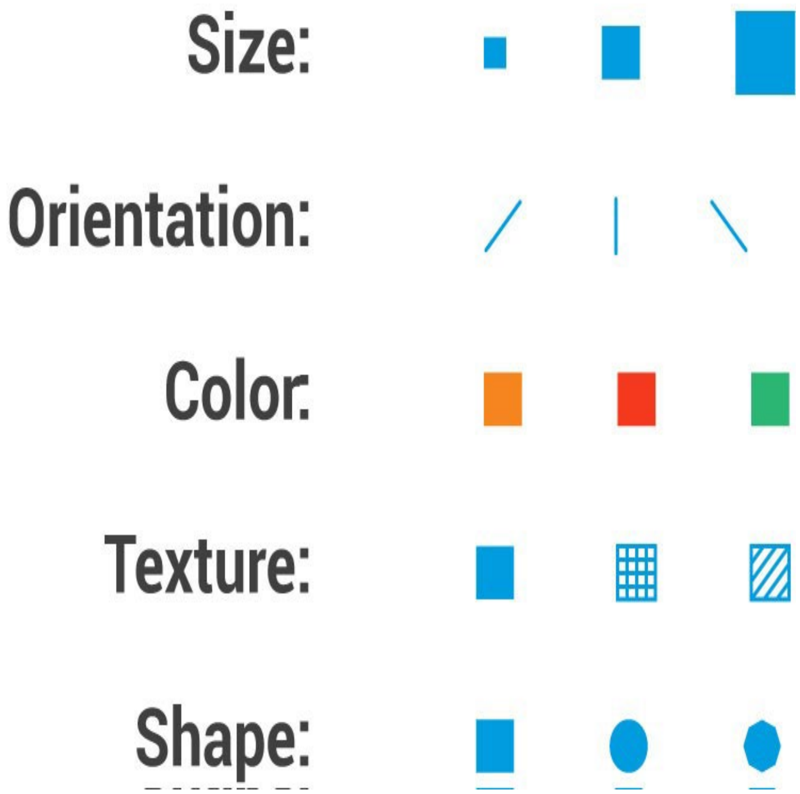
- Visualisers encode, giving visual properties to data values (graphics)
- Visually differentiate elements from other elements during design process
- Originally designed by Jaques Bertin (Semiologie Graphique, 1967) and intended for cartography
- “**Visual Variables** are a specified set of symbols that can be applied to data in order to translate information”
- 12 Visual variables: arranged in specific order they convey information (location, size, shape, orientation, colour: hue, value, saturation; texture, arrangement, crispness, resolution and transparency)

Information Encoding



Graphical Elements

Information Encoding

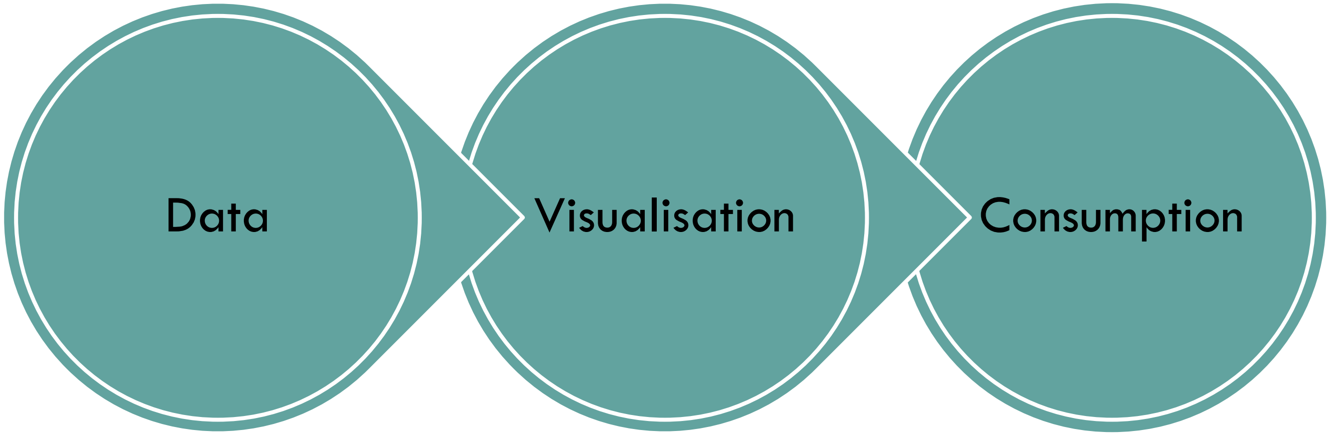


Graphical Properties

2. INTERPRETING: INTERACTING, ANALYSING

INFORMATION VISUALISATION: INTERACTIVITY

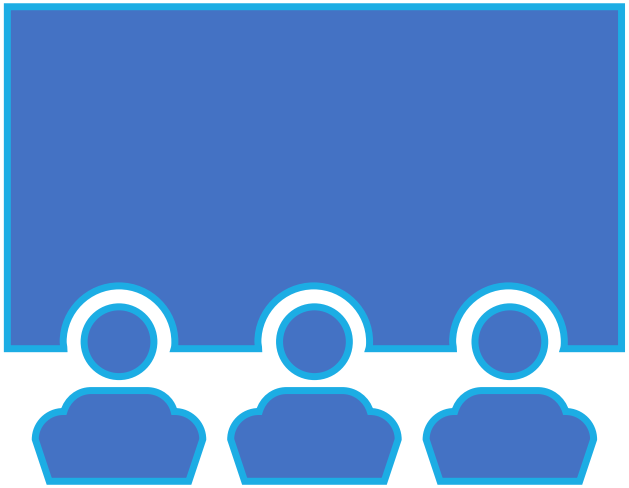
- Expands the physical limits of what you can show in a given space (e.g. large ranges of data)
- Increases the quantity and broadens the variety of angles of analysis to serve different curiosities
- Facilitates manipulations of the data displayed to handle varied interrogations
- Increases the overall control and potential customisation of the experience
- Extends scope for exploring different techniques for engaging users

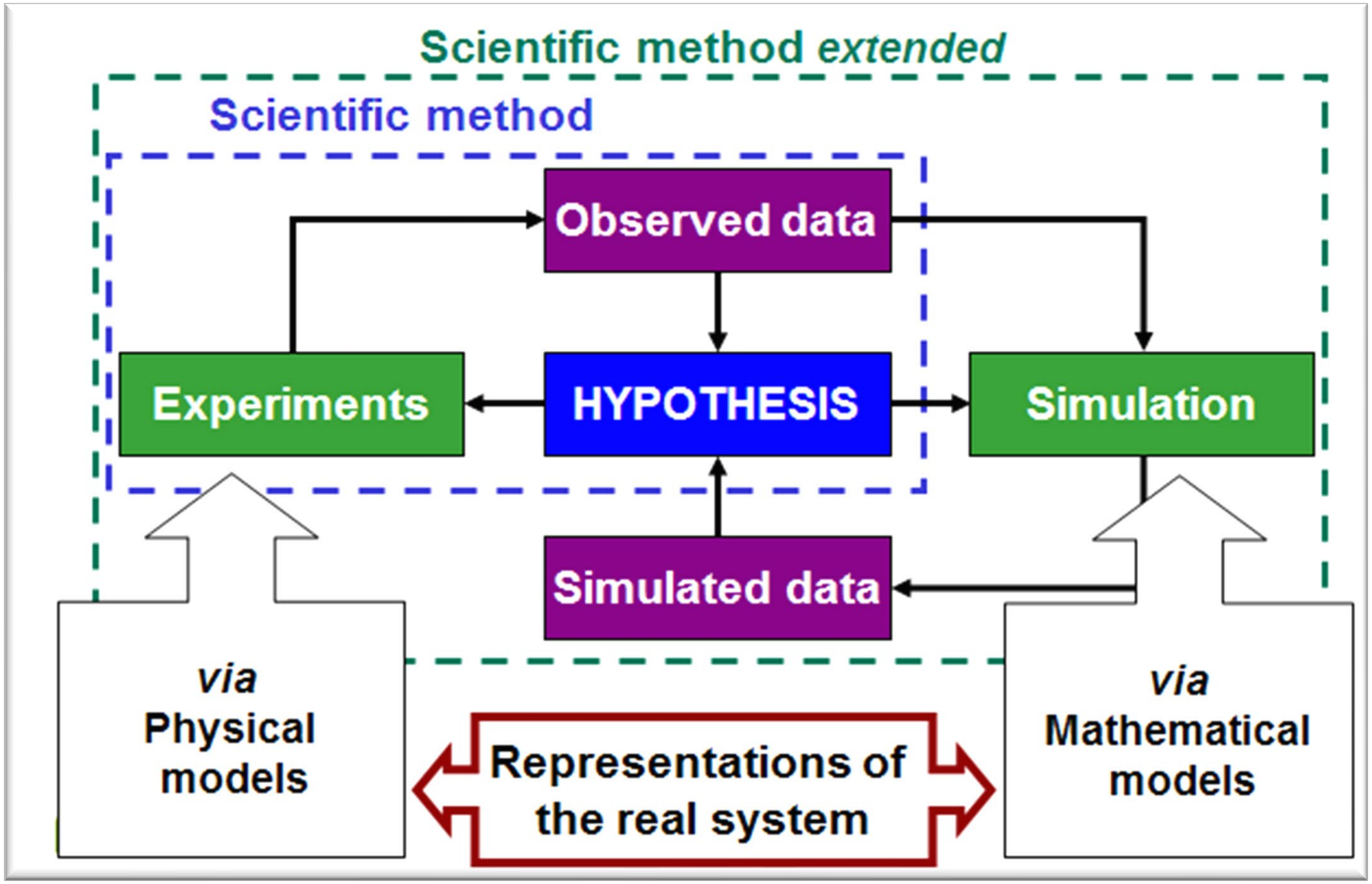


PASSIVE VISUALISATION

INFORMATION EXHIBITION

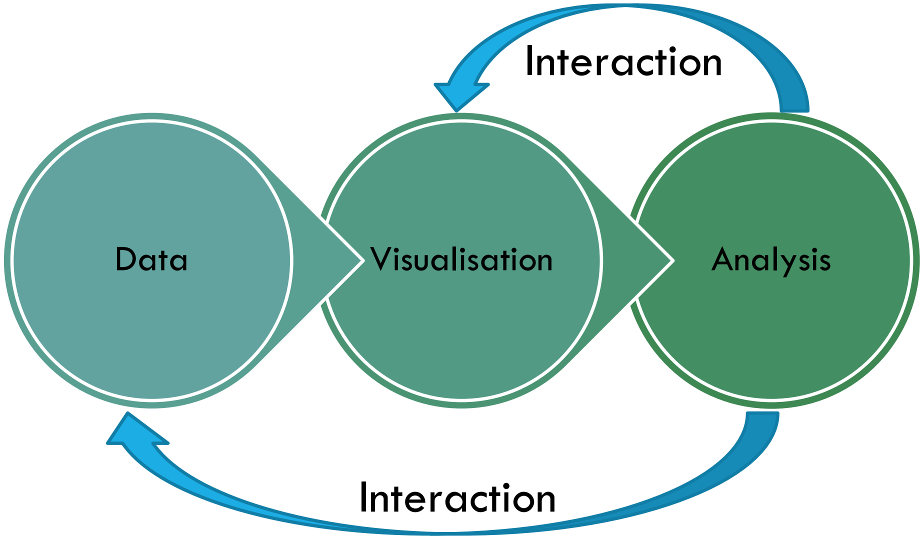
- Viewers interpret data themselves: relies on their knowledge of the subject-matter
- Visual displays of data similar to an exhibition of artwork
- Useful for specific audiences (e.g. boardroom meetings)
- Usually quite narrow focus May be part of a bigger display (dashboards, newspaper article)





INFORMATION VISUALISATION: STATIC

INTERACTIVE VISUALISATION



INFORMATION VISUALISATION: INTERACTIVITY

- Interaction Types:
  - Interaction for **data** adjustments: Affecting what data is displayed
  - Interaction for **presentation** adjustments: Affecting how the data is displayed

INFORMATION VISUALISATION: INTERACTIVITY

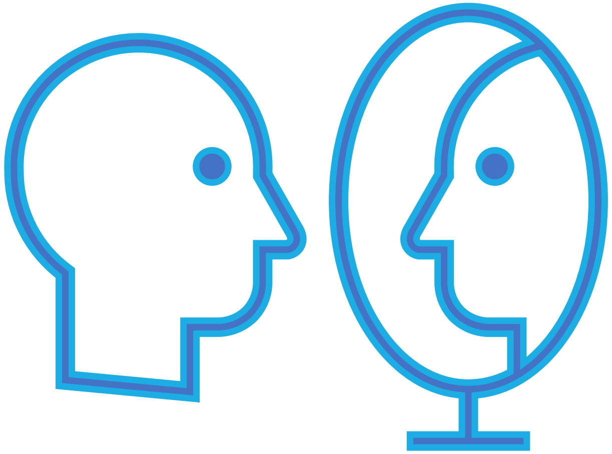
Data Adjustments:

- **Framing** allows users to modify the criteria by which data is displayed
- **Navigation** allows users to expand or explore greater levels of detail in the displayed data
- **Animation** especially useful for temporal data
- **Sequence:** predefined series of angles to build a story
- **Contribution:** incorporation of user input

INFORMATION VISUALISATION: INTERACTIVITY

Presentation Adjustments:

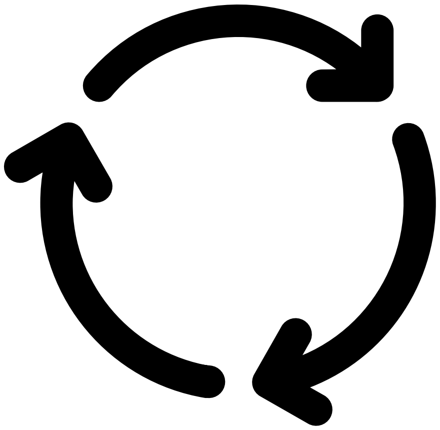
- **Focus:** what data is visually emphasised and, sometimes, how it is emphasised
- **Annotation** adding extra details through pop-ups / tooltips (e.g. chart annotations: labels, legends, captions)
- **Orientation** providing indications of screen location (eg cursor points)



INFORMATION VISUALISATION: INTERACTIVITY

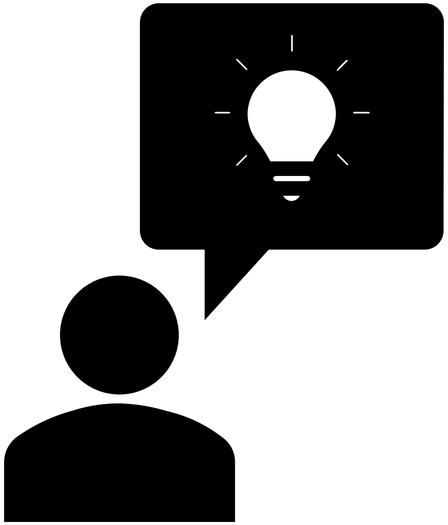
Different interactive features:

- **Events** - input interaction (such as a click)
- **Controls** - applied to a control (maybe a button) or element on your display
- **Functions** - the resulting operation that is performed (e.g. filter the data)

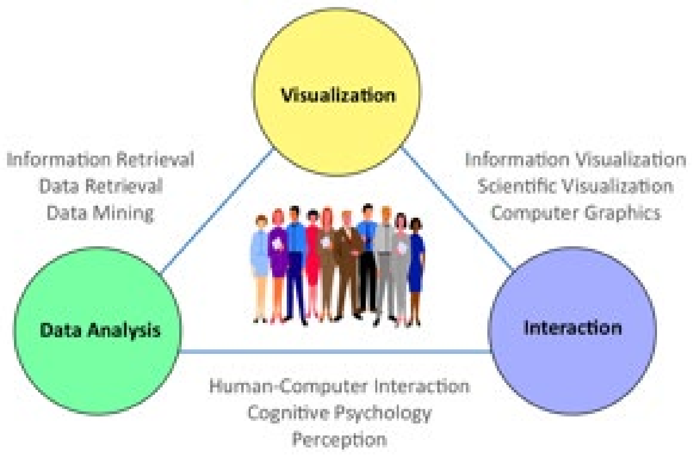


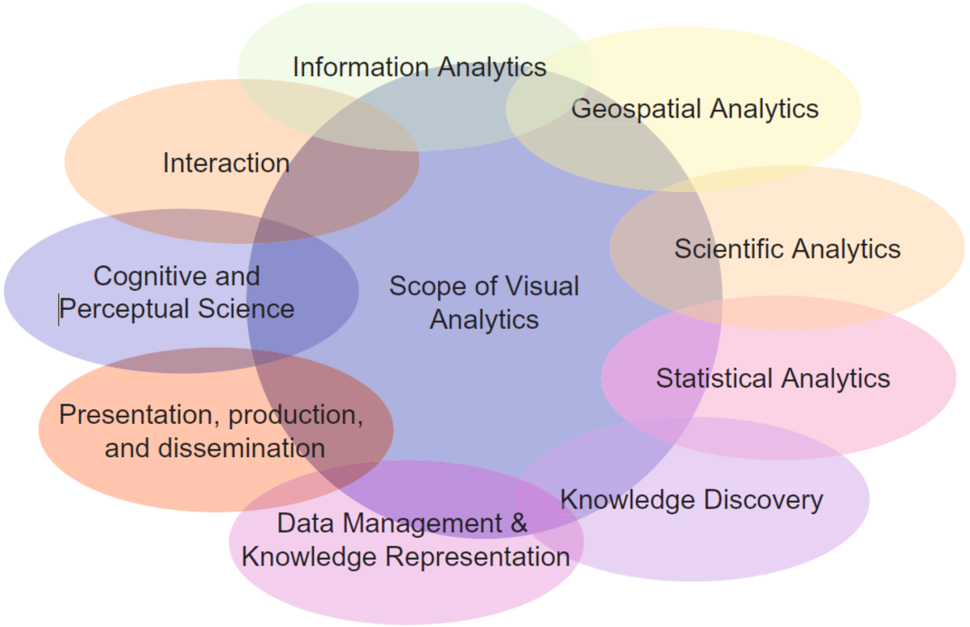
VISUAL ANALYTICS

- "Combines automated analysis techniques with interactive visualisations for effective understanding, reasoning, and decision making on the basis of very large and complex data sets" (Keim et al, 2008)
- "Visual analytics combines automatic and visual analysis methods with **human interactive** exploration." (Keim et al, 2008)



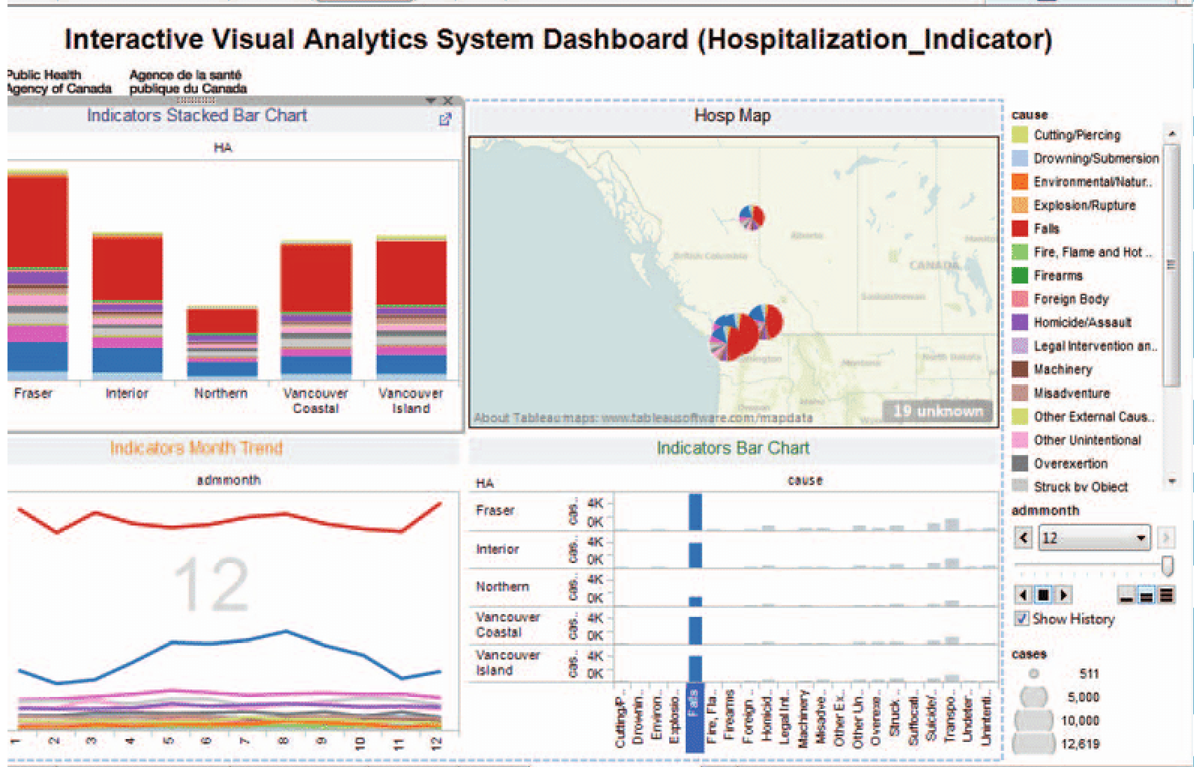
Visual Analytics

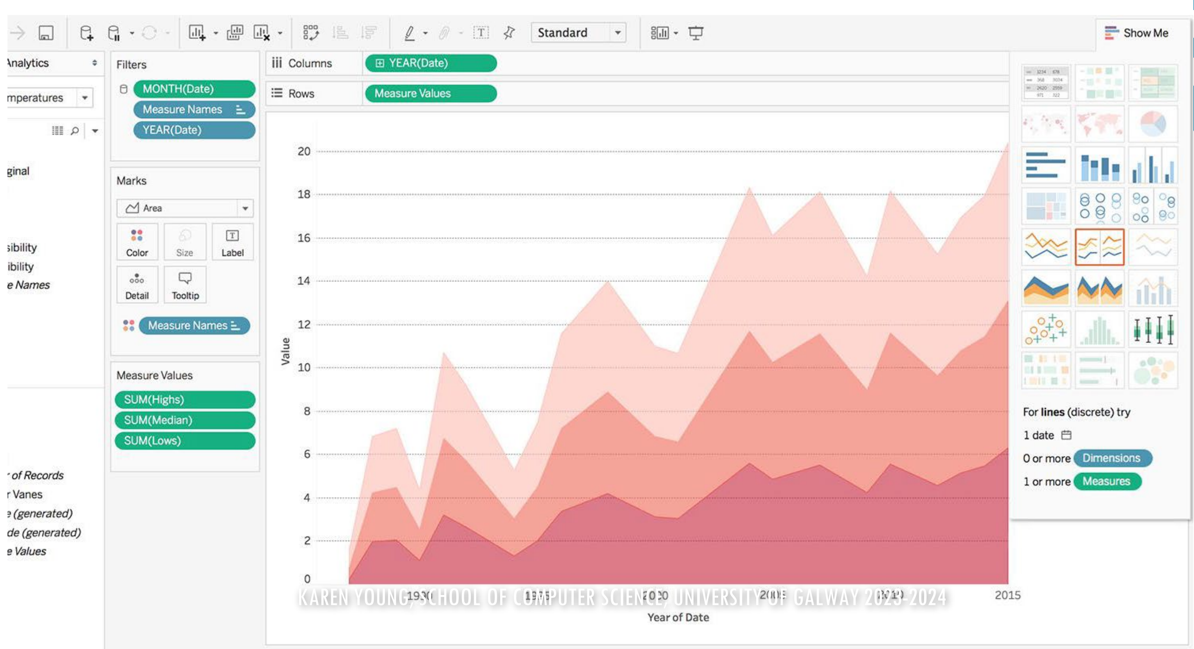




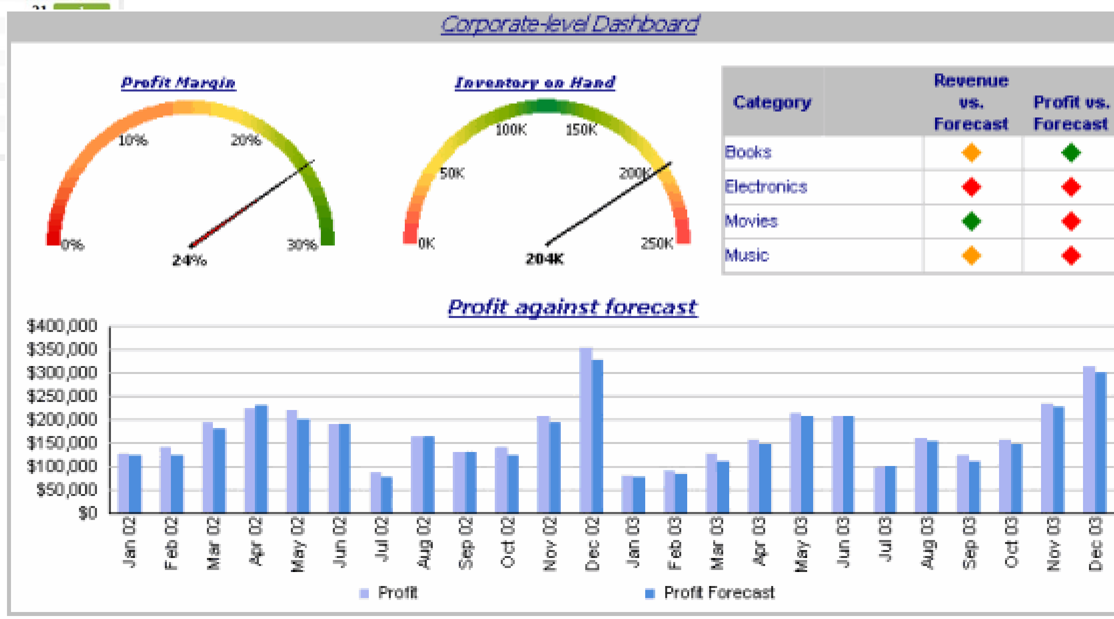
https://visual-analytics.eu/faq/

VISUAL ANALYTICS: WHAT TO SHOW?





Dashboard Examples



3. UNDERSTANDING: SENSEMAKING, STORYTELLING

UNDERSTANDING?

Figure it Out: Getting from information to understanding (Anderson & Fast):

- **Foraging:** Locating resources that will lead to understanding
- **Tuning:** Adjusting resources to align with desired understanding
- **Externalizing:** Moving resources out of the head and into the world
- **Constructing:** Forming new knowledge structures in the world

FORAGING

Foraging happens anytime we need information from the world, in any form, to accomplish a task:

- Searching: To look for, or locate the position of, resources in the world
- Probing: To acquire more detailed information from the world
- Animating: To initiate, and optionally, control motion in a resource
- Collecting: To gather resources for future use

TUNING

Tuning happens whenever you adapt a resource to your own needs

- Cloning: To create an identical copy of a resource
- Collecting: To gather resources for future use
- Cutting: To remove unwanted resources
- Filtering: To expose, conceal, or transform parts of a resource that have certain characteristic

EXTERNALISING

The point of externalizing, as an interaction, is to add information to the world:

- Annotating: To add useful markings and meta-information to a resource
- Linking: To establish relationships between resources
- Generating: To create new information structures in the world

CONSTRUCTING KNOWLEDGE

Constructing is how we assemble new shapes, using the information at hand to fashion meaningful structure

- Chunking: To group independent yet related resources into a unified structure
- Composing: To create a new resource by assembling other resources into a meaningful structure
- Fragmenting:To dismantle a resource into its component parts
- Rearranging: To alter the position of a resource or the elements within
- Repicturing: To convert a resource from one form, or shape, into another.

HOW TO SUPPORT SENSEMAKING?

"Algorithmic thinking uses artificial intelligence to break things down so they can be analyzed. Sensemaking—using "human intelligence to develop a sensitivity toward meaningful differences—what matters to other people as well as ourselves," connects things and puts them in context."

(Madjsberg, 2017)

HOW TO SUPPORT SENSEMAKING?

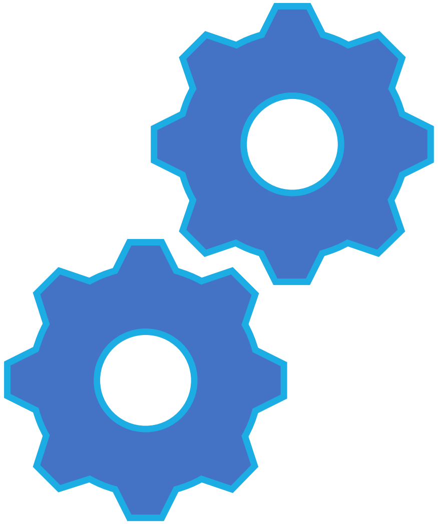
- Sensemaking activities: not pre-defined, goals formed during ongoing discourse between the user and the information
- Interaction: Dynamic, Engagement
- Interaction design decisions influence goal formation, task performance and ultimate performance

INFORMATION VISUALIZATION TOOLS

PROGRAMMING LANGUAGES

- Advantages: Complete control, usually free
- Disadvantages: Learning Curve

- Examples:
  - D3.js
  - R
  - Python Processing

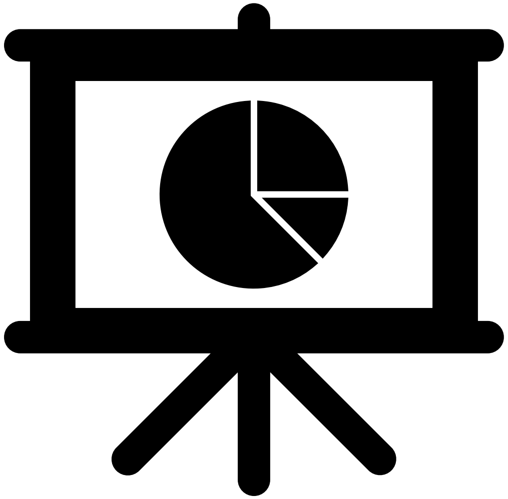


D3.JS

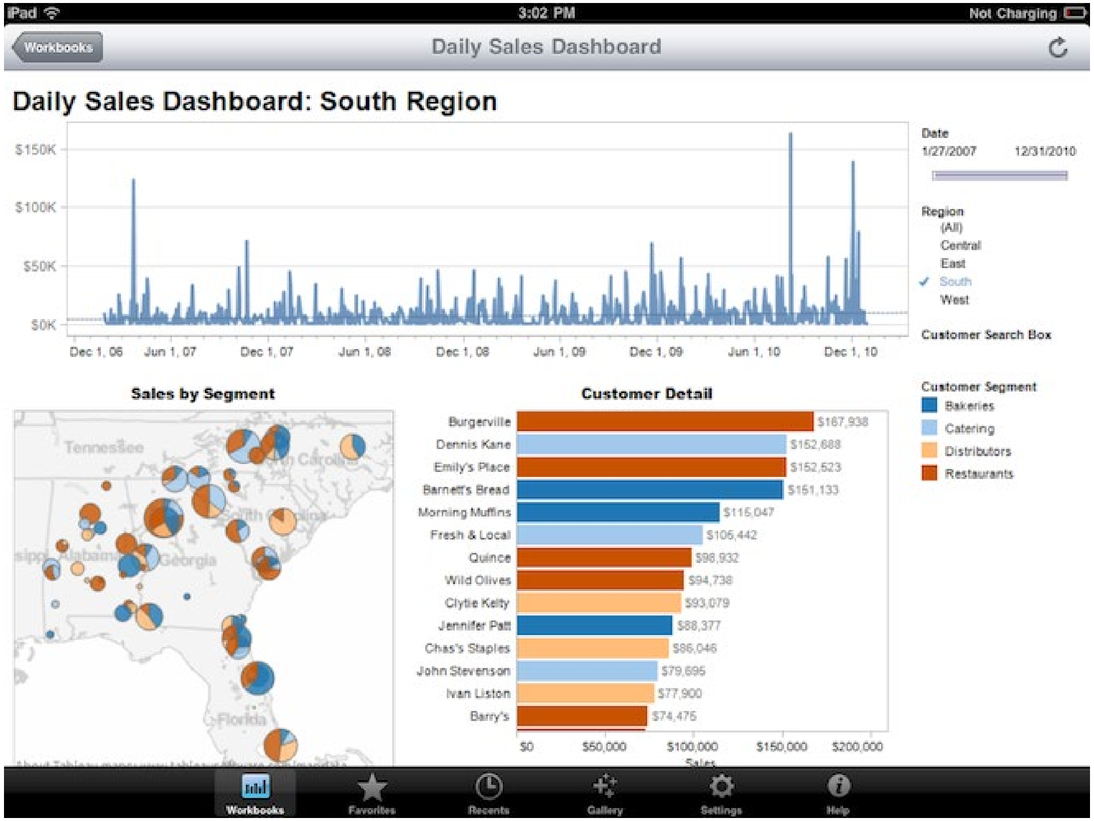

Box Plots
Bubble Chart
Bullet Charts
Calendar View
Non-contiguous Cartogram
Chord Diagram
Dendrogram
Force-Directed Graph
Circle Packing
Population Pyramid
2000
Stacked Bars
Streamgraph

SOFTWARE PACKAGES

- Advantages: Easy to use, predetermined charts
- Disadvantages: Less control, potentially expensive (though a number offer free basic versions or academic licenses)
- Examples:
  - Tableau
  - Microsoft BI
  - Qlik
  - PlotLy



TABLEAU



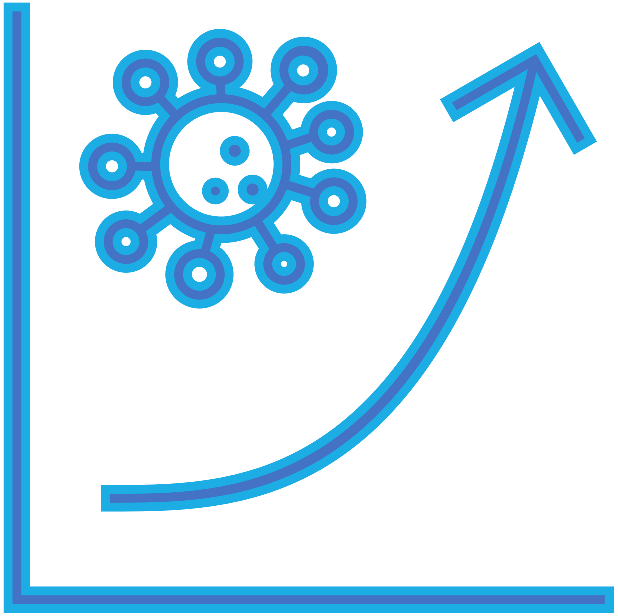
iPad
3:02 PM
Not Charging
Workbooks
Daily Sales Dashboard
Daily Sales Dashboard: South Region
$150K
$100K
$50K
$0K
Dec 1, 06
Jun 1, 07
Dec 1, 07
Jun 1, 08
Dec 1, 08
Jun 1, 09
Dec 1, 09
Jun 1, 10
Dec 1, 10
Date
1/27/2007
12/31/2010
Region
(All)
Central
East
South
West
Customer Search Box
Sales by Segment
Tennessee
Alabama
Georgia
Florida
Customer Detail
Burgerville $167,938
Dennis Kane $152,688
Emily's Place $152,523
Barnett's Bread $151,133
Morning Muffins $115,047
Fresh & Local $106,442
Quince $98,932
Wild Olives $94,738
Clytie Kelty $93,079
Jennifer Patt $88,377
Chas's Staples $86,046
John Stevenson $79,695
Ivan Liston $77,900
Barry's $74,475
$0
$50,000
$100,000
$150,000
$200,000
Customer Segment
Bakeries
Catering
Distributors
Restaurants
Workbooks
Favorites
Recents
Gallery
Settings
Help

INFORMATION VISUALISATION: PROCESS

Information Visualisation Process:
(“Introduction to Information Visualization” Riccardo Mazza)

1. Define the **problem**
2. Define the **data** to be represented: quantitative, ordinal (intrinsic order), categorical
3. Define the **dimensions** required to represent the data: dependent variables against independent variables:

   - Univariate: single dependent variable
   - Bivariate: two dependent variables
   - Trivariate: three dependent variables
   - Multivariate: more than three dependent variables

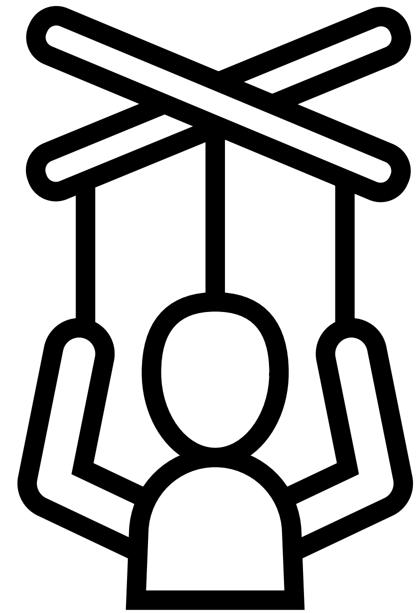


INFORMATION VISUALISATION

4. Define the structures of the data: how datasets relate to each other: linear, temporal, spatial, hierarchical, networked

5. Define the interaction required from the visualization:

> **Static models:** “as is”, e.g. maps in a Road Atlas
>
> **Transformable models:** user can transform/modify data
>
> **Manipulable models:** user has control over the generation of views, zooming in/out, rotating etc.



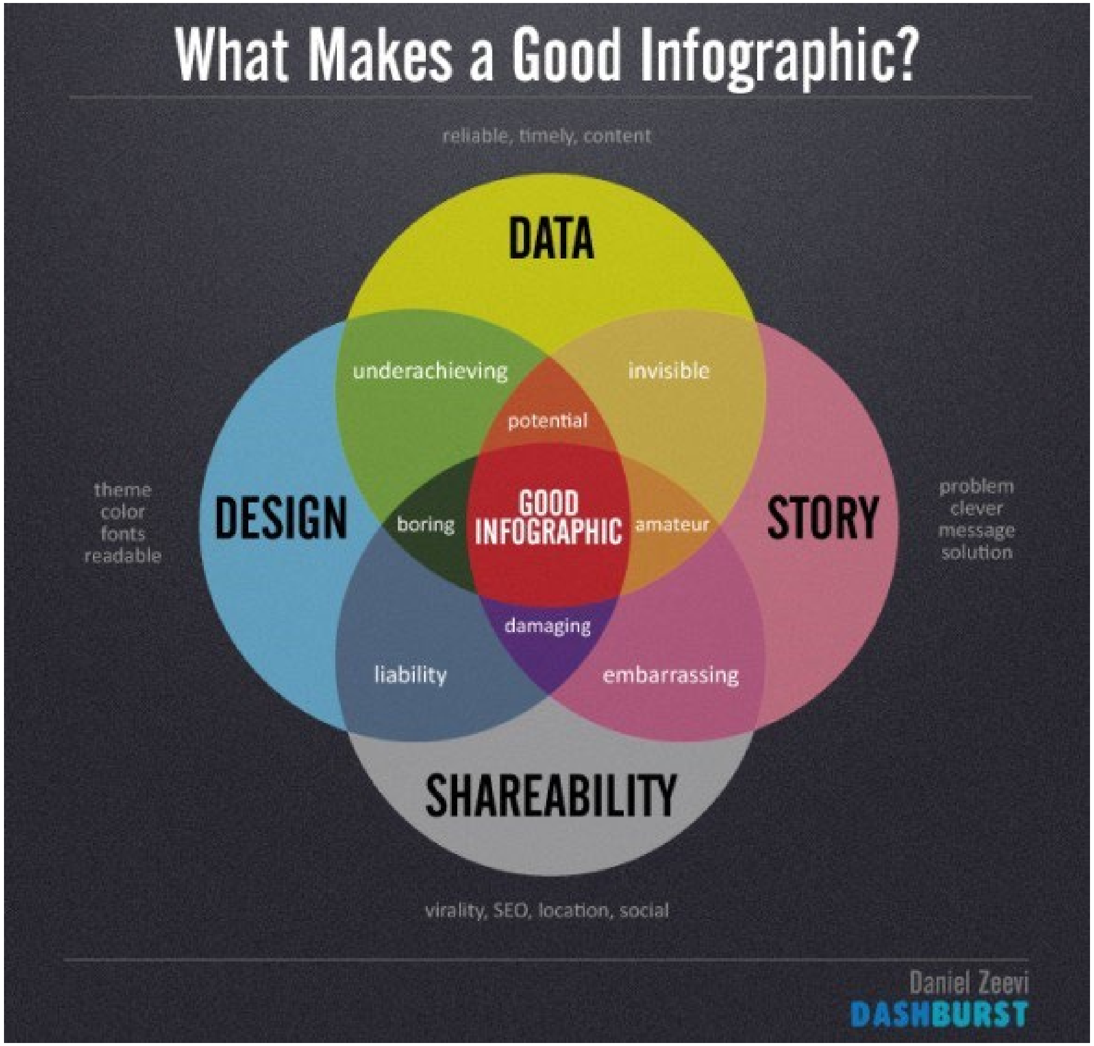
INFORMATION VISUALISATION

Good Visualisation is always about **compromise**

Good Visualisation is always about **good decisions**: you need to be familiar with all your options (things you could do) and aware of the things that will influence your choices (things you will do)

Examples? Elections; Covid-19?

INFORMATION VISUALISATION



HCI: LECTURE 9 REVIEW

- DESIGN THINKING 4: PROTOTYPE (Information Design)
  - Information Visualisation
    - Perception: Representation
    - Interpretation: Interaction, Analysis
    - Understanding

- LECTURE 10: Evaluation

HUMAN COMPUTER INTERACTION

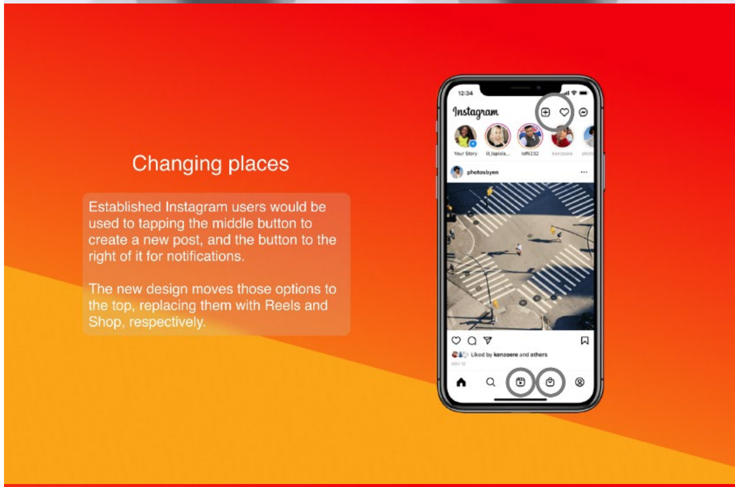
Lecture 10 Overview: Evaluation

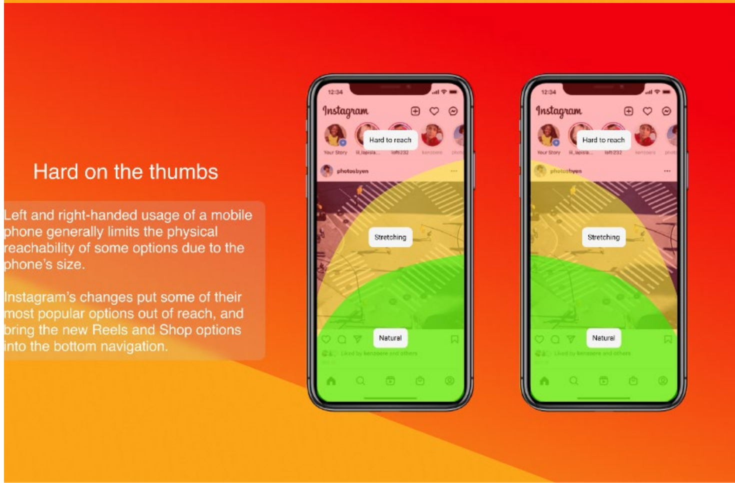
- Challenges of Evaluation
- Evaluation: Methods & Measures
  - Heuristics
  - Usability
  - Experiments
- Evaluation Results
- Evaluation Framework: DECIDE

WHY?

EVALUATION: RATIONALE

- Why evaluate? We already know what works and what doesn't, what users like and don't?
- Established products / platforms: strong user base, why evaluate?
- Examples:
  - PS 5: Inserting Disc
  - Instagram: Reels & Shopping
  - Other?





EVALUATION

- HCI is difficult to design
- Content, meaning, insight, experience central to design success, not technology: these are central competences for designers
- Designers can fail to evaluate objects objectively
- Evaluation needs to be frequent & varied
- Key Questions:
    - Why? What? Who? Where? When?

and then

  - How?

EVALUATION: CHALLENGES

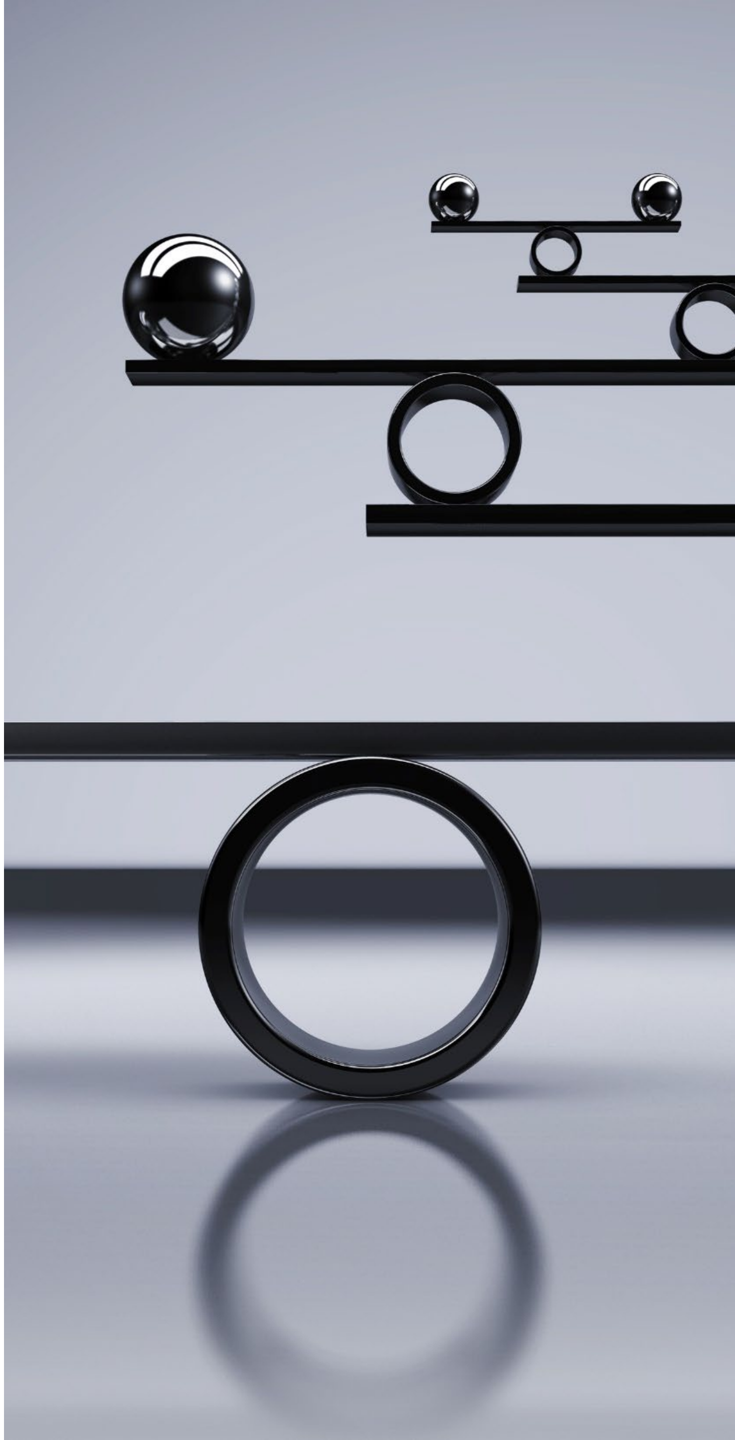
- Evaluation viewed as common sense: assumptions
- Purpose of evaluation: Goals - Users or Business Need?
- Easier to build this way: human factors come first
- Testing on yourself: you are not typical
- Evaluation is carried out on wrong people - non-representative
- Lack of time to conduct evaluations or consider evaluation results
- No universal measure of usability

WHAT?

WHAT TO EVALUATE?

- Useful
- Usable: Usability
- Findable
- Credible
- Desirable
- Accessible
- Valuable

(Peter Morville)

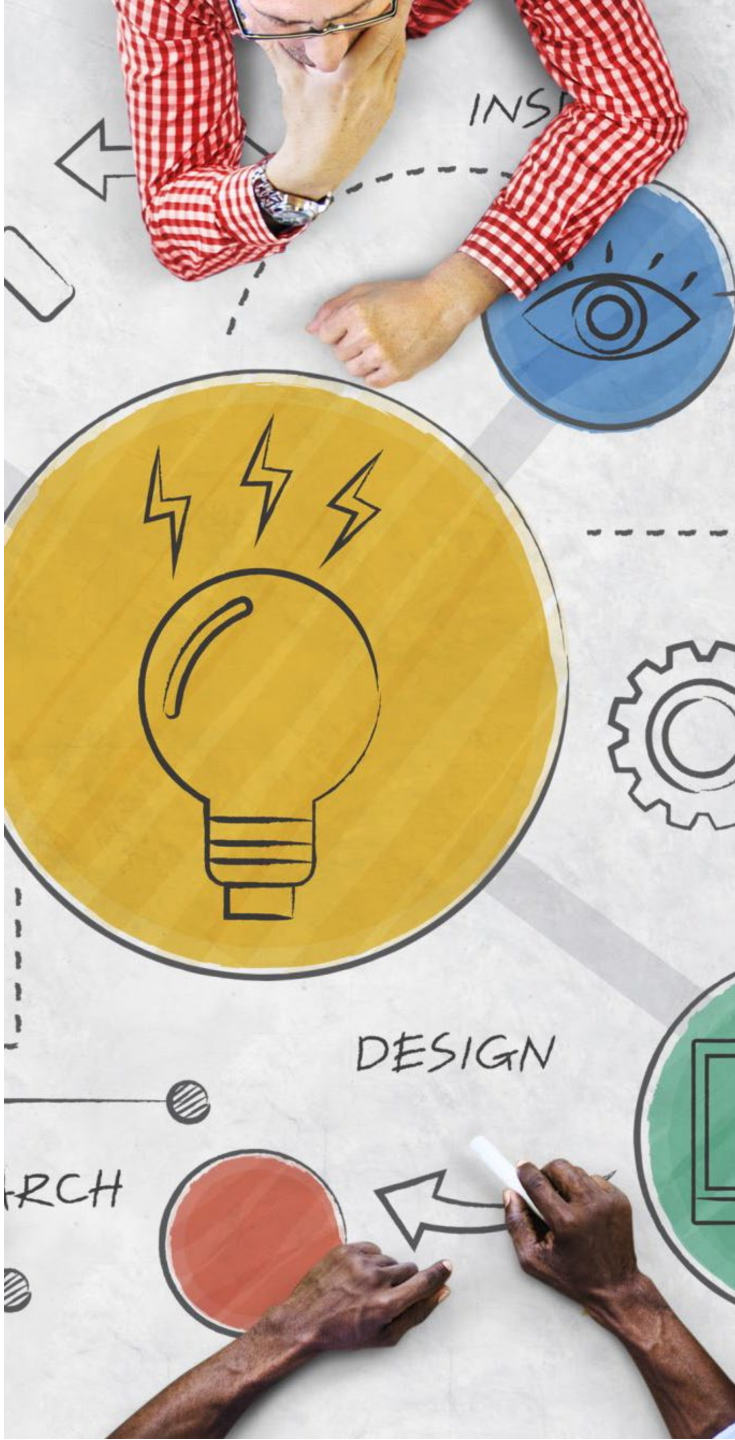


WHAT TO EVALUATE?

- Usability: Property of System or Usage?
- Essential (homogeneous) Vs. Relational (heterogeneous)
- System or Interaction?
- User Interaction:
  - Cognitive
  - Social
  - Affective
  - Physical
  - All of the above: UX

WHAT TO EVALUATE?

- Artefact: design idea or prototype or system
- System Usability:
  - Effectiveness: Usefulness, Usability
  - Efficiency
  - User Satisfaction: UX, Used
- Data:
  - Quantitative
  - Qualitative



WHAT TO EVALUATE?

- You can't test everything!
- How do you decide what to test?
- Testing Goals: Prioritise
  - Can you change it?
  - Risk
  - Business Impact
  - User Impact

HOW?

EVALUATION METHOD CHOICE

- Design Vs Implementation
- User Vs Expert
- Laboratory Vs Field study (control Vs naturalness)
- Response: Immediate vs Delayed

EVALUATION METHOD CHOICE

- Evaluation Technique:
  - Subjective vs Objective
  - Quantitative vs Qualitative measure
  - Information Provided (detail (font) vs general (usability))
  - Immediacy of Response
  - Intrusiveness
  - Resources

EVALUATION TECHNIQUES

- Critique: Heuristics
- Query techniques (& Analytics)
- Observational techniques
- Experimental designs
- Monitoring physiological responses

EVALUATION METHODS

Method	Controlled settings	Natural settings	Without users
Observing	x	x	
Asking users	x	x	
Asking experts		x	x
Testing	x	x	
Modeling			x

EVALUATION: HEURISTIC

- General principle or rule of thumb
- An inspection-based technique for identifying usability problems in UI's
- Nielsen & Molich (1990): qualitative critique of a system using a set of relatively simple & general heuristics
- Excellent for earlier designs; high impact for low cost
- How? - Several independent evaluators critique a system – twice – to identify potential usability problems
- No evaluator finds everything; some find more than others

EVALUATION: HEURISTICS

When to Critique?

- Before user Testing: pick up small problems before users
- Before Redesigning: what works and what needs to change
- Provide Evidence: articulate problems, ammunition for redesign
- Before Release: smooth product before release

EVALUATION: HEURISTICS

- Kritsch evaluated 10 Heuristic Frameworks; 91 heuristics (UXDesign.com)

- 6 Usability Components:

1. Learnability: referenced by 35% of all usability attributes (6.5 of 10 frameworks)
2. Efficiency: referenced by 24%
3. Satisfaction: referenced by 21%
4. Utility: referenced by 7%
5. Errors: referenced by 9%
6. Memorability: referenced by 4%

EVALUATION: HEURISTICS

- Which framework? Nielsen: holistic
- Mix and match heuristics. Add, remove, validate, adjust for specific use cases and domains.

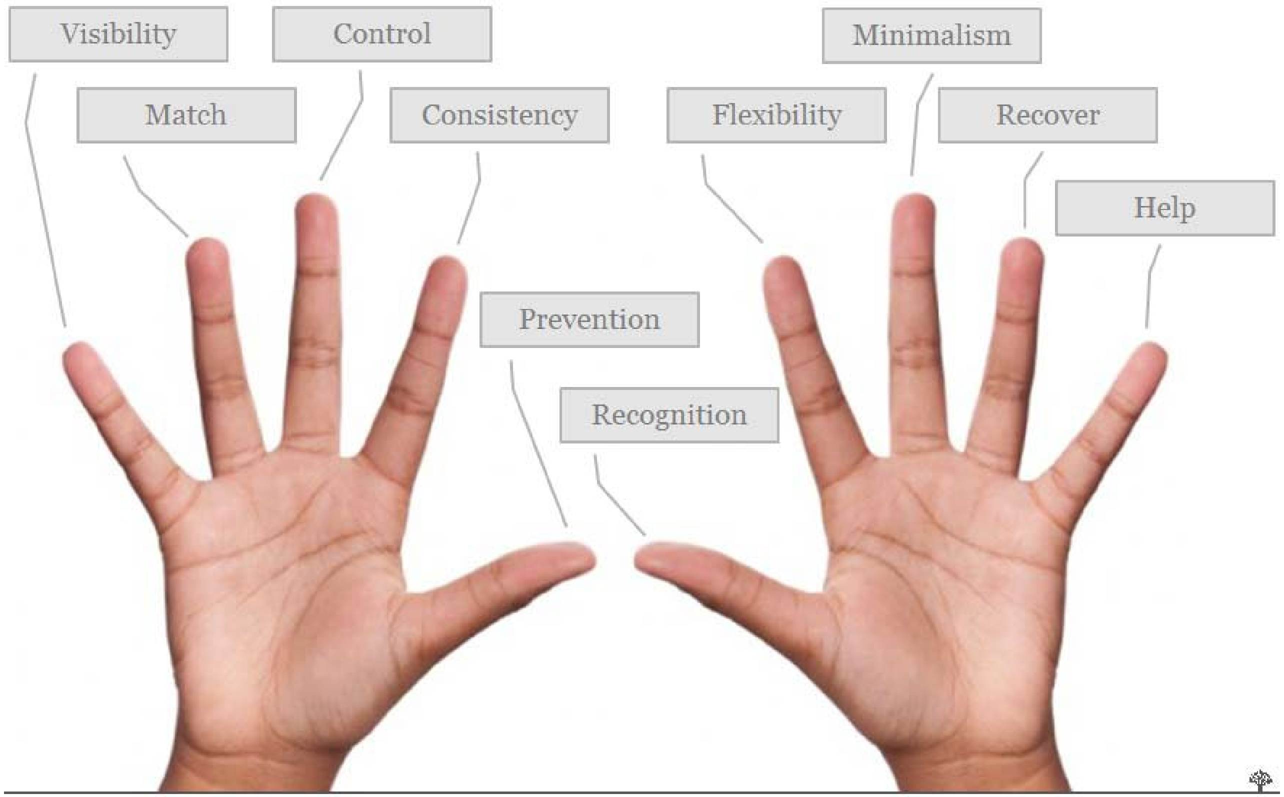
- Use Rams to improve user **Satisfaction**
- Use the **Learnability** frameworks to focus evaluation efforts around intuitiveness (Bastien & Scapin, ISO, Kaniasty, Nielsen, Shneiderman, SUS, or Bouccher)
- Try the System Usability Scale for a quick, **quantifiable review** with a Learnability focus
- Boucher's criteria for a simplified and balanced evaluation of **Efficiency** and **Learnability**

EVALUATION: HEURISTIC

Ten Heuristics (Nielsen):

1. **Visibility** of system status
2. **Match** between system and real world
3. User **control** and freedom
4. **Consistency** and standards
5. **Error prevention**
6. **Recognition** rather than recall
7. **Flexibility** and efficiency of use: shortcuts
8. **Aesthetic** and minimalist design
9. Help users recognize and **recover** from **errors**
10. **Help** and documentation

https://www.nngroup.com/articles/ten-usability-heuristics/



EVALUATION: HEURISTIC

KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY, 2023-2024

EVALUATION: HEURISTIC

- Severity ratings: 4: catastrophic – 1: cosmetic

    4 – usability catastrophe

    3 – major usability problem

    2 – minor usability problem

    1 – cosmetic problem only

    0 – this is not a usability problem

- Number of evaluators?

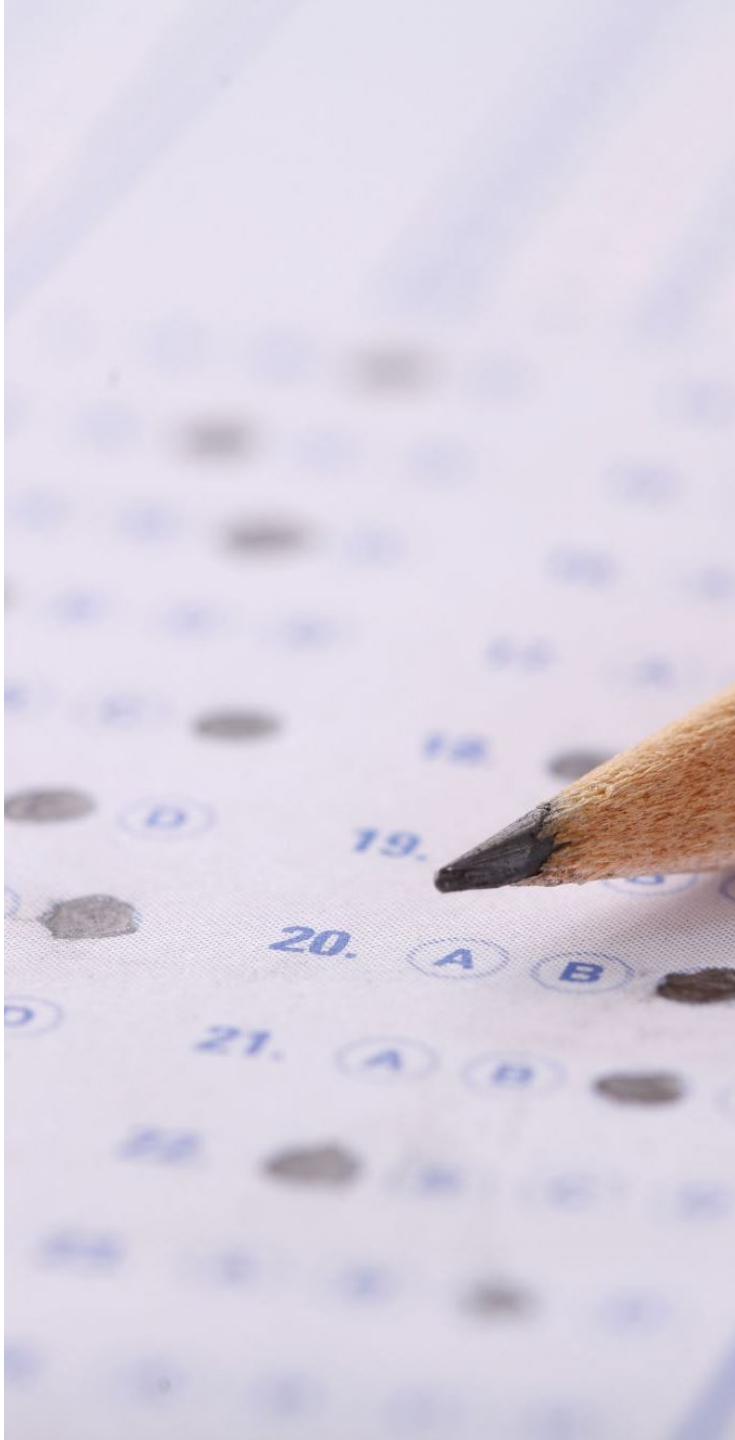
    1: 35% of problems found

    3-5: 65-75% of problems found

    Diminishing returns thereafter

QUERY: SURVEY

- Time consuming to produce and must be done correctly
- Once produced - can provide a vast body of information
- Good for attitude measurement across large groups
- Good design:
  - Mixture of open & closed questions
  - Structure questions carefully: general to detailed
  - Not too long
  - Try it out prior to its actual use
- Problems: loaded terms; suggested responses; lack of precision; subject embarrassment



QUERY: INTERVIEW

Interviews:

- More active user involvement
- More exploration, richer data
- Self report data
- Structured / Unstructured
- More time consuming to conduct
- Evaluator experience / bias
- More difficult to analyse

SELF-REPORT SOFTWARE INSTRUMENT: PREMO

- PrEmo is a non-verbal self-report software instrument that measures 14 emotions that are often elicited by product design
- Emotional responses difficult to measure because their nature is subtle (low intensity) often mixed (i.e. more than one emotional response at the same time)
- Does not rely on words
- Each of the emotions is portrayed by an animation of dynamic facial, bodily, and vocal expressions
- For use in internet surveys, formal interviews, and qualitative interviews, e.g., to identify the concept with the most pleasant emotional impact as a discussion tool in consumer interviews

EVALUATION ANALYTICS: PREMO

KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY, 2023-2024

ANALYTICS

- **ESM**: Experience Sampling Method
- A set of methods designed to repeatedly request people to document and report their thoughts, feelings and actions outside the laboratory, within the context of their everyday life
- Sending requests can be timed, random, triggered by context variables or triggered by user actions
- Requests and answers can be sent through a variety of devices (internet, web browser, text messaging on mobile phone, etc.)
- Strengths: Does not depend on recall (no memory effects)
- Provides insights into variability over time
- Weakness: Requires high compliance, high effort (interferes with activity)

OBSERVATIONAL STUDIES

- Important not to disturb the way an individual works on a task - watch extraneous conditions: Hawthorne effect
  - Clear Goals: scope, hypothesis?
  - Ethics: consent, stress, time limit
  - Pilot your study: ideally two pilots: colleague, one real user
  - Collect your results: co-operative evaluation, thinking aloud?
  - Debrief: holistic review
- Examples?

THINKING-ALOUD (MONK ET AL)

- One popular and successful method is the ***Thinking-Aloud*** method (Monk et al)
- Really powerful insights
- Users perform tasks - you monitor/observe their performance and thought processes while doing tasks
- Need to prompt people: not natural
- Decide ahead of time what you will and won't help on
- Try to avoid specific questions
- Not useful for collecting numeric task completion data: delays user in task
- Also can use usability labs - with outside observers

CO-OPERATIVE EVALUATION

- A procedure that encourages collaboration between users and designers: users ask evaluator questions and evaluator questions them about their understanding, thought processes etc.
- Natural process: work through a set of tasks
- Identify most important improvements to consider
- Steps:
  - Recruit users
  - Prepare tasks
  - Interact and record
  - Debrief users
  - Summarise your observations

USABILITY TESTING

- Goals & questions focus on how well users perform tasks with the product
- Comparison of products or prototypes is common
- Focus is on time to complete task & number & type of errors
- Data collected by video & interaction logging
- User satisfaction questionnaires & interviews provide data about users’ opinions

USABILITY PRINCIPLES

- Similar to design principles, except *more prescriptive*
- Used mainly as the basis for evaluating systems
- Example principles:
  - Visibility of system status
  - Match between system and the real world
  - Consistency and standards
  - Error prevention
  - Recognition rather than recall
  - Flexibility and efficiency of use

USABILITY?

"However, the reality is that we all continue to experience frustrations when using interactive digital technologies, and often we would say that we do find them difficult to use. ***Even so, frustrating user experiences may not be due to some single abstract construct called 'usability', but instead be the result of unique complex interactions between people, technology and usage contexts.*** Interacting factors here must be considered together. It is not possible to form judgements on the severity of isolated usage difficulties, user discomfort or dissatisfaction. Overall judgements on the quality of interactive software must balance what can be achieved through using it against the costs of this use. There are no successful digital technologies without what could be usability flaws to some HCI experts (I can *always* find some!). Some technologies appear to have severe flaws, and are yet highly successful for many users. Understanding why this is the case provides insights that move us away from a primary focus on usability in interaction design." (Cockton)

USABILITY ENGINEERING

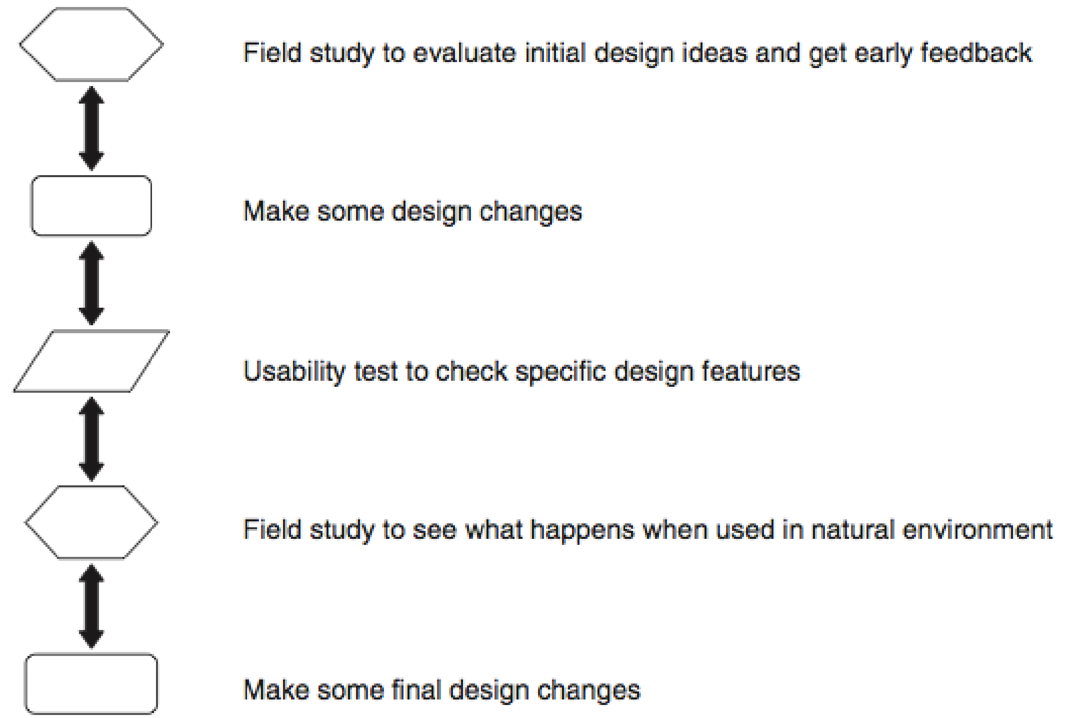
- All design decisions should be conscious and visible
- Need ways to measure results against agreed criteria
- Requires the adoption of a good list of attributes that are measurable
- Usability specification will state how criteria will be measured, what they are, what the pre-conditions are
- Should also specify worst case, lowest acceptable level, planned case, best case and “now” level

USABILITY CHECKLIST

Usability checklist (learnability, throughput, satisfaction):

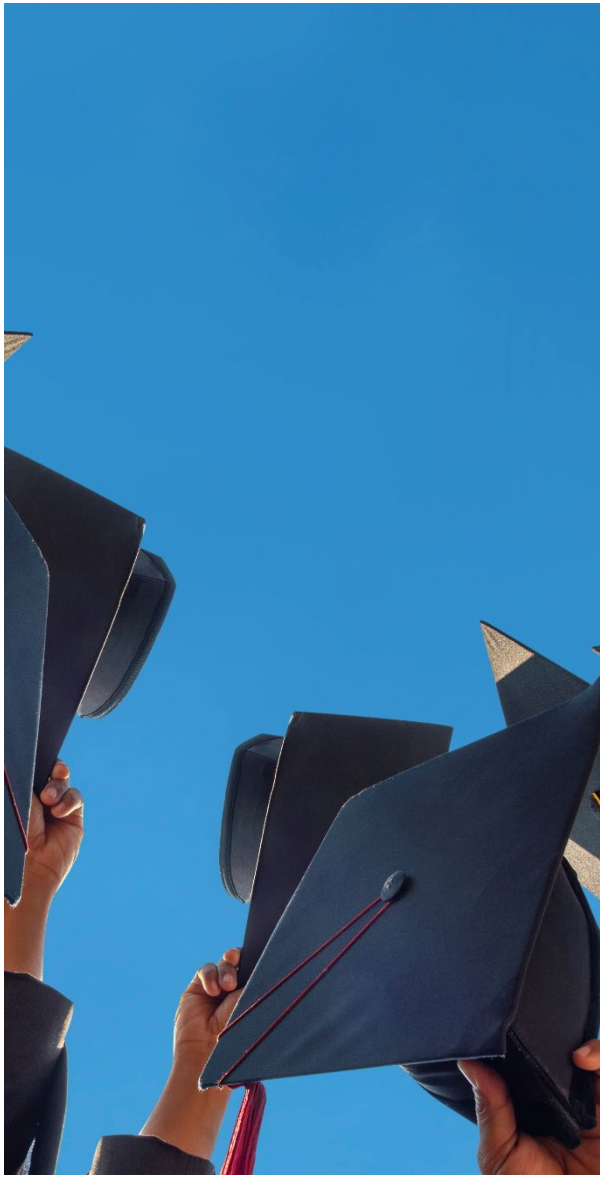
- Time taken to complete the task
- Percentage of task completed
- Ratio of success to failure
- Time spent dealing with errors
- Use of help and on-line documentation: frequency
- Percentage of favourable/unfavourable user comments
- Number of repetitions or failed commands
- Number of commands not used
- Number of good features recalled by user

USABILITY & FIELD STUDY



USABILITY: USERS?

- Graduating Users: Beginners to Intermediate to Expert
- "*Information in the world and information in the head*"; Donald Norman, *DOET*
- ***World vectors*** are required by beginners and more expert users for advanced or seldom-used functions
- ***Head vectors*** are used extensively by intermediates and even moreso by experts
- New users happy with world vectors, but as they progress they develop working sets: provide a head vector as well as world vector, and a path by which user can learn head vector



EVALUATION: EXPERIMENTS

- Controlled evaluation of specific aspects of interactive behaviour
- Hypothesis: chosen by evaluator
- Subjects?
- Variables: Independent (controlled by evaluator), Dependent
- Experiment Design: Comparative/ Absolute
  - Identify the problem and formulate hypothesis
  - Design & execute experiment
  - Examine data from experiment
  - Communicate the results

COMPARATIVE EVALUATION

- Is Interface X better than Interface Y?
- What is ***better***?
- Answer: “it depends”
- What does it depend on?
- Dependent Variables: Measures:
  - Time
  - Errors
  - Recall
  - Conversions (purchases)
  - Emotional response

EVALUATION: EXPERIMENTS

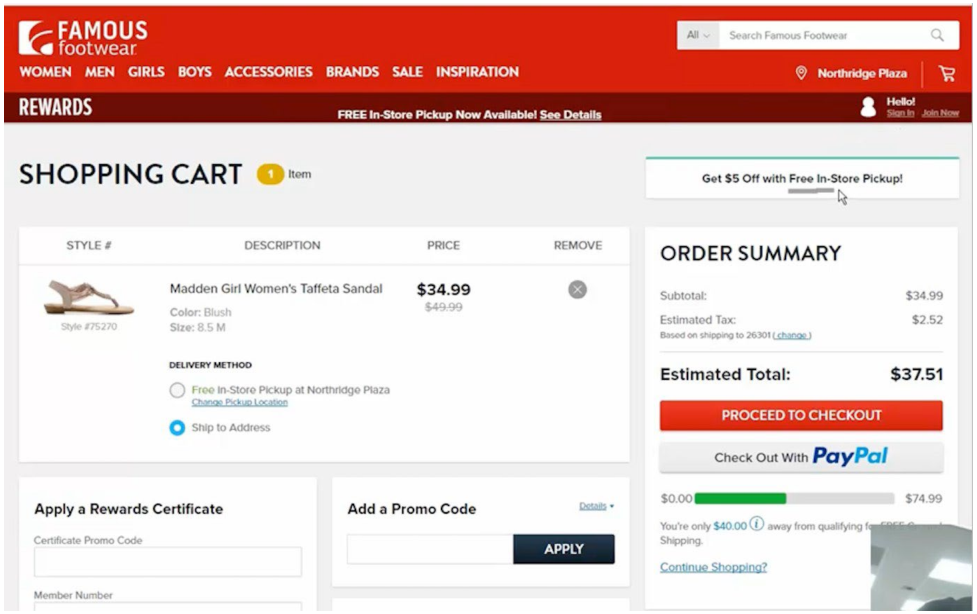
- **Manipulations** (independent variables – controlled by experimenter; e.g. colour, size)
- **Measures** (dependent variables; e.g. duration, errors, feelings)
- Problems which can interfere with results:
  - Practice effect
  - Fatigue effect
  - Order effect

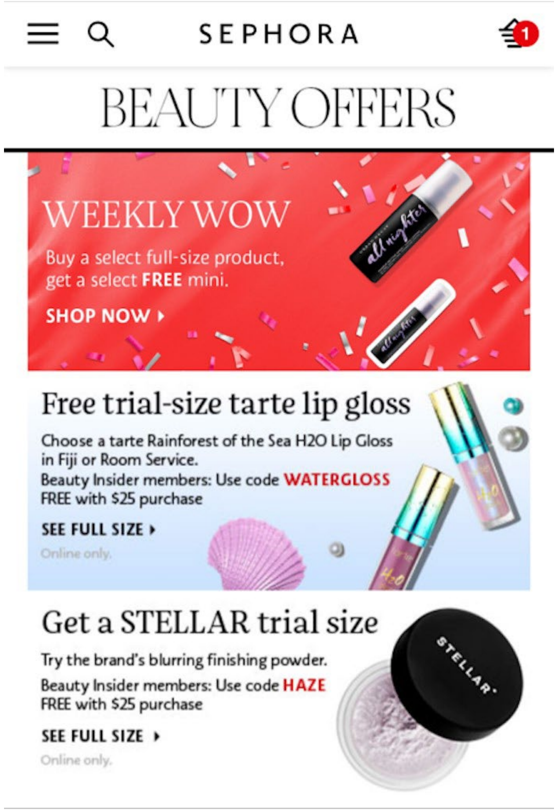
EVALUATION: EXPERIMENTS

- An example: evaluating icon design
- Hypothesis : User will remember the natural icons more easily than the abstract ones
- Null hypothesis: no difference between recall of the icon types
- Between-subjects or Within-subject design? Why?

ONLINE EXPERIMENTS

- Online Experiments: randomly split traffic to website between 2 / more UI versions
- What do you want to measure: meaningful statistics: click throughs, conversions, etc.
- Key Findings:
  - **Commitment Escalation**: ask them to commit a little upfront, then add a little more later
  - Small, insignificant changes: big impact (coupons, company name etc.)
  - Our **expectations** are often wrong: e.g. images preferred over video


FAMOUS footwear
WOMEN MEN GIRLS BOYS ACCESSORIES BRANDS SALE INSPIRATION
Northridge Plaza
REWARDS
FREE In-Store Pickup Now Available! See Details
Hello!
SHOPPING CART 1 Item
Get $5 Off with Free In-Store Pickup!
STYLE # DESCRIPTION PRICE REMOVE
Madden Girl Women's Taffeta Sandal
Color: Blush
Size: 8.5 M
$34.99
$49.99
DELIVERY METHOD
Free In-Store Pickup at Northridge Plaza
Ship to Address
ORDER SUMMARY
Subtotal: $34.99
Estimated Tax: $2.52
Estimated Total: $37.51
PROCEED TO CHECKOUT
Check Out With PayPal
$0.00 $74.99
Continue Shopping?
Apply a Rewards Certificate
Certificate Promo Code
Member Number
Add a Promo Code
APPLY


SEPHORA
BEAUTY OFFERS
WEEKLY WOW
Buy a select full-size product, get a select FREE mini.
SHOP NOW
Free trial-size tarte lip gloss
Choose a tarte Rainforest of the Sea H2O Lip Gloss in Fiji or Room Service.
Beauty Insider members: Use code WATERGLOSS
FREE with $25 purchase
SEE FULL SIZE
Online only.
Get a STELLAR trial size
Try the brand's blurring finishing powder.
Beauty Insider members: Use code HAZE
FREE with $25 purchase
SEE FULL SIZE
Online only.

WEB EVALUATIONS

- Web site evaluations: ready-to-hand measures of web server logs – easy but appropriate?
- What is easy to measure via a web server is rarely what is needed for meaningful relevant user experience evaluation
- **PULSE** measures are Page views, Uptime, Latency, Seven-day active users (i.e. count of unique users who used system at least once in last week), and Earnings.
- Research at Google (Rodden at al, 2010): **HEART** UX measures
- **HEART**: Happiness, Engagement, Adoption, Retention, and Task success

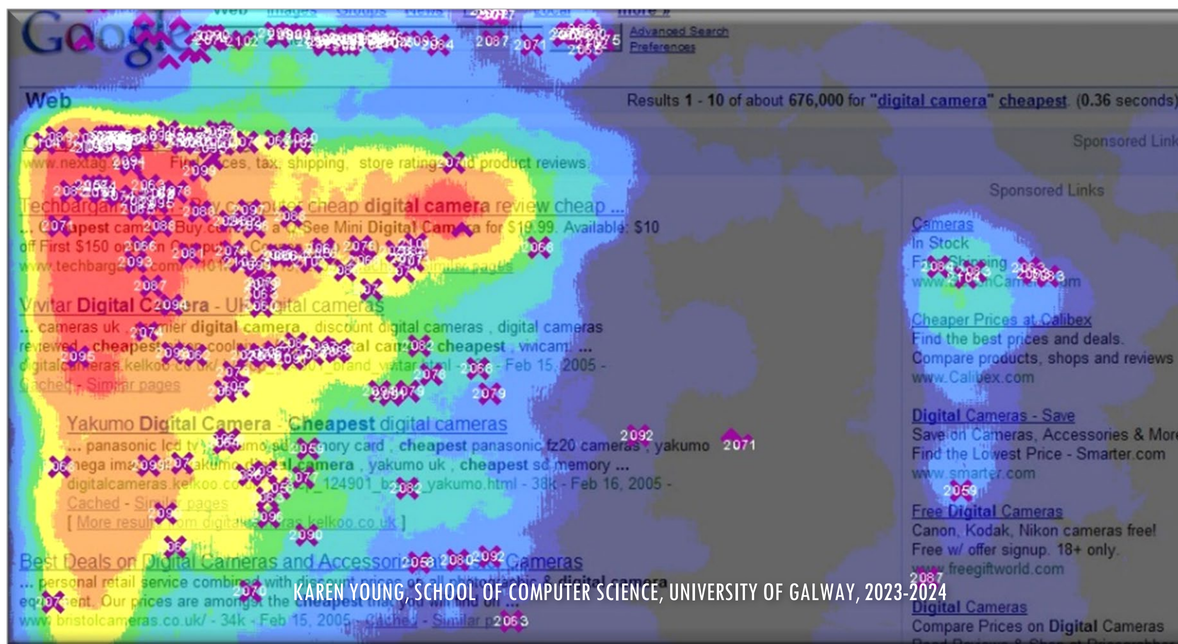
PHYSIOLOGICAL MEASURES

- Physiological measurements: Why?
- Heart activity; blood pressure, volume and pulse
- Activity of the sweat glands; galvanic skin response(GSR)
- Electrical activity in muscle; electromyogram (EMG)
- Electrical activity in the brain; electroencephalogram(EEG)

EYE TRACKING

- High tech method; requires equipment
- Strengths: hard-to-articulate behaviours; compelling visualising data; exciting clients
- Molich (2008: CUE 7 Study): eye tracking did not identify any new issues over inexpensive methods
- Eye tracking: fixations don't communicate meaning: interpretation (where, not why)
- Problems: time, cost, complexity, technical
- Used effectively, can provide insights
- Not essential to usability testing; Decision made according to testing goals and considerations

EYETRACKING



MOBILE EVALUATION

- Mobile usage:
  - Commuting
  - At home
- Drivers for engagement:
  - Daydreaming
  - Quick wins, help me now
  - Monitoring and instant gratification
- Barriers:
  - Security
  - Screen size
  - Connectivity
- Most effective: short, interrupted interactions that can be integrated into routine; time saving or entertainment

RESULTS

EVALUATION: RESULTS

- How to capture evaluation results?
  - What type of data: quantitative (less time consuming), qualitative
  - Note taking: pen & paper, computer
  - Video recording: rich data, can grab success / challenge and share with others, time consuming
  - Screen recording: good for capturing UI, not users' facial expressions
- Debrief users afterwards

EVALUATION: RESULTS

- Observation & interviews:
  - Notes, pictures, recordings
  - Video
  - Logging
- Analyses
  - Categorized
  - Categories can be provided by theory
    - Grounded theory
    - Activity theory

EVALUATION: RESULTS

- What to do with collected evaluation data?
  - What does my data look like?
  - What are overall numbers?
  - Are the differences real: Pearson chi-squared test (discrete rate data), t-tests (continuous), anova tests (> 2 conditions): which vacuum cleaner, which input device is faster for input?
- Use multiple evaluation methods together: combination better than sum of parts

EVALUATION: CONSIDERATIONS

- **Validity**: does the method measure what it is intended to measure?
- **Reliability**: does the method produce the same results on separate occasions?
- **Ecological validity**: does the environment of the evaluation distort the results?
- **Biases**: Are there biases that distort the results?
- **Scope**: How generalizable are the results?

EVALUATION: CHALLENGES

- Evaluation Method
  - Suitability of Method: essential vs. relational
  - Test Environment
  - Completeness of prototype
- Users
  - Previous experience
  - Motivation and interest
  - Sample size
- Evaluators
  - How experience?
  - Are they biased?

DECIDE FRAMEWORK

- Well-planned evaluations are driven by clear goals and appropriate questions
- DECIDE Framework (Preece, Rogers & Sharp):
  - **D**etermine the overall goals the evaluation addresses
  - **E**xplore the specific questions to be answered
  - **C**hoose the evaluation paradigm and techniques to answer the questions
  - **I**dentify the practical issues: e.g. selecting participants, finding evaluators, equipment etc.
  - **D**ecide how to deal with the ethical issues
  - **E**valuate, interpret, and present the data

HUMAN COMPUTER INTERACTION

Lecture 10 Review: Evaluation

- Challenges of Evaluation
- Evaluation: Methods & Measures
  - Heuristic
  - Usability
  - Experiments
- Evaluation Results
- Evaluation Framework: DECIDE

EVALUATION

KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY, 2023-2024

HUMAN COMPUTER INTERACTION

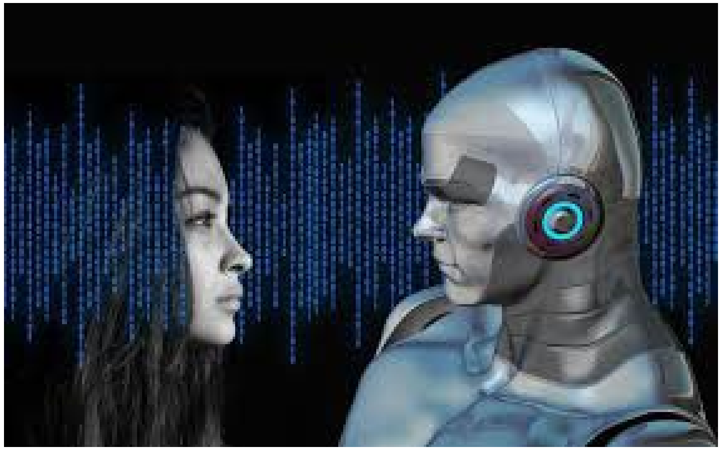
Lecture 11 Overview:

Future Interactions?

- Interactions with? Agents, Avatars, Robots, IOT
- Web 3.0
- XR: AR-MR-VR
- Affective Computing

AGENTS

- Agents: autonomous, active computer processes; communicate with people/agents; adapt their behaviour
- Computers have access to very limited view of people's activities: mouse, keyboard movements?
- Make inferences from collected data
- Metaphors for "agents": travel, real-estate, secret, professional agent, slave
- Two types of Agent:
  - Personalisation agents
  - Domain knowledge agents



AVATARS

- Avatars: translated from *Sanskrit* as incarnation
- Graphical representation of the user or the user's alter ego or character
- 2D: icons in online communities; 3D in games or virtual worlds
- Originated in 1985 by Richard Garriott for the computer game Ultima IV: Quest of the Avatar
- User has emotional, social & ethical connection and responsibility for Avatar

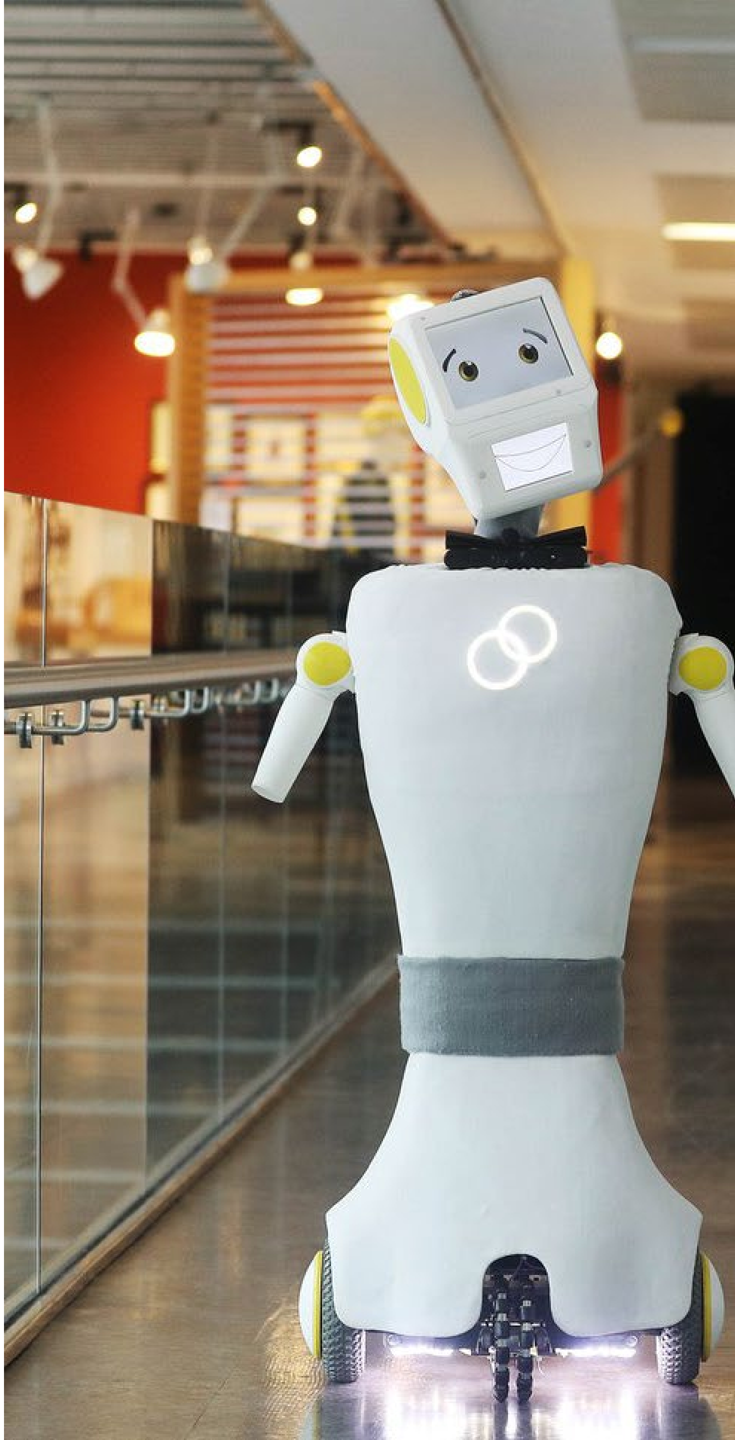



ROBOTS

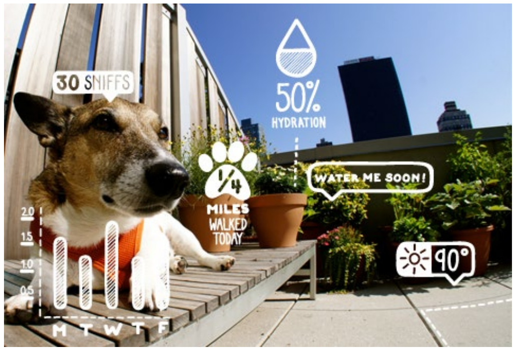
KAREN YOUNG, SCHOOL OF COMPUTER SCIENCE, UNIVERSITY OF GALWAY SEMESTER I 2022-2023

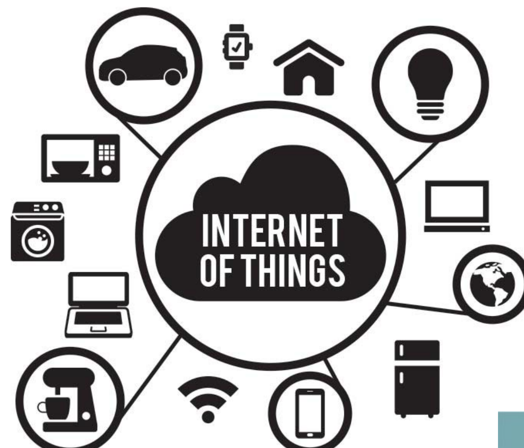
ROBOTS

- Robots: moving target
- Human-Robot interaction?(HRI)
  - Remote investigators of hazardous locations (nuclear power stations, bomb disposal); search & rescue helpers (fires) and far-away places (Mars)
  - Domestic robots that give assistance: robot lawnmowers or vacuum cleaners
  - Provide companionship: Nursebot "Pearl", TCD Stevie (RTE Nov. 2017); Service provision (elderly care) or Social mediation (e.g. autism)
- Ethics of robots that exhibit human-like behaviours?
- TCD Stevie
- Developed to augment not replace human care



Internet of Things





IOT INTERACTIONS

1. Short Form: immediate, urgent issue; 5-15 secs: quick resolution

2. Medium Form: two goals: planning for future events, or changing recurring scheduling; 15-30 secs – more user mental effort

3. Long Form: rare if ever, ideally only performed on initial setup; longer than 30 secs

WEB3?

Web 1.0

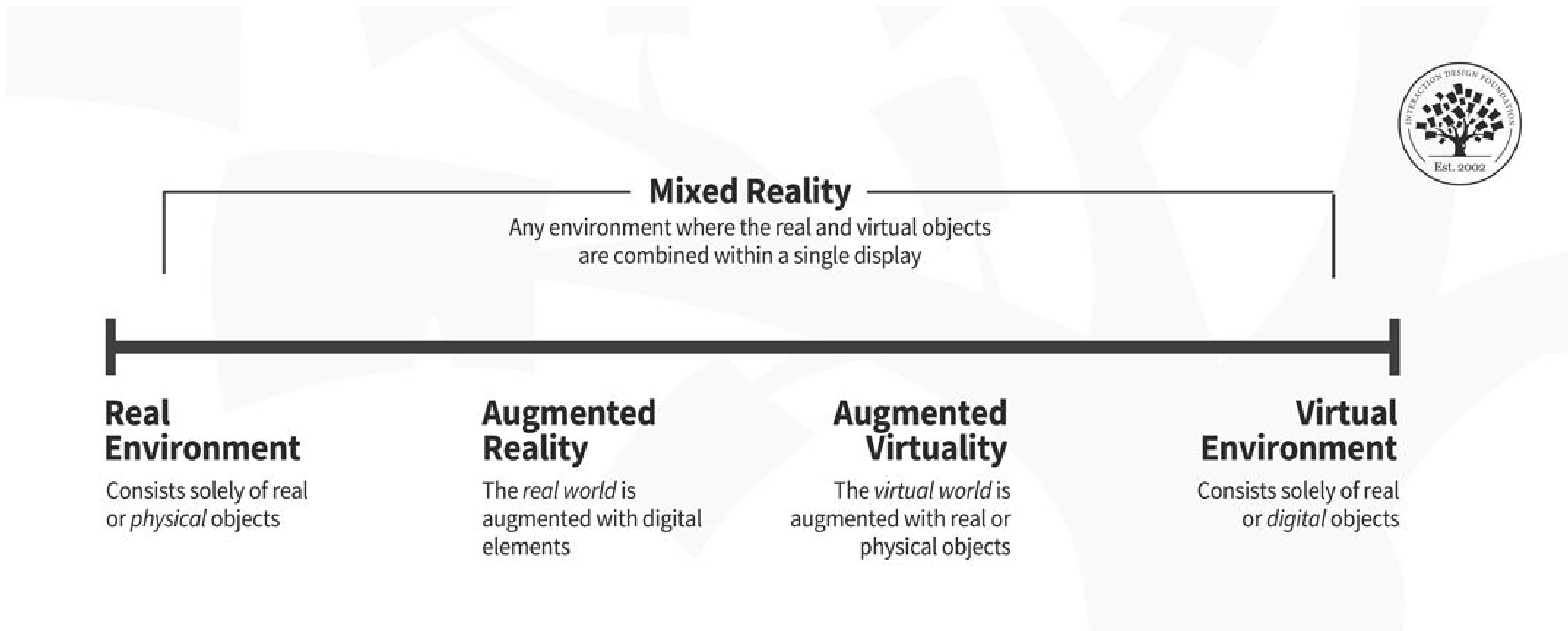
Digital Filing cabinet

Web 2.0

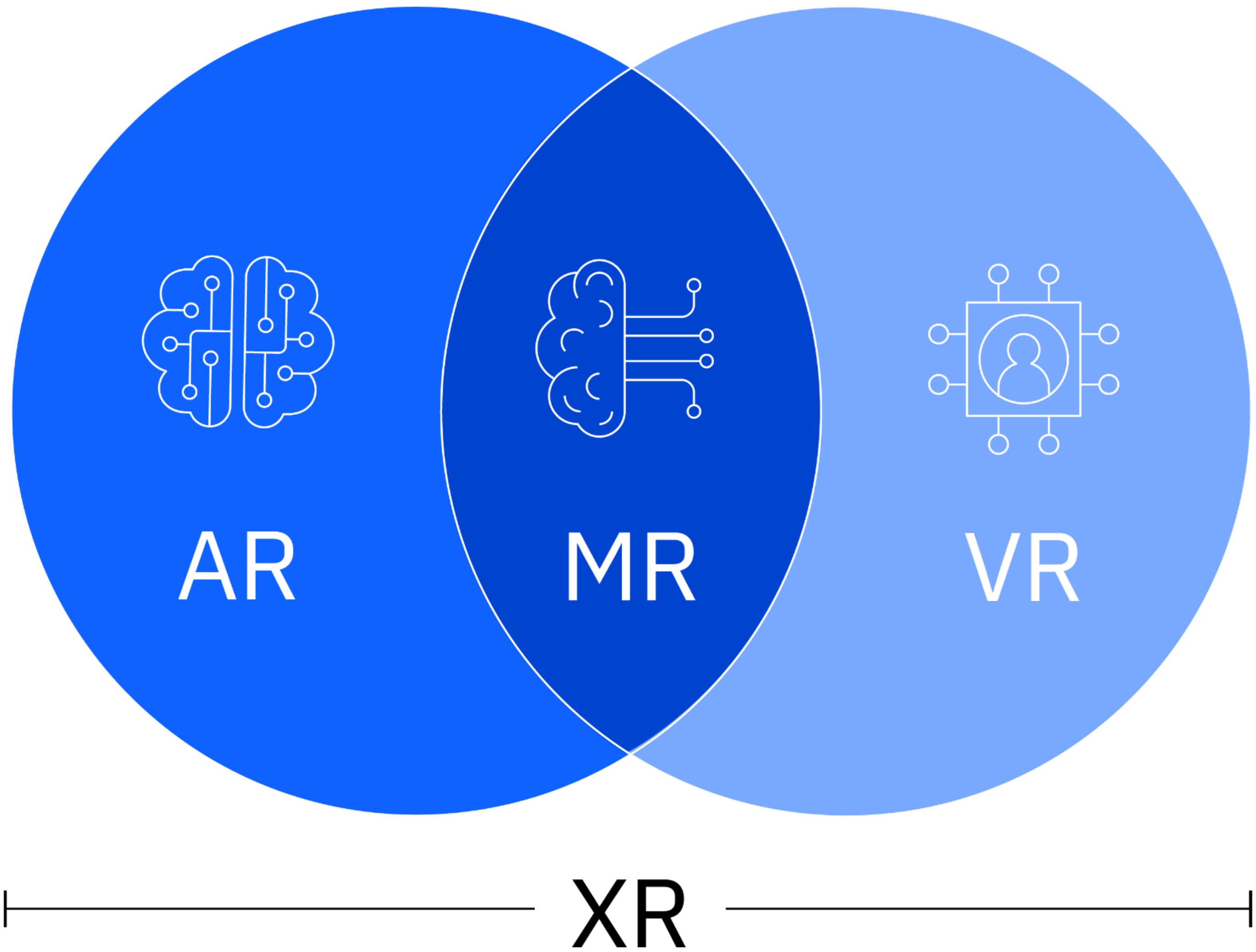
Social Media (2D)

Web 3.0

3D, XR: VR, AR, Digital Twins, Smart Spaces, Virtual Assistants



VIRTUALITY CONTINUUM

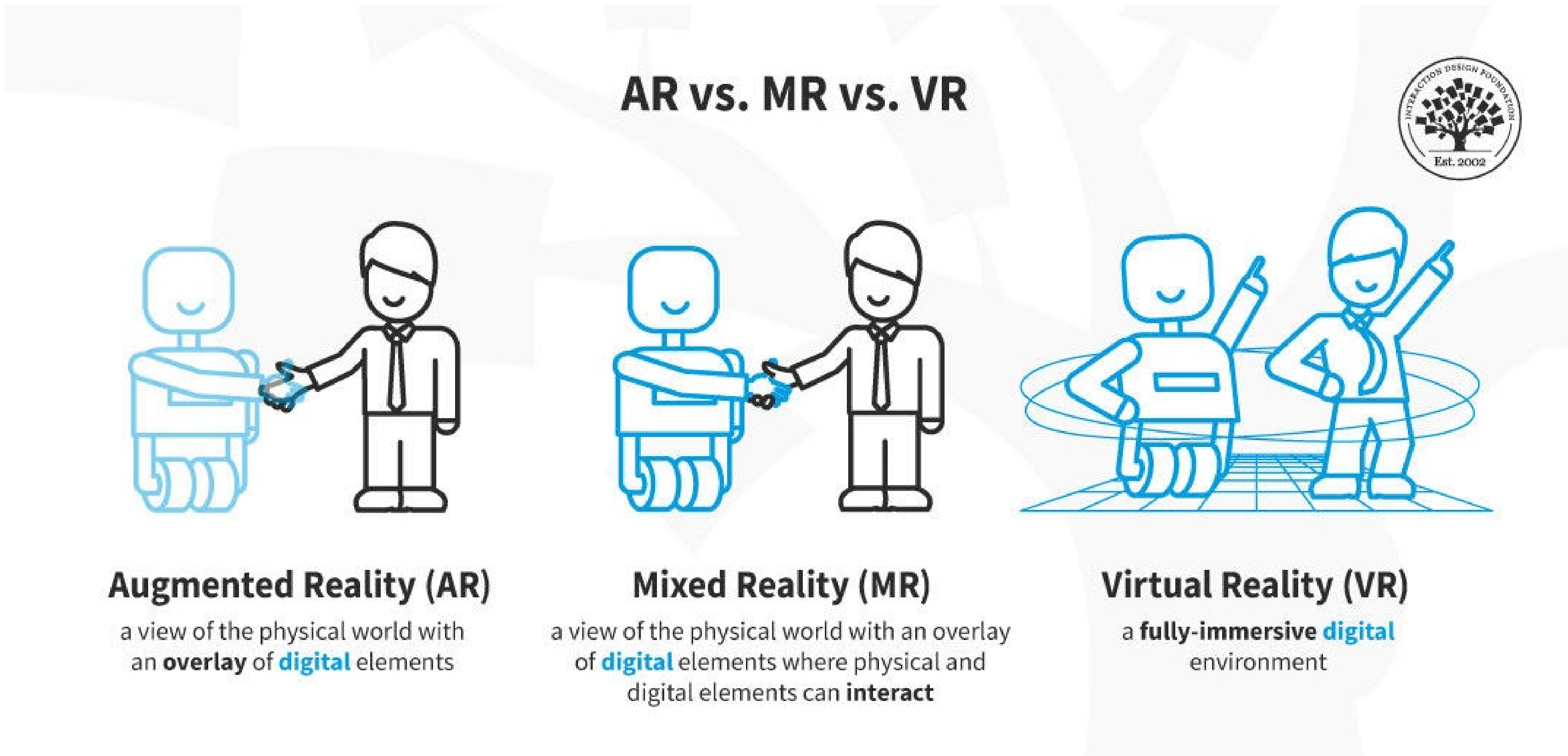


Augmented Reality (AR)
Digital content on top of the real world

Mixed Reality (MR)
Digital interacts with the real world

Virtual Reality (VR)
Digital environments that shut out the real world

IBM Institute for Business Value



XR INTERACTIONS

VIRTUAL REALITY

- Real world blocked out
- 3D Space
  - Virtual presence: comfortable in virtual world
  - Place: matching your movements and perception, built into VR headsets
  - Plausibility: world is real and responsive
- Embodiment: feeling that you are interacting with your body in virtual world
- VR: Magical Interaction
- Active & Passive Interactions

VR DESIGN CHALLENGES

- Comfortable VR experience?

https://www.interaction-design.org/literature/article/beyond-ar-vs-vr-what-is-the-difference-between-ar-vs-mr-vs-vr-vs-xr

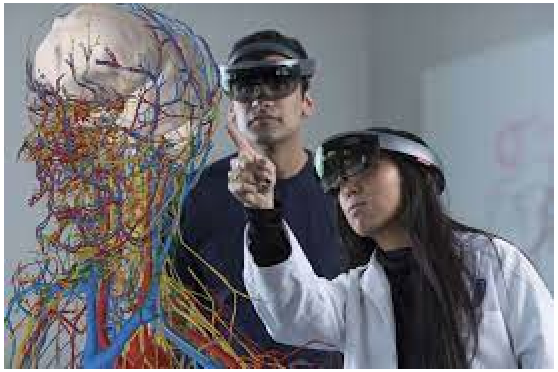
- Human perception: reality as perceived by our senses
- Lack of defined standards: Hardware & Software (Metaverse Standards Forum, June 2022): 3D graphics, geospatial systems, physical simulation and photorealistic content authoring
- Security
- Emotion tracking – virtual avatar imitating real-life facial expressions
- Most challenging is the design of UI & navigation: freedom of movement, ease of control, system responsiveness, device input: voice, gesture, click, haptics

VR DESIGN CHALLENGES

- *Head Mounted Displays (HMD):*
- *Designing these devices continues to be a study in contradictions. They must be extremely low power, with small enough batteries to make them comfortable to wear. But they also must be able to process large amounts of streaming image data in real time, and with a screen refresh rate high enough to prevent motion sickness. In addition, they must last long enough between charges to make it attractive to consumers. Also, they must stay relatively cool, because the device is worn over the face, and they need to be secure, include high-speed I/O and advanced communications technology — and still be affordable*

VR DESIGN CHALLENGES

- Diverse VR use cases: no one size fits all
- High-speed gaming: processing speed and latency
- Surgical training application: clarity and accuracy are priorities, e.g. 8K display with force feedback provides feeling of doing a real operation on a live person
- VR Training: flight, aerospace, military, communications
- Phobia Treatment



METAVERSE

The metaverse is a digital artificial intelligence (AI) platform with a 3D user interface that provides immersive user experiences

- **VR: AR-MR-VR: 3D & AI**: heavy processing requirements
- **Customisable avatars** & digital goods: Creator economy
- **Builtin cryptocommerce & NFTs**
- **Realtime environments**: IoT, IoE
- **Spatial audio**

Gerd Leonhard (2022)

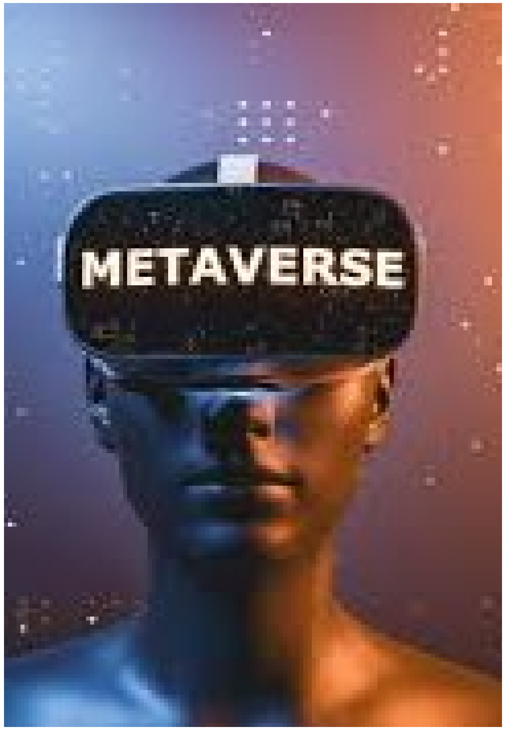
METAVERSE COMPANIES

- Meta CEO Mark Zuckerberg has repeatedly called Apple's 15 to 30% App Store commission monopolistic, saying the company's App Store "blocks innovation, blocks competition"
- Meta recently announced it would take a 47.5% cut of digital asset purchases in the Metaverse, when it begins allowing in-world purchases
- Its rival, Apple, took the news as an opportunity to lob a shot at its competitor

METAVERSE

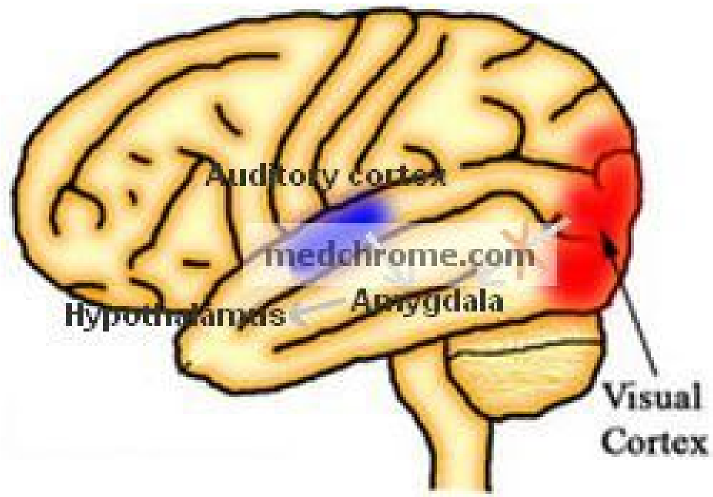
- An evolution of existing tech: CUI, 3D spaces, VR, blockchain
- Challenges:
  - Computing power required: 10 years away (Intel CEO)
  - Sustainability: computers currently 20% of global CO_2 emissions
  - Data: Privacy?
  - Interoperability? Decentralisation?
- Gerd Leonhard:

https://www.youtube.com/watch?v=QfuaV8g0OAY&t=53s



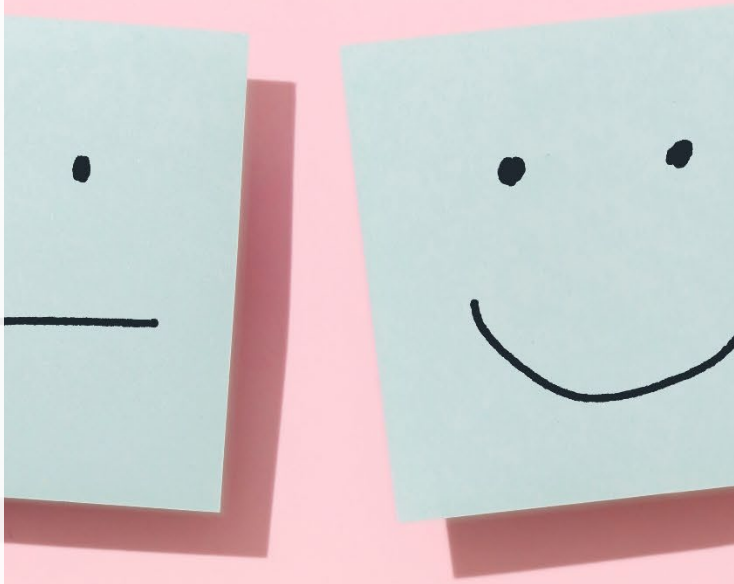
AFFECTIVE COMPUTING

- Recognition of important role of emotions in intelligent human functioning
- Emotions improve our decision making: make us smart!
- Importance of Emotion: neuroscience research
- Complexity and overhead of defining, communicating and interpreting affect: Why?
- What applications? For whom?



AFFECTIVE SYSTEMS

- Applying knowledge from emotional to digital world
- "*Affective HCI is when emotional information is communicated by the user in a natural way, recognised by the computer and used to **improve** the interaction*", Picard 2003
- Affective computing levels:
  - Designing interactive systems which evoke human emotions: designing for pleasure or virtual environments to treat phobias
  - Getting computers to recognise human emotions and react accordingly
  - Computers expressing emotion?



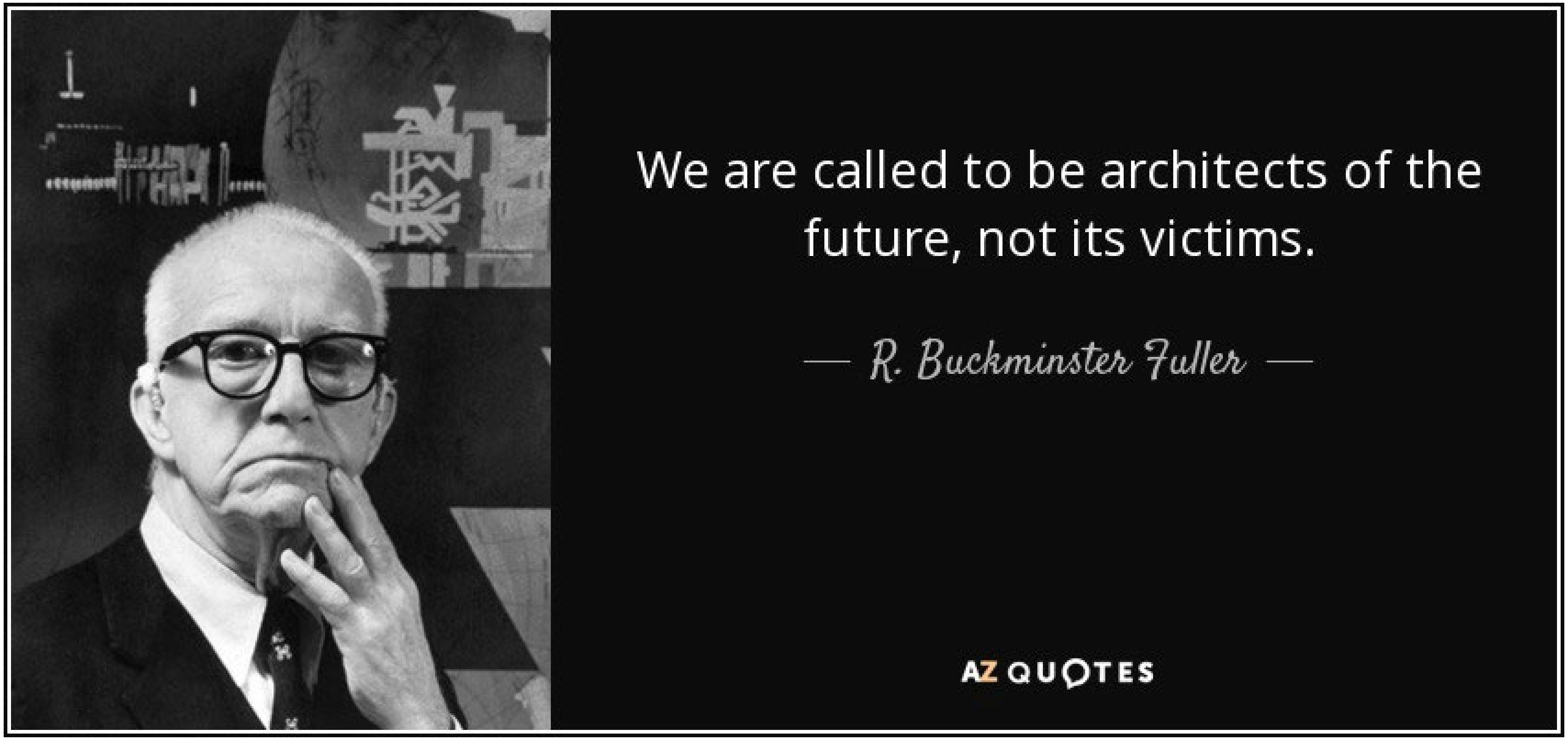
AFFECTIVE SYSTEMS

"In the growing field of "affective computing," robots and computers are being developed to analyze facial expressions, interpret our emotions, and respond accordingly. Applications include, for instance, monitoring an individual's health and well-being, gauging student interest in classrooms, helping diagnose signs of certain diseases, and developing helpful robot companions." (Picard)

- Challenge: human diversity
- Human brains instinctively catch these variations; machines struggle – DL Techniques
- MIT Machine Learning Model (Picard et al): MoE Neural Networks

AFFECTIVE SYSTEMS

"It could, for example, run in the background of a computer or mobile device to track a user's video-based conversations and learn subtle facial expression changes under different contexts. "You can have things like smartphone apps or websites be able to tell how people are feeling and recommend ways to cope with stress or pain, and other things that are impacting their lives negatively," Feffer says. This could also be helpful in monitoring, say, depression or dementia, as people's facial expressions tend to subtly change due to those conditions. "Being able to passively monitor our facial expressions," Rudovic says, "we could over time be able to personalize these models to users and monitor how much deviations they have on daily basis — deviating from the average level of facial expressiveness — and use it for indicators of well-being and health."
(Picard, MIT)



What kind of future do we want?

FUTURE HCI?

- Being the computer / Being within the computer – rather than accessing the computer
- Technology: tool or purpose?
- Always being online – rather than having access to an online world: "go there, buy there but live there?" (Leonhard)
- Proxy experiences
- Reality? Perfect, convenient simulation over a complicated, messy reality
- Dehumanisation: Nature Deficit Disorder: suffocating our humanity
- More addicting: who's protecting us, our humanity?

FUTURE INTERACTIONS?

"We must consider conversations, engagements, and embodiments, not simply slick gestures, mechanics, or tools that sensationalize or romanticize a fantasy notion of interaction."
Gajendar, 2017

Future Interactions? (Circolo del design)
https://www.youtube.com/watch?v=xPpfMxB7C_0

FUTURE HCI?

- What kind of future do we want?
- Technology: a tool or a purpose?
- Who benefits? Technology as modern oil industry
- Market size of all extended reality technologies combined is expected to reach USD 125.2 billion by 2026
- Future of Internet?
- *Algorithms know the logic of everything but the feeling (truth?) of nothing*
  - More user monetization, digital inequality, feudalism, surveillance, dehumanization, simulations, loneliness, confusion, abuse

HUMAN COMPUTER INTERACTION

Lecture 11:
Future Interactions?

Lecture 12:
CT318 Course Review & Examination

HUMAN COMPUTER INTERACTION

Lecture 12: HCI Review

- Course Review
- Design Projects
- Exam: Structure
- Exam: Guidelines, Marking Scheme

WHAT IS HCI?

*"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."*

(ACM SIGCHI, 1992)

WHAT IS HCI?

"Interaction design of digital media, physical products and ubiquitous intelligent environments has passed the phase where development was predominantly technology driven. ***Content****,* ***meaning****,* ***insight*** *and* ***experience*** *have become the key design drivers and thus increasingly central competences for designers."*

Aalto University, Finland

EVOLUTION OF HCI

Waves of interaction: mapping of users to devices:

- **First wave**: one device, many users (e.g., mainframe systems)
- **Second wave**: one device, one user (e.g., the personal computer)
- **Third wave**: many devices, one user
- **Fourth wave**: many devices, many users (e.g., pervasive and XR computing systems with multiple interconnected devices embedded in a room and available for anyone to use)

HCI: COURSE OBJECTIVES

Concern is with the total joint performance of user and computer system in the world:

1. Understanding centrality of **Design** effort to HCI success
2. Understanding **human** capabilities
3. Potential & diversity of **computing** technology
4. **Techniques** and models into SDLC
5. Design Thinking
6. Analytical/empirical techniques for **evaluating** systems

HCI: COURSE OBJECTIVES

Interaction Design: interface between technology & people:

- **People**: human cognition and emotion
- **Technology**: sensory and motor systems
- **Interface / Interaction**: knowledge of the scientific method and design techniques to perform valid tests of their ideas before deploying them

HCI: COURSE OBJECTIVES

- A combination of ***creative insight*** and ***analytical thinking***
- Course: analysis, design, critique & evaluation
  - What is HCI Success?
  - Design Principles
  - Design Thinking
  - Creative: Design / Idea Generation
  - Implementation: Prototyping
  - Analytical: Evaluation

COURSE REVIEW

- HCI: Interaction Design; Good Design; Design Thinking
- The Interaction: Design Thinking; ID Process; Interaction Models; Frameworks (PACT, DECIDE)
- People: Stakeholders; Users; Human Diversity
- UX: Why, What, How?
- DT / Interaction Design Process:
  - DT: Empathise & Define; Needfinding: user, task
  - DT: Ideate: Conceptual Design; Alternative Designs
  - DT: Prototyping; Physical Design: Different Interfaces, Visual, Information Design
  - Evaluation
- Interaction Developments: Future Interaction

COURSE REVIEW: TOPICS

- HCI: Introduction, Context
- Interaction Design: Design? Good Design?
- UX: Why, What, How?
- Interaction Models & Frameworks
- Design Thinking, ID Process
- Design for whom? Human Diversity / Users / Requirements / Empathy
- Conceptual Design: Ideation
- Prototyping
- Visual Design
- Information Design
- Evaluation
- Interaction Developments
- *Humanity Centred Design?*

DESIGN PROJECTS

Prototype Evaluation:

- Goal: How to find most valuable changes for next design iteration?
- Select appropriate method for your prototype and audience:
  - Prototype: Interactive? If not – can't evaluate user interaction
  - Audience: Ideally with representative users – but if not, e.g. astronauts, personas? Heuristics
- Conduct evaluation
- Analyse results – insights, improvements
- Report: prioritise findings

DESIGN PROJECTS

Design Project Rubric:

- A: Excellent submission, addressing the required elements in a thorough or a thoughtful or innovative & thoughtful manner
- B: Very good submission, with due consideration of the required elements
- C: Satisfactory submission, considering some of the required elements
- D: Minimal coverage of required elements
- F: Inadequate submission, failing to meet requirements

EXAM STRUCTURE

- Two hour paper: manage timing
- Question 1 is compulsory: PACT & interactive system design
- Answer TWO out of other THREE Questions
- Multiparts: marks indicated

EXAM GUIDELINES

- Time management: Question 1
- Make a point; then illustrate with example
- Use examples: personal experience, class examples, examples from your reading etc.
- Additional reading etc. informs your opinion on subjects
- Your opinion is valued – considered reflection - not **waffle!**

EXAM GUIDELINES

Create:

- Interactive system for X (User Needs)
- Evaluation Plan, Techniques
- Visual design / Information design for X

Reflect:

- Which interaction style / posture / user feedback / evaluation technique for X
- Successful Interaction Design: design models, human / computer responsibilities, physical, cognitive & emotional
- Gulfs of execution & evaluation, World & head vectors, Threshold & ceiling, Anthropomorphism
- Future interaction technologies: potential

EVALUATION PLAN

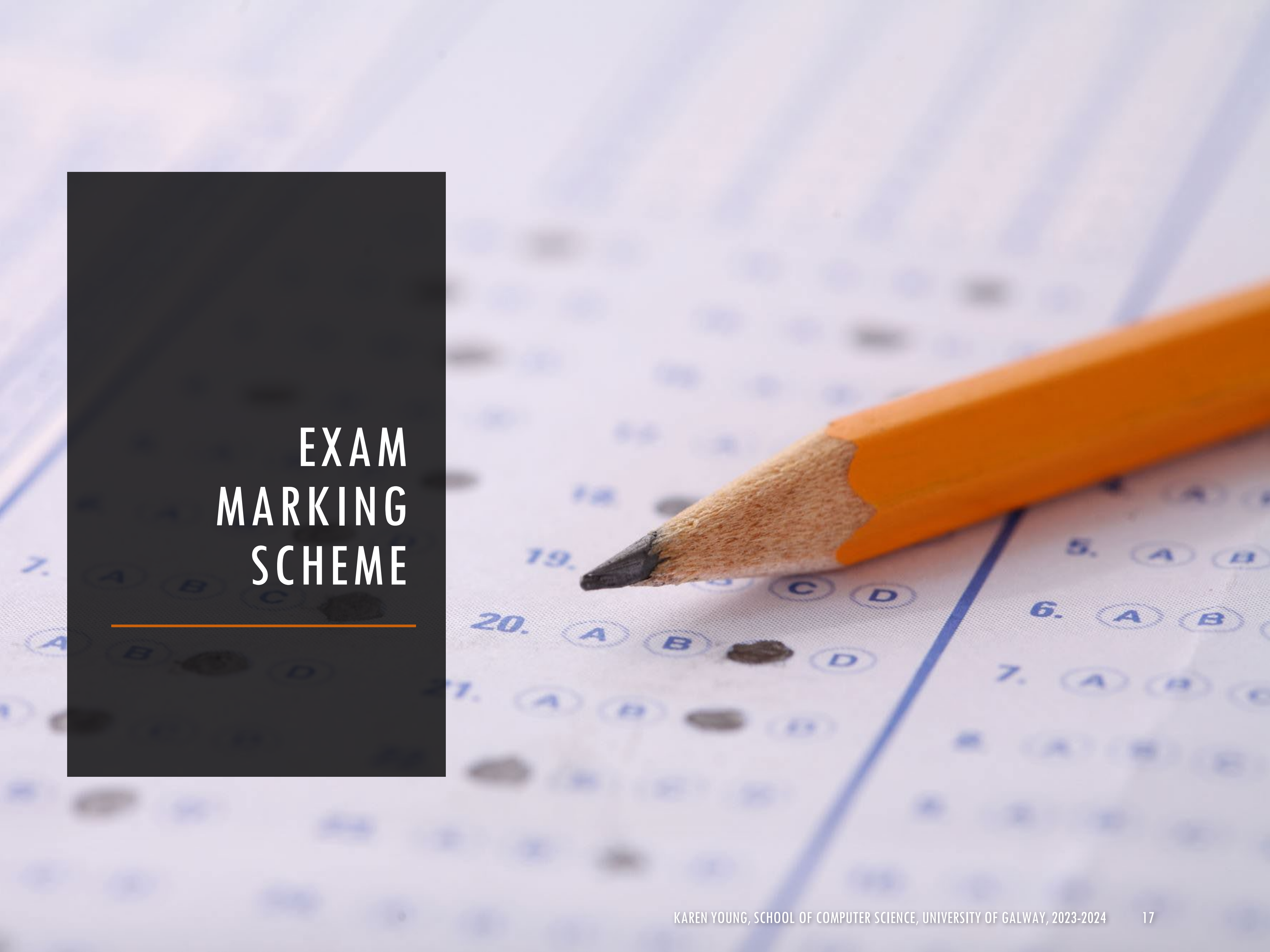
Evaluation Plan:

- DECIDE Framework
- 5W's 1H: Why, Who, What, Where, When and How
- Example: *Wellbeing* App
  - Why? (Exam question!)
  - **Who?**
  - **What?**
  - Where?
  - **When?**
  - **How?**

EXAM GUIDELINES

Apply:

- **Models:** Interaction Model, Laseau's Design Funnel, Mental Models
- **Frameworks:** PACT (Lecture 5), DECIDE, Interaction styles, Interaction Modes, Interaction Metaphors
- Prototyping techniques
- Universal Design
- Memo explaining use of X to colleagues



EXAM MARKING SCHEME