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CPE 111 Discrete Mathematics for Computer Engineers
International Program, 2022
Homework 1, due on LEB2 at noon on 17 Aug 2022

Chapter 1
Sec 1.1

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

a) Do not eat in the classroom.

Not a proposition ; it's a command.

b) What time is it?

Not a proposition ; it's a question.

c) There is pollution in Bangkok.

This is a proposition that is true ; there have sound and air polution.

d) $4 + x = 5$.

Not a proposition ; its truth value depends on x

e) The moon is made of green cheese

This is a proposition that is false.

f) $2n \geq 50$.

Not a proposition ; its truth value depends on n

2. Suppose that Smartphone A has 256MB RAM and 32GB ROM, and the resolution of its camera is 8 MP; Smartphone
B has 288 MB RAM and 64 GB ROM, and the resolution of its camera is 4 MP; and Smartphone C has 128 MB RAM and 32 GB ROM, and the resolution of its camera is 5 MP. Determine the truth value of each of these propositions.

b) Smartphone C has more ROM or a higher resolution camera than Smartphone B.

It's true because C has 5 MP resolution compared to B is only 4 MP.

d) If Smartphone B has more RAM and more ROM than Smartphone C, then it also has a higher resolution camera.

It's false due to the hypothesis is true but the conclusion is false.

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3. Determine whether these biconditionals are true or false.

a) 2 + 2 = 4 if and only if 1 + 2 = 3.

True ↔ False = False #

b) 1 + 1 = 2 if and only if 2 + 3 = 5.

True ↔ True = True #

c) 1 + 1 = 3 if and only if monkeys can fly.

False ↔ False = True #

d) 0 > 1 if and only if 2 > 1.

False ↔ True = False #

4. Construct a truth table for each of these compound propositions.

c) $q \oplus (p \wedge q)$

p	**q**	**$p \wedge q$**	**$q \oplus (p \wedge q)$**
T	T	T	F
T	F	F	T
F	T	F	T
F	F	F	F

#

e) $(q \rightarrow \neg p) \rightarrow (p \leftrightarrow q)$

p	q	¬p	$q \rightarrow \neg p$	$p \leftrightarrow q$	$(q \rightarrow \neg p) \rightarrow (p \leftrightarrow q)$
T	T	F	F	T	T
T	F	F	T	F	F
F	T	T	T	F	F
F	F	T	T	T	T

5. Evaluate each of these expressions.

a) (1 1011 ⊕ 1 1001) ⊕ 1 1010

Sol'n

11011 ⊕ 11001 = 00010

00010 ⊕ 11010 = 11000 #

b) (1 0011 ∨ 0 1000) ∧ (1 0001 ∨ 1 1010)

Sol'n

(I) 10011 ∨ 01000 = 11011 —(1)

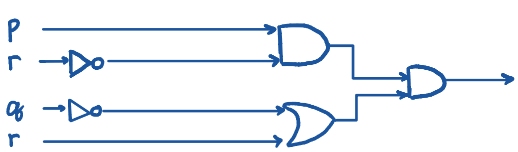
(II) 10001 ∨ 11010 = 11011 —(2)

(1) ∧ (2): 11011 ∧ 11011 = 11011 #

Sec 1.2

6. Construct a combinatorial circuit using inverters, OR gates, and AND gates that produces the output

$(p \wedge \neg r) \wedge (\neg q \vee r)$ from input bits p, q, and r.



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Sec 1.3

7. Use De Morgan's laws to find the negation of each of the following statements.

a) Kwame will take a job in industry or go to graduate school.

Given $p \vee q$ Kwame will not take a job in industry and will not go to graduate school

$\neg (p \vee q) = ?$ $\neg (p \vee q) = (\neg p) \wedge (\neg q)$ #

b) James is young and strong.

Given $p \wedge q$ James is not young, or he is not strong.

$\neg (p \wedge q) = ?$ $\neg (p \wedge q) = (\neg p) \vee (\neg q)$ #

8. Determine whether $(\neg p \wedge (p \rightarrow q)) \rightarrow \neg q$ is a tautology. ∴ Proof that it is not a tautology #

p ¬p	q ¬q	p → q	(¬p ∧ (p → q))	(¬p ∧ (p → q)) → ¬ q
T F	T F	T	F	T
T F	F T	F	F	F
F T	T F	T	T	T
F T	F T	T	T	T

9. Show that $\neg p \rightarrow (q \rightarrow r)$ and $q \rightarrow (p \vee r)$ are logically equivalent.

p	q	r	¬p	q → r	p v r	¬p → (q → r)	q → (p v r)
T	T	T	F	T	T	T	T
T	T	F	F	F	T	T	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	F	F
F	F	T	T	T	T	T	T
F	F	F	T	T	F	T	T

∴ They are logically equivalent. #

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Sec 1.4

9. Let Q(x) be the statement "x +10 > 2x." If the domain consists of all integers, what are these truth values?

a) Q(5) True

b) $\exists x\, Q(x)$ True

c) $\forall x\, Q(x)$ False

g) $\exists x \neg Q(x)$ True

10. Determine the truth value of each of these statements if the domain of each variable consists of all real numbers.

a) $\exists x(x^2 = 2)$ True

b) $\exists x(x^3 = -1)$ True

c) $\forall x(x^2 + 1 \geq 2)$ True

d) $\exists x(x^2 \neq x)$ True

e) $\forall x(x^2 > x)$ False

Sec 1.5

11. Determine the truth value of each of these statements if the domain of each variable consists of all real numbers.

a) $\forall x \exists y\, (x = y^2)$ False

b) $\exists x \forall y\, (xy = 0)$ True

c) $\exists x \exists y\, (x - y = y - x)$ True

d) $\exists x \forall y\, (y = 0 \rightarrow xy = 1)$ False.

e) $\forall x \exists y\, (x+2y = 2 \wedge 2x + 4y = 5)$ False

f) $\forall x \forall y \exists z\, (z = (x + y) / 2)$ True.