**CSE112 Artificial Intelligence**， **Week 11 2019**

## Exercises And Tutorial Questions

**Question 1.** Express the following sentences using unary predicates and propositional connectives.

1. John is a tall child.
2. x is short or tall.
3. John is not a clever.
4. Peter is not a clever child.
5. A country is a good holiday resort if it is sunny and dry

**Question *2*.** Assume the propositional symbols in question 4. Assume also that: (a) the symbol **** represents the negation operator ‘not’; (b) the symbol **** represents the conjunction connective ‘and’; (c) the symbol **** represents the disjunction connective ‘or’; (d) the symbol **** represents the implication connective; and (e) the symbol **** 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.

1. A  C
2.  (F  D)
3.  (N  B)

(d) (G  L)    E

(e) A   (C  H)

(f)  (K   B)

(g) F D 

(h) H   (A C)

**Question 3.** Translate the following expressions of propositional logic into reasonably natural English, assuming the key in question 2:

1. E B
2. J  K
3. E  L
4. (C  L) N

|  |  |  |
| --- | --- | --- |
| **A** | Mel Gibson directed Braveheart | TRUE |
| **B** | Keanu Reeves starred in Spider-Man 2 | FALSE |
| **C** | Keanu Reeves starred in The Matrix trilogy | TRUE |
| **D** | Mel Gibson is an actor | TRUE |
| **E** | Keanu Reeves is an actress | FALSE |
| **F** | Kirsten Dunst is an actress | TRUE |
| **G** | Kirsten Dunst starred in Spider-Man 2 | TRUE |
| **H** | Keanu Reeves is married to Kirsten Dunst | FALSE |
| **J** | Spider-Man 2 was released in 2004 | TRUE |
| **K** | The Matrix trilogy is set in 13th century Scotland | FALSE |
| **L** | Keanu Reeves is a woman | FALSE |
| **M** | Kirsten Dunst is single | TRUE |
| **N** | Keanu Reeves is an actor | TRUE |

**Question 4.** Translate the following English sentences into propositional logic, using the appropriate propositional symbols from question 3.

1. Keanu Reeves and Kirsten Dunst starred together in Spider-Man 2
2. If Keanu Reeves is Kirsten Dunst’s husband, then Kirsten Dunst is not single and Keanu Reeves is not an actress
3. Spider-Man 2 didn’t star either Kirsten Dunst or Keanu Reeves
4. If Keanu Reeves is a woman, then he isn’t an actor and isn’t married to Kirsten Dunst

## Question 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 made out of. Based on the answers you gave in question 3, and your knowledge of the truth tables for negation, conjunction, disjunction, implication and equivalence, work out whether the following expressions are true or false:

* 1. E  B
  2. (C  L) N

(c) (H  M)  (M  H)

(d) (K  L) N

# Question 6

Apply the DPLL algorithm to the following formula (¬P ∨ ¬Q ∨ ¬R) ∧ (¬Q ∨ ¬R) ∧ R

to check if it is satisfiable

# Question 7

Given atomic propositions x, y, and z, we consider the following formula: (x ∨ y ∨ z) ∧ (x ∨ ¬y) ∧ (y ∨ ¬z) ∧ (z ∨ ¬x) ∧ (¬x ∨ ¬y ∨ ¬z)

1. Check if this formula is in conjunctive normal form (CNF).
2. Apply the DPLL algorithm to this formula to determine whether the formula is satisfiable or is a contradiction