

COMP 1805 Discrete Structures I

Assignment 1

Due: May 17, 2016 at the end of class

- Write down your name and student number on **every** page.
 - You must have a cover page that clearly states **your name, student number, and course number**. If you do not have a cover page with this information, your assignment will not be marked.
 - The questions should be answered in order and your assignment sheets must be stapled, otherwise the assignment will not be marked.
 - Every part of every question is worth 2 marks. This means question 1 is worth 6 marks, question 2 is worth 6 marks, etc. The grading scheme for each question is 2 for correct answer, 1 for an answer that is not completely correct and 0 otherwise.
1. Determine, for each statement, whether it is a proposition. Justify your answer in either case.
 - (a) “Good luck!”
 - (b) “When am I ever going to use this?”
 - (c) “This is awesome.”
 2. Let x be the proposition “I exercise”, y be the proposition “I am in shape”. Translate the following expressions into English.
 - (a) $x \rightarrow y$
 - (b) $x \wedge \neg y$
 - (c) $\neg y \oplus x$
 3. Translate the following logical propositions into English expressions. Let a be the proposition “The economy is improving”, b be “I make money”, c be “I have a job”, and d be “I finish my degree at Carleton”.
 - (a) $(d \wedge a) \rightarrow c$
 - (b) $\neg c \rightarrow \neg b$
 - (c) $(\neg a \wedge \neg c) \rightarrow d$
 4. Translate the following English expressions into logical statements. You must explicitly state what the atomic propositions are and then show their logical relation.
 - (a) The sun is shining and it is raining.
 - (b) If I open a suspicious file then I get a virus and if I get a virus then I do not open a suspicious file.
 - (c) If I don’t come to every tutorial or make all the assignments then I will not learn the material.

5. Consider the statement “If I build a large rocket and it does not explode or fall over then I will go to space”.

- (a) Translate the statement into logic. You must explicitly state what the atomic propositions are.
- (b) Give the negation of the logical statement.
- (c) Translate the negated logical statement back into English.

6. Determine which of the following statements are True and explain why or why not.

- (a) $1 + 1 = 3$ or the moon is made of cheese.
- (b) If the earth is round then $9 > 20$.
- (c) If $7 + 4 < 11$ then the earth is rotating around the sun.

7. Determine if the following are tautologies, contradictions or contingencies. You may use truth tables.

- (a) $\neg((p \wedge \neg q) \vee (\neg q \wedge p)) \vee \neg((\neg p \vee q) \wedge (\neg q \vee p))$
- (b) $\neg((y \rightarrow \neg x) \rightarrow (x \rightarrow \neg y))$
- (c) $(y \leftrightarrow x) \rightarrow (\neg(y \wedge x) \wedge (y \vee \neg x))$

8. Determine if the following are tautologies, contradictions or contingencies. You cannot use truth tables to justify your answers. Use either logical equivalences or some other means that does not use truth tables.

- (a) $(p \wedge \neg q) \leftrightarrow (p \rightarrow q)$
- (b) $\neg(\neg(\neg a \vee \neg b) \rightarrow (z \rightarrow (a \wedge b)))$
- (c) $(\neg z \wedge \neg y) \rightarrow \neg((z \vee x) \wedge (\neg x \vee y))$

9. Translate the following into English, where $P(x)$ is “ x is pink”, $F(x)$ is “ x is fluffy” and $D(x)$ is “ x dances on rainbows”. The universe of discourse is all unicorns.

- (a) $\neg \exists x (P(x) \wedge (F(x) \wedge \neg D(x)))$
- (b) $\forall x ((D(x) \wedge \neg F(x)) \rightarrow \neg P(x))$

10. Let $B(x)$ be “ x is brave”, $S(x)$ be “ x is stupid”, $G(x)$ be “ x goes to space” and $L(x)$ be “ x lands safely”. The universe of discourse is all Kerbals. State the following logically.

- (a) Not all brave Kerbals who go to space land safely.
- (b) There is exactly one stupid Kerbal who has landed safely.