65070503410 CHARUNTHON LIMSEELO

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.

65070503410 CHARUNTHON LIMSEELO

3. Determine whether these biconditionals are true or false.

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

True $\leftrightarrow$ True = True #

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

True $\leftrightarrow$ True = True #

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

False $\leftrightarrow$ False = True #

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

False $\leftrightarrow$ 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	$\neg$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 $\oplus$ 1 1001) $\oplus$ 1 1010

Sol'n

$$\begin{array}{r} 11011 \\ \oplus\ 11001 \\ \hline 00010 \end{array} \qquad \begin{array}{r} 00010 \\ \oplus\ 11010 \\ \hline 11000 \end{array} \ \#$$

b) (1 0011 $\vee$ 0 1000) $\wedge$ (1 0001 $\vee$ 1 1010)

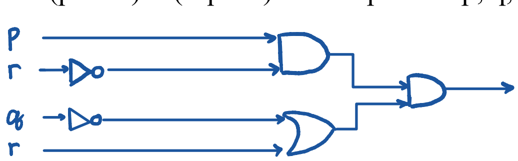
Sol'n

$$\text{(I)}\ \begin{array}{r} 10011 \\ \vee\ 01000 \\ \hline 11011 \end{array} \text{— (1)} \qquad \text{(II)}\ \begin{array}{r} 10001 \\ \vee\ 11010 \\ \hline 11011 \end{array} \text{— (2)} \qquad (1) \wedge (2)\ \begin{array}{r} 11011 \\ \wedge\ 11011 \\ \hline 11011 \end{array} \ \#$$

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.



#

6507050341O CHARUNTHON LIMSEELO

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

$\neg (p \lor q) =$? $\neg(p \lor q) = (\neg p) \land (\neg q)$ #

b) James is young and strong.

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

$\neg (p \land q) =$? $\neg(p \land q) = (\neg p) \lor (\neg q)$ #

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

p ¬p	q ¬q	$p \to q$	$(\neg p \land (p \to q)$	$(\neg p \land (p \to q)) \to \neg q$
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 $\neg p \to (q \to r)$ and $q \to (p \lor r)$ are logically equivalent.

p	q	r	$\neg p$	$q \to r$	p v r	$\neg p \to (q \to r)$	$q \to (p \lor r)$
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. #

65070503410 CHARUNTHON LIMSEELO

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) ∃x Q(x) True

c) ∀x Q(x) False

g) ∃x ¬ 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.