

Informatics 1 – Computation & Logic: Tutorial 1

Propositional Logic: An Introduction

Week 3: 30 September - 4 October 2013

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:

<i>A</i>	<i>Sam Mendes directed Skyfall</i>	
<i>B</i>	<i>Leonardo DiCaprio starred in Skyfall</i>	
<i>C</i>	<i>Leonardo DiCaprio starred in Django Unchained</i>	
<i>D</i>	<i>Quentin Tarantino is a director</i>	
<i>E</i>	<i>Leonardo DiCaprio is an actress</i>	
<i>F</i>	<i>Judi Dench is an actress</i>	
<i>G</i>	<i>Judi Dench acted in Skyfall</i>	
<i>H</i>	<i>Leonardo DiCaprio was married to Judi Dench</i>	
<i>J</i>	<i>Django Unchained was released in 2012</i>	
<i>K</i>	<i>Skyfall is set in 16th century Scotland</i>	
<i>L</i>	<i>Leonardo DiCaprio is a woman</i>	
<i>M</i>	<i>Judi Dench used to be married</i>	
<i>N</i>	<i>Leonardo DiCaprio is an actor</i>	

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 Judi Dench both starred in Skyfall*

(b) *If Leonardo DiCaprio was Judi Dench's husband, then Judi Dench was married and Leonardo DiCaprio is not an actress*

(c) *Skyfall did not star either Judi Dench or Leonardo DiCaprio*

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

5. The truth or falsity of a complex expression of propositional logic is a function of the truth/falsity of the propositional symbols it 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) $(K \wedge \neg L) \rightarrow N$

6. Consider the expression $(H \rightarrow \neg M)$. Work out whether this expression is true or false. Can you explain why this expression is true/false, considering its English translation and the true/false values of the literals?

This tutorial exercise sheet was originally written by Mark McConville, and revised by Paolo Besana, Thomas French and Areti Manataki. Send comments to A.Manataki@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	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T