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.

b) What time is it?

c) There is pollution in Bangkok.

d) $4 + x = 5$.

e) The moon is made of green cheese

f) $2n \geq 50$.

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.

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

3. Determine whether these biconditionals are true or false.

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

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

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

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

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		
F	T		
F	F		

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

p	q	$\neg p$	$q \to \neg p$	$p \leftrightarrow q$	$(q \to \neg p) \to (p \leftrightarrow q)$
T	T	F			
T	F	F			
F	T	T			
F	F	T			

5. Evaluate each of these expressions.

a) $(1\ 1011 \oplus 1\ 1001) \oplus 1\ 1010$

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

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.

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 $p \vee q$

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

b) James is young and strong.

Given $p \wedge q$

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

8. Determine whether $(\neg p \wedge (p \rightarrow q)) \rightarrow \neg q$ is a tautology.

p	q	$p \rightarrow q$	$(\neg p \wedge (p \rightarrow q)$	$(\neg p \wedge (p \rightarrow q)) \rightarrow \neg q$
T	T			
T	F			
F	T			
F	F			

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

p	q	r	$\neg p$	$q \rightarrow r$	$p \vee r$	$\neg p \rightarrow (q \rightarrow r)$	$q \rightarrow (p \vee r)$
T	T	T					
T	T	F					
T	F	T					
T	F	F					
F	T	T					
F	T	F					
F	F	T					
F	F	F					

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) $Q(5)$

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

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

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

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

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

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

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

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

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

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) $\forall x \exists y\ (x = y^2)$

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

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

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

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

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