# Informatics 1 - Computation and Logic: Tutorial 1

## Propositional Logic: An Introduction

Week 3: 1 - 5 October 2012

Please attempt the entire worksheet in advance of the tutorial, and bring with you all work, including (if a computer is involved) printouts of code and test results. Tutorials cannot function properly unless you do the work in advance.

You may work with others, but you must understand the work; you can't phone a friend during the exam.

Assessment is formative, meaning that marks from coursework do not contribute to the final mark. But coursework is not optional. If you do not do the coursework you are unlikely to pass the exams.

Attendance at tutorials is **obligatory**; please let your tutor know if you cannot attend.

1. Here are some propositional symbols, together with the English sentences they represent:

| | | |
|---|---|---|
| $A$ | *James Cameron directed Avatar* | |
| $B$ | *Leonardo DiCaprio starred in Avatar* | |
| $C$ | *Leonardo DiCaprio starred in Inception* | |
| $D$ | *Christopher Nolan is a director* | |
| $E$ | *Leonardo DiCaprio is an actress* | |
| $F$ | *Sigourney Weaver is an actress* | |
| $G$ | *Sigourney Weaver acted in Avatar* | |
| $H$ | *Leonardo DiCaprio is married to Sigourney Weaver* | |
| $J$ | *Inception was released in 2010* | |
| $K$ | *Avatar is set in 20th century Scotland* | |
| $L$ | *Leonardo DiCaprio is a woman* | |
| $M$ | *Sigourney Weaver is married* | |
| $N$ | *Leonardo DiCaprio is an actor* | |

Every expression of propositional logic is either **true** or **false**, and no expression can be both true and false. Based on the relationship between propositional symbols and English sentences above, your own general knowledge, and, if need be, the Internet Movie Database, decide whether each proposition is true or false.

2. Assume the propositional symbols in Question 1. Assume also that: (a) the symbol $\neg$ represents the negation operator 'not'; (b) the symbol $\wedge$ represents the conjunction connective 'and'; (c) the symbol $\vee$ represents the disjunction connective 'or'; (d) the symbol $\rightarrow$ represents the implication connective; and (e) the symbol $\leftrightarrow$ represents the equivalence connective.

   Some of the following are well-formed expressions of propositional logic and the others are symbol soup. Decide which is which.

   (a) $A \ \wedge \ \neg C$

   (b) $\neg (F \rightarrow D)$

   (c) $\leftrightarrow (N \ \neg \ B)$

   (d) $(G \vee \neg L) \leftrightarrow \neg \neg E$

   (e) $A \vee \neg (C \rightarrow H)$

   (f) $\vee (K \rightarrow \neg \neg B)$

   (g) $F \vee D \wedge$

   (h) $H \wedge \neg (A \leftrightarrow \neg C)$

3. Translate the following expressions of propositional logic into reasonably natural English, assuming the key in Question 1:

   (a) $E \wedge B$

   (b) $J \vee \neg K$

   (c) $E \rightarrow L$

   (d) $(C \ \wedge \ \neg \ L) \rightarrow N$

4. Translate the following English sentences into propositional logic, using the appropriate propositional symbols from Question 1:

   (a) *Leonardo DiCaprio and Sigourney Weaver both starred in Avatar*

   (b) *If Leonardo DiCaprio is Sigourney Weaver's husband, then Sigourney Weaver is not single and Leonardo DiCaprio is not an actress*

   (c) *Avatar did not star either Sigourney Weaver or Leonardo DiCaprio*

   (d) *If Leonardo DiCaprio is a woman, then he isn't an actor and isn't married to Sigourney Weaver*

5. The truth or falsity of a complex expression of propositional logic is a function of the truth/falsity of the propositional symbols it is consists of. Based on the answers you gave in Question 1, and your knowledge of the truth tables for negation, conjunction, disjunction, implication and equivalence, work out whether the following expressions are true or false:

   (a) $E \wedge B$

   (b) $(C \wedge \neg L) \rightarrow N$

   (c) $(H \rightarrow \neg M) \wedge (M \rightarrow \neg H)$

   (d) $(K \wedge \neg L) \rightarrow N$

*This tutorial exercise sheet was originally written by Mark McConville, revised by Paolo Besana, and further revised and extended by Thomas French. Send comments to* `s.bijani@ed.ac.uk`

## Truth tables of the basic operators

| $A$ | $B$ | $A \wedge B$ |
|---|---|---|
| T | T | T |
| T | F | F |
| F | T | F |
| F | F | F |

| $A$ | $B$ | $A \vee B$ |
|---|---|---|
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | F |

| $A$ | $B$ | $A \to B$ |
|---|---|---|
| T | T | T |
| T | F | F |
| F | T | T |
| F | F | T |