Lecture 3: Applications of Logic

This lecture outlines two important applications of logic:

- Russell's theory of descriptions, in the philosophy of language
- The semantic web: providing information for intelligent internet agents

**Russell's theory of descriptions**

Russell said that statements of the form "The *blah* is whatever" really contain 3 separate statements:

- There is a *blah*.
- There is no more than one *blah*.
- Every *blah* is whatever.

**Analysis and formalisation**

Let the domain be people, $Kx$ mean $x$ is the king of France, and $Bx$ mean $x$ is bald. Then "The king of France is bald" should, according to Russell, be formalised in this way.

$$
\exists x[Kx] \\
\forall x[\forall y((Kx & Ky) \rightarrow x = y)] \\
\forall x[Kx \rightarrow Bx]
$$

Note that this violates our principle that the formula should be as similar to the English as possible. Russell argues that the English does not show the real logical structure of the statement.

**Names and truth**

- *Greg has two feet.*
  Greg exists and so do his feet. There are two of them, so the sentence above is true.

- *Pegasus has two wings.*
  Pegasus is a mythical winged horse. It does not actually exist. Maybe it is true, because it is part of the mythology. Maybe it is false, because Pegasus does not exist. What do you think?

- *The king of France is bald.*
  The (present) king of France does not exist either, but we have no way of deciding the truth of this last statement.

These last two are known as problems of *referential failure*.
Sense and reference

This analysis makes the statement false, and also makes “Pegasus has two wings” false.

An alternative theory, due to Frege, distinguishes between the sense and the reference of a name. It allows a name like “Pegasus” to be meaningful, and sentences like “Pegasus has two wings” to be true, even though there is no Pegasus.

QL only deals with reference (extension), not sense. Quine gives another example that motivates an account of sense: “creature with a heart” and “creature with kidneys” do not mean the same thing, but they are true of exactly the same creatures, so in QL they are equivalent.

Agents using the web

If you wanted to travel to the Université Paul Sabatier in Toulouse (France), you would probably open a web browser and begin searching and checking air-fares, bus time-tables, hotel availability ...

If all this information was available in a machine understandable form, an intelligent agent could plan your trip and make the bookings for you.

This is the aim of the semantic web, currently being developed and standardised by the World Wide Web Consortium (W3).

RDF, OWL, the usual alphabet soup

- “machine understandable format” for complex information like this means some sort of logic language
- OWL stands for web ontology language (out of order!) - an ontology is like a QL key
- it comes in 3 levels, for different trade-offs between expressiveness and computational complexity of reasoning
- in the middle level OWL-DL, the DL stands for description logic

Browsing and reasoning

In the next few years, web pages will contain stuff like QL formulae, your browser will contain theorem proving software, and obtaining the information you want will be much easier.

Advanced web-designers will probably need to know a little logic too!
## Exercises

### In Class
- **Tomassi, Chapter 5**
  - Page 233 Exercise 5.7: 1 odds, 2 odds, 3 odds
  - Page 240 Exercise 5.8.3 odds and ". . . is louder than . . ."
  - Page 248 Exercise 5.10.1 odds

### Homework Assignment
- **Tomassi, Chapter 5**
  - Page 233 Exercise 5.7: 1 (ii) (xii), 2 (ii) (viii), 3 (ii) (xiv)
  - Page 240 Exercise 5.8.3 evens
  - Page 248 Exercise 5.10.1 (ii) (vi)