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 efficient systems
• Designing smart systems (guest lecturer)
• 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 via an interface containing notations, described along a number of dimensions.
Cognitive Dimensions of Notations (CDNs): Analytical Frame

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

Me  Exploratory Design  Interface (Google Slides)

“Can I make my slides less ugly?”
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.
  - An operation involves manipulating and changing both the content and the structure of the information.

- **Modification**
  - Changing structure only.
  - An operation involves changing the structure of the information, not keeping the content intact.

- **Transcription**
  - From one notation to another.
  - An operation involves copying information from one notational form to another, often between different media or contexts.

- **Incrementation**
  - Adding data or information.
  - An operation involves adding data or information to an existing database or data structure.

- **Reading**
  - Seeking information or data.
  - An operation involves retrieving or accessing data or information from a database or data structure.
CDNs: Profile

- Activity
  - Low
  - Medium
  - High

Dimension
Ideal value of the dimension for the 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)
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
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