Lecture 8: Designing complex systems
Case studies on applying theory to hard HCI problems
Overview of the course

• Theory driven approaches to HCI
• Design of visual displays
• Goal-oriented interaction
• Designing smart systems (guest lecturer)
• Designing efficient systems
• Designing meaningful systems (guest lecturer)
• Evaluating interactive system designs
• Designing complex systems
What are some things that make designs complex?

- How complex is the domain?
- How many different tasks might a user perform?
- How well defined are the outcomes? (Wicked problems, L3)
- How easy is it to understand each part?
- When the parts are put together how easy is to guess the behaviour?
- Does the system do things when the user isn’t there? (Attention Investment from L3)
Designing tasks vs interaction spaces

Consider a (slightly silly) APIs for sending a message:

1. `sendTheRightMessage()`
2. `sendMessage(Enum message)`
3. `sendMessage(String message, Urgency status)`

• Naive design would result (1). Complex systems tend to be built out of reusable components that the users configure (2,3)
• Building this kind of system involves discussing tradeoffs as well as detailed design decisions
• This is the kind of system that most of you will build:
  
  Programming languages, APIs, AI systems
Broad brush techniques

- Descriptions of specific actions result in a ‘death by detail’
- Don’t describe specific actions with an interface
  - Describe interaction with a level of *analytical distance* from the interface
  - Use an *analytical frame* which is a way of structuring a description of an interaction
  - The description can then be compared to an ideal for a domain to become a critical perspective (see Lecture 1)
- These techniques often give names to the patterns
Cognitive Dimensions of Notations (CDNs): Analytical Frame

A user performs an activity in an interface containing notations, described along a number of dimensions.
Cognitive Dimensions of Notations (CDNs): Analytical Frame

A user performs an activity. Interface containing notations, described along a number of dimensions.
CDNs: A simple example

Me

Exploratory Design

“Can I make my slides less ugly?”

Interface (Google Slides)
CDNs: A simple example (Demo)

- One described change “Make the font of the headings Comic Sans”
  - Select the first slide, change the font
  - Select the second slide, change the font
  - Yawn.
- This is repetition Viscosity, many operations to perform one change
- Design maneuver: Introduce an Abstraction (master slide), decreases Viscosity, but increases Premature Commitment
- NB: CDNs analysis is meaningless independent of an interface.
CDNs: Activities

- **EXPLORATION**: Manipulating both information and structure. Exploration involves manipulating and changing both the content and the structure of the information.

- **MODIFICATION**: Changing structure only. Modification involves changing the structure of the information, not keeping the content.

- **TRANSCRIPTION**: From one notation to another. Transcription involves copying information from one notational form to another, often between different media as well.

- **INCREMENTATION**: Adding data items. Incrementation involves adding new content, but not changing the information structure.

- **READING**: Seeking information or gist. Reading involves moving the reader or receiver to the information.
CDNs: Dimensions
CDNs: Profile
CDNs: Profile
Case Study: Dynamo’s type system
Dynamo

- Language for exploring building designs
- Live Demo
- Includes a constructor `Point(x, y, z)` and array literal syntax `[1,2]

Design question for discussion:

“What should `Point([0, 1, 2], 10, 10)` do?”
- What activities are important?
What about intelligent systems?
Interaction with Machine Learning

- Research in 2011 by Sumit Gulwani at Microsoft Research
- “Synthesises a program from input-output examples”
  - How do you choose the examples? (Premature commitment?)
  - How do you know what will happen? (Progressive evaluation?)
- Now Excel FlashFill (demo requires Excel 2013/16)
  - Paste a list of semi-structured text data into the left column
  - Type an example transform result in top cell to the right, then <Enter>
  - Press <Ctrl+E>
Conversational agents

- Do they build a user model, goal model or task model?
- Will this be more or less complex than FlashFill?
- How can you see it the model?
  - i.e. what is the notation?
- How could you modify the model?
  - … in response to errors (yours, or the system’s)
  - … if you change your goals?
- Does having a ‘body’ help?
  - (remember metaphor)

Amazon Echo / Alexa agent
Human issues in machine learning

- Ethics and accountability
  - automating and/or justifying bias and prejudice
- Digital humanities
  - treating text and images as meaningful and sophisticated
  - (rather than just statistical fodder)
- Reward
  - who does the intellectual ‘work’ of providing training corpus content, data labelling, how are they paid, and where do the profits go?
Some current research problems
Augmented reality is still a visual representation (remember metaphor?)
Programming, or direct manipulation?

- Many Internet of Things (IoT) devices have physical switches etc
  - But how do you define configuration, policy, future action?
  - Now we need a notation - or a programming language
- Remember behavioural economics and attention investment
  - Even around your house, bounded rationality happens

Philips Hue Light control
Global challenges

• Is knowledge infrastructure built to ...
  • … prioritise low income populations
  • … advance United Nations Sustainable Development Goals (human rights, education etc)?
Further interest...

• Part II: Project
• Part II/Part III Computer Music (not in 2020)
• Part II/Part III Advanced Graphics
• Part III: Interaction with Machine Learning
• Research Skills: Working with artists and designers; How to interpret experimental results; Introduction to qualitative research methods; How to design surveys; Assessing the quality of experience