Knowledge-Based Systems

Dr. Derek Bridge

Science Building, Room 336
d.bridge@cs.ucc.ie
http://www.cs.ucc.ie/∼dgb/courses/kbs.html

- Teaching: 1 hr lecture per week; 2 hrs private study per week, poss prac after Xmas
- Written exam: $1\frac{1}{2}$ hr closed paper, worth 80%
- Year's work: Spring term research paper ('essay'), worth 20%
- Prerequisites: sets, functions, relations, logic, algorithm and problem complexity

Taking an Artificial Intelligence (AI) approach

- Consider use of a dumb robot for packing chocolates.
- Two approaches for dealing with 'abnormal' situations:
  - engineering approach:
    — try to eliminate 'abnormal ' situations
  - AI approach:
    — make robot more flexible.

Defining AI

- 'Full-blown' definitions

  "AI studies how to build machines who think."

  - machines that act like humans
  - machines that think like humans
  - machines that act rationally
  - machines that think rationally
- Techniques-oriented definitions

  "AI studies 'non-algorithmic' programs."

  - the application of search to knowledge
  - the application of knowledge to search

Defining AI, cont'd

- Problem-oriented definitions

  "AI uses computers to do tasks that are done by humans and seem to require intelligence, e.g. fault-finding, medical diagnosis, proving mathematical theorems."

  "AI is concerned with programs that provide solutions (or approximations to solutions) to problems which are 'difficult' to solve by traditional methods. The difficulty stems from the presence in the problem of disorder, uncertainty, lack of precision or inherent intractability."

Knowledge-Based Systems (KBS)

A KBS typically

- is deliberative rather than reactive (i.e. actions follow from reasoning not reflexes)
- uses declarative knowledge rather than procedural knowledge
- uses quite a lot of knowledge rather than relying on 'weak methods'

So we are concerned with
— acquisition of
— representation of and
— reasoning with
knowledge.

Deliberative v. reactive

- A reactive agent might have a set of situation-action rules:

  ```
  IF condition THEN action
  ```

  used as follows:

```
do forever:
   sense the world;
   find a rule whose condition is true;
   execute the rule's action
```

- A deliberative agent projects the effects of possible actions on mental representations of the world before acting.
- Hybrid systems are possible
  e.g. 'compiling' deliberation into reaction.

Declarative v procedural knowledge

- Procedural knowledge: ‘how’
  e.g.
  go from A to B, then from B to C, then C to D

- Declarative knowledge: ‘what’
  e.g.
  A and B are connected,
  B and C are connected,
  C and D are connected

- Declarative knowledge
  — is easier to change
  — item can be used for multiple purposes
  — is easier to reason with
  — can allow a program to be ‘introspective’

- Systems often contain both kinds.

Lots of knowledge v ‘weak methods’

- ‘Weak methods’
  - use simple representations for current state of the world, agent’s actions, agent’s goal

- A KBS will tend to
  - use representations of the above that are ‘richer’ and can be reasoned with
  - use heuristics to guide and constrain search
  - use notions of uncertainty and utility

This course

- Within the general area of KBS, our focus is
  - **NOT** machines that are smart
  - but machines that are less stupid

- and our approach is
  - *neat* rather than *scruffy*
  - i.e. principles (logic and other CS theory)
  - not kludges (hackery)