

Assignment 1 Solution

Exercise 1:

- a) It is not a proposition
- b) It is a proposition, false: there are black flies in Maine.
- c) It is not a proposition
- d) If z belongs to R , this is a true proposition
If z belongs to C , this is not a proposition
- e) It is not a proposition
- f) It is a proposition
True: my money is spent on kittens
False: my money is not spent on kittens

Exercise 2:

- a) If I don't run 5km each Sunday, then I'm not athletic.
- b) I don't run 5km each Sunday and I'm not athletic.
- c) I'm either not athletic or I run 5km each Sunday and I am athletic.

Exercise 3:

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

Exercise 4:

- a) True
- b) True
- c) False
- d) True

Exercise 5:

- a) Inclusive or
- b) Inclusive or
- c) Exclusive or
- d) Exclusive or

Exercise 6:

- a) **Converse:** if it is mind bogglingly complex, it looks easy.
Contrapositive: if it is not mind bogglingly complex, it doesn't look easy.
Inverse: if it doesn't look easy, it is not mind bogglingly complex.
- b) **Converse:** it is a sunny summer day whenever I go to the beach.
Contrapositive: it is not a sunny summer day whenever I don't go to the beach.
Inverse: I don't go to the beach whenever it is not a sunny summer day.
- c) **Converse:** when I sleep until noon, it is necessary that I stay up late.
Contrapositive: when I don't sleep until noon, it is necessary that I don't stay up late.
Inverse: when I don't stay up late, it is necessary that I don't sleep until noon.

Exercise 7:

a) $\neg p \rightarrow \neg q$

p	q	$\neg p$	$\neg q$	$\neg p \rightarrow \neg q$
T	T	F	F	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

b) $p \leftrightarrow \neg p$

p	$\neg p$	$p \leftrightarrow \neg p$
T	F	F
T	F	F
F	T	F
F	T	F

c) $(\neg p \vee \neg q) \rightarrow (p \wedge \neg q)$

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

d) $\neg p \oplus (p \vee \neg q)$

p	q	$\neg p$	$\neg q$	$p \vee \neg q$	$\neg p \oplus (p \vee \neg q)$
T	T	F	F	T	T
T	F	F	T	T	T
F	T	T	F	F	T
F	F	T	T	T	F

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

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

f) $(p \leftrightarrow q) \oplus (p \leftrightarrow \neg q)$

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

Exercise 8:

- a) If $x - 2 < 0$ then $x := (x+1)/2$
 $-1 < 0 \Rightarrow \text{True}$. So $x = 2/2 = 1$
- b) If $(2x + 2 = 3)$ OR $(3x + 1 = 3)$ then $x := x * 2$
 $(2 + 2 \neq 3)$ and $(4 \neq 3) \Rightarrow \text{False or False} \Rightarrow \text{False}$. So $x = 1$
- c) if $(x + 3 = 2)$ AND $(3x + 4 = 1)$ then $x := x - 2$
 $(4 \neq 2)$ and $(7 \neq 1) \Rightarrow \text{False and False} \Rightarrow \text{False}$. So $x = 1$
- d) if $(x > x)$ XOR $(x < x)$ then $x := x + 2$
 $(1 = 1) \Rightarrow \text{False xor False} \Rightarrow \text{False}$. So $x = 1$
- e) if $x < 2$ then $x := x \bmod 2$
 $(1 < 2) \Rightarrow \text{True}$. So $x = 1 \bmod 2 = 1$

Exercise 9:

- a) Joyce is not angry: truth value = $1 - 0.9 = 0.1$
 Martha is not hungry: truth value = $1 - 0.3 = 0.7$
- b) Joyce is angry and Martha is hungry: truth value = 0.3
 Neither Joyce is angry nor Martha is hungry: truth value = 0.1
- c) Joyce is angry, or Martha is hungry: truth value = 0.9
 Joyce is not angry, or Martha is not hungry: truth value = 0.7