



Please solve the following exercises and submit **BEFORE 8:00 a.m. of Tuesday 16 September.**

**Exercise 1** **(10 points)**

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Which of these are propositions? What are the truth values of those that are propositions?

- a) What's your name?
- b) There are no black flies in Maine.
- c)  $\frac{1}{y} = 5$
- d)  $z^2 > -1$
- e) Do not pass! Just go!
- f) My money is spent on kittens.

**Exercise 2** **(10 points)**

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Let  $j$  and  $p$  be the propositions

$r$  : I run 5 km each Sunday

$s$  : I am athletic.

Express each of these propositions as an English sentence.

- a)  $\neg r \rightarrow \neg s$
- b)  $\neg r \wedge \neg s$
- c)  $\neg s \vee (r \wedge s)$

**Exercise 3** **(10 points)**

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Let  $p$ ,  $q$ , and  $r$  be the propositions

$p$  : You get an A in this class.

$q$  : You know how to solve every problem in the exam.



$r$  : You solve every assignment on your own.

Write these propositions using  $p$ ,  $q$ , and  $r$  and logical connectives (including negations).

- If you didn't solve every assignment on your own, you wouldn't know how to solve every problem in the exam.
- You solve every assignment on your own, you know how to solve every problem in the exam, and you get an A in this class.
- You get an A in the class, but you haven't solved every assignment on your own; nevertheless, you know how to solve every problem in the exam.
- To get an A in this class, it is necessary for you to solve every assignment on your own.
- Solving every assignment on your own is sufficient for knowing how to solve every problem in the exam.
- If you didn't get an A in this class, then you didn't know how to solve every problem in the exam; and if you didn't know how to solve every problem in the exam, then you haven't solved every assignment on your own.

#### **Exercise 4** **(10 points)**

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Determine whether these biconditionals are true or false.

- $7 * 2 = 14$  if and only if  $3/0$  is undefined.
- $2 + 2 = 5$  if and only if Michael Jackson is still alive.
- $5 * 5 = 25$  if and only if  $1 - 1 = 2$ .
- $12 > 15$  if and only if  $-15 > -12$ .

#### **Exercise 5** **(10 points)**

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For each of these sentences, determine whether an inclusive or, or an exclusive or, is intended. Explain your answer.

- To enter the country you need a passport or a voter registration card.



- b) Enrolling in CMPS211 or MATH201 is required.
- c) Dinner includes steak or chicken.
- d) When you need it, you can't find it or it is not available.

**Exercise 6** **(10 points)**

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State the converse, contrapositive, and inverse of each of these conditional statements.

- a) If it looks easy, it is mind bogglingly complex.
- b) I go to the beach whenever it is a sunny summer day.
- c) When I stay up late, it is necessary that I sleep until noon.

**Exercise 7** **(10 points)**

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Construct a truth table for each of these compound propositions.

- a)  $\neg p \rightarrow \neg q$
- b)  $p \leftrightarrow \neg p$
- c)  $(\neg p \vee \neg q) \rightarrow (p \wedge \neg q)$
- d)  $\neg p \oplus (p \vee \neg q)$
- e)  $(\neg p \leftrightarrow \neg q) \leftrightarrow (q \rightarrow p)$
- f)  $(p \leftrightarrow q) \oplus (p \leftrightarrow \neg q)$

**Exercise 8** **(10 points)**

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What is the value of x after each of these statements is encountered in a computer program, if  $x = 1$  before the statement is reached?

- a) if  $x - 2 < 0$  then  $x := (x+1)/2$

- b) if  $(2x + 2 = 3)$  OR  $(3x + 1 = 3)$  then  $x := x * 2$
- c) if  $(x + 3 = 2)$  AND  $(3x + 4 = 1)$  then  $x := x - 2$
- d) if  $(x > x)$  XOR  $(x < x)$  then  $x := x + 2$
- e) if  $x < 2$  then  $x := x \bmod 2$

### Exercise 9

(20 points)

Fuzzy logic is used in artificial intelligence. In fuzzy logic, a proposition has a truth value that is a number between 0 and 1, inclusive. A proposition with a truth value of 0 is false and one with a truth value of 1 is true. Truth values that are between 0 and 1 indicate varying degrees of truth. For instance, the truth value 0.9 can be assigned to the statement “Joyce is *Angry*,” because Joyce is *angry* most of the time, and the truth value 0.3 can be assigned to the statement “Martha is *hungry*,” because Martha is *hungry* slightly less than half the time. Use these truth values to solve the following exercises.

- a) The truth value of the negation of a proposition in fuzzy logic is 1 minus the truth value of the proposition. What are the truth values of the statements “Joyce is not *angry*” and “Martha is not *hungry*?”
- b) The truth value of the conjunction of two propositions in fuzzy logic is the minimum of the truth values of the two propositions. What are the truth values of the statements “Joyce is *angry* and Martha is *hungry*” and “Neither Fred is *angry* nor Martha is *hungry*?”
- c) The truth value of the disjunction of two propositions in fuzzy logic is the maximum of the truth values of the two propositions. What are the truth values of the statements “Joyce is *angry*, or Martha is *hungry*” and “Joyce is not *angry*, or Martha is not *hungry*?”