CS172 Tutorial Sheet for Tutorials in Week 7

Writing statements in predicate logic **(Textbook §4.2)**

When translating sentences into the formal syntax of predicate logic you should start by identifying the constant and predicate symbols that you use (and providing a key for them).

Example: Translate "No boy or girl loves Peter"

- First, work out the symbols you'll need:

Constants:	p	stands for Peter
Properties:	Bx	means x is a boy
	Gx	means x is a girl
Relations:	Lxy	means x loves y

- Then, break down the sentence to translate it:
  - We first observe that it is a negation: $\neg$(some boy or girl loves Peter)
  - There is one unknown (variable) here: the person, who is either a boy or a girl, and who loves Peter. Calling them x, we can say of this person: $(Gx \vee Bx) \wedge Lxp$. The parentheses are important here.
  - Finally, we need to figure out how to introduce the variable: "some" is an existential assertion (i.e. one or more, but not everybody), so we get: $\neg(\exists\, x \cdot (Gx \vee Bx) \wedge Lxp)$.
- Also remember the usual idioms:
  - "All P are Q" is usually translated as $(\forall\, x \cdot Px \rightarrow Qx)$.
  - "There are some P who are Q" is usually translated as $(\exists\, x \cdot Px \wedge Qx)$.

  Can you see why it would be incorrect to translate these as $(\forall\, x \cdot Px \wedge Qx)$ and $(\exists\, x \cdot Px \rightarrow Qx)$ respectively?

Exercises

Translate the following sentences from natural language to the formal language of predicate logic.

1. If John loves Mary then Mary loves John too.
2. Every boy loves Mary.
3. Not all girls love themselves.
4. Peter loves some girl who loves John.
5. No phone is a real computer.
6. If something is a phone then its not a real computer.
7. Every apple is either green or yellow.
8. There is an apple that is neither green nor yellow.
9. No apple is blue.
10. Every man likes every tasty apple.
11. Everybody is walking and talking.
12. Somebody is sleeping but somebody is not sleeping.
13. All animals are mortal.
14. If some student is bothering Mary, she gets annoyed.
15. Everyone who talks will be sent out.
16. If John is right, somebody took his pen.
17. If someone is rich, everyone is jealous.
18. Everyone who is a doctor should come forward, the rest should remain seated.
19. Every human is male or female, but there is an animal that is neither male nor female.

Acknowledgement: this set of translation exercises are based on some of those at the Logic in Action website