minds and machines (1)

connexions between computing science and psychology

computing science and psychology: where do they connect?

- **computing science:** the study of computational processes and structures
- **psychology:** the science of the mind and behaviour

connexions

- **human computer interaction (HCI)**
  - improve computer systems and software by accounting for the psychology of human users
- **cognitive science (COGS)**
  - understand how the mind works (using computational tools and models)
- **artificial intelligence (AI)**
  - build systems (softeware and/or hardware) that exhibit 'intelligent' behaviour

these areas (especially COGS and AI) deal with fundamental questions, such as:

- what is intelligence?
- why do humans behave in certain ways?
- what is creativity?
- do we have free will?
- which human activities and behaviours can be carried out / simulated by computer programs?
- how can computers best be used to support / complement human activities?

studies in HCI, AI and COGS blend basic research on the way we sense and interact with our world with practical applications

some application areas:

- language
- vision
- touch
- sound/music

some applications

- smart robots
  - navigate dangerous areas
  - enable remote surgery
  - respond to thought commands of paralysed people
- learning tools
  - with built-in cognitive models of learning, allowing individualised tutoring
- therapeutic aids
  - stimulate communication in autistic children
  - enable distance art therapy
- better user-computer interfaces
  - enable access to technology via images, sound, touch
  - retrieve images based on similarity to other images
  - automate language translation

language

- earliest computer scientists envisioned computers for *natural language processing*
- many potential applications, e.g., making it easier to work with computers, build better search engines, ...
- early goal was *automated language translation*; encountered significant problems, e.g.,
  - *ambiguity* in word meaning, so bilingual dictionary insufficient to select words
  - also difficult to rearrange word order in new language

Eliza

how does it work?

componenets of Eliza code

- Eliza has
  - a (key, phrase) table called *qa* — data
  - an array of phrases called *unknowns*
- Eliza can
  - produce an answer to the user's input text — method (function)
    - if the user's input contains a keyword, Eliza's response is the corresponding phrase from *qa*
    - otherwise, Eliza outputs a random phrase from *unknowns*

qa: the key-response table

- you get to decide what entries it has
- in the lab, it initially looks like:

key	response
mother	tell me more about your family
classes	it appears you have some issues with school

code to initialize *qa*

```
qa.put("mother", "Tell me more about your
  family.");
qa.put("classes", "It appears that you
  have some issues with school.");
```

unknowns: the array of phrases

- you get to decide what entries it has
- in the lab, it initially looks like:

0	Please, elaborate on that a little more
1	Please, do go on
2	I'm not sure I understand what you're getting at
3	Why do you think that this is so?

code to initialize *unknowns*

```
String[] unknowns = {
      "Please elaborate on that a little more.",
      "Please, do go on.",
      "I'm not sure I understand what you're
        getting at.",
      "Why do you think this is so?"
    };
```

Eliza: producing an answer the *produceAnswer* method

- the user's *inputText* is converted (tokenized) into an ordered list of words, *tokenizedInput*
- the words (tokens) are examined one by one
- if a token is a keyword, then respond with the corresponding response in *qa*
- otherwise a random response from *unknowns* is chosen

method to produce the answer

```
public String produceAnswer(String userText) {
  StringTokenizer tokenizedInput = new StringTokenizer(userText);
  String curr, theAnswer = "";

  while (tokenizedInput.hasMoreTokens() && theAnswer.equals("")) {
     curr = inputText.nextToken();
     if (qa.containsKey(curr)) {
        theAnswer = (String)qa.get(curr);  }
  }
  if (theAnswer.equals("")) {
     theAnswer=unknowns[gimme_a_number()]; }
  return theAnswer;
}
```

code for Eliza: three short files

- eliza.html: web page interface
- ElizaApplet.java: code to set up and maintain the text boxes in the window
- MyEliza.java: code that determines how Eliza responds to the inputs of the user
  - this is the only file you will change in the lab

applets

- ElizaApplet.java is an applet (small application)
- applets are Java programs that run only as part of a web page
- the applet is started when the eliza.html page is opened

how could Eliza do better?

- use one of multiple possible responses to each keyword, chosen randomly
- direct the conversation back to a keyword that appeared earlier in the program
- respond to sentences like “I _____ you” with “Why do you _____ me?”
- create a “lexicon” of word associations, to move on to new subjects from old

does Eliza display intelligence? understanding?

we'll consider two points of view:

- Turing's test of intelligence (1950)
- Searle's argument as to why programs cannot explain human cognition (1980)

Turing's test (1950)

- a judge has conversations (via teletype) with two systems, one human, the other a machine. The conversations can be about anything, and proceed for a set period of time (e.g., an hour).
- if, at the end of this time, the judge cannot distinguish the machine from the human on the basis of the conversation, then Turing argued that we would have to say that the machine was intelligent.

Searle's argument

- when done without any *understanding* of the meaning of the language, natural language processing cannot be said to simulate the human mind
- programs, by themselves, are not sufficient to produce intentionality

Eliza and Turing's Test

- the original Eliza program was not intended by its creator, Joseph Weizenbaum, to demonstrate intelligence. In fact, the general acceptance of ELIZA as being "intelligent" greatly concerned Weizenbaum, who subsequently stepped back from research in Artificial Intelligence
- nevertheless, Eliza stimulated much research on *natural language processing*, now a major subfield of cognitive science (psychology + philosophy + linguistics + computer science)

Eliza summary

- We've seen:
  - how to build Eliza, a simple natural language processing program;
  - that by studying how computers might simulate human capabilities in natural language processing, we can challenge notions of what intelligence is.
- **Food for thought:** Given the difficulty that computers have with natural language processing, how does the brain do it? Can we build devices that simulate the brain's "algorithm"?

resources

- Sun's website on java applets:
  - http://java.sun.com/applets/
  - http://java.sun.com/docs/books/tutorial/applet/
- John Searle's "Mind, Brains, and Programs" essay:
  - http://members.aol.com/NeoNoetics/MindsBrainsPrograms.html
- Chapter 23 of text