

# Homework #1

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Discrete Math for Computing: January 2017 - May 2017

## 1a

$p =$  “I will dance a jig”,  $q =$  “I will have fun doing it”

$$p \wedge q \therefore p$$

$p \wedge q$	$p$
T	T

## 1b

$p =$  “Morgan will join a band next year”,  $q =$  “she will be playing alone”.

$$p \therefore p \vee q$$

$p$	$p \vee q$
T	T

## 1c

$p =$  “I work all week on this homework”,  $q =$  “I will answer all the problems”,  
 $r =$  “I will understand all the material”.

$$p \rightarrow q, q \rightarrow r \therefore p \rightarrow r$$

$p \rightarrow q$	$q \rightarrow r$	$p \rightarrow r$
T	T	T

2a

$$p \wedge \neg p$$

$p$	$\neg p$	$p \wedge \neg p$
T	F	F
F	T	F

2b

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

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

2c

$$p \rightarrow \neg p$$

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

2d

$$p \oplus p$$

$p$	$p \oplus p$
T	F
F	F

2e

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

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

**2f**

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

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

Tautology!

**2g**

$$(p \wedge q) \vee r$$

$p$	$q$	$r$	$p \wedge q$	$(p \wedge q) \vee r$
T	T	T	T	T
T	T	F	T	T
T	F	T	F	T
T	F	F	F	F
F	T	T	F	T
F	T	F	F	F
F	F	T	F	T
F	F	F	F	F

**2h**

$$(p \vee q) \wedge r$$

$p$	$q$	$r$	$p \vee q$	$(p \vee q) \wedge r$
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	F
F	F	F	F	F

2i

$$(p \leftrightarrow q) \leftrightarrow (q \leftrightarrow r)$$

$p$	$q$	$r$	$(p \leftrightarrow q)$	$(q \leftrightarrow r)$	$(p \leftrightarrow q) \leftrightarrow (q \leftrightarrow r)$
T	T	T	T	T	T
T	T	F	T	F	F
T	F	T	F	F	T
T	F	F	F	T	F
F	T	T	F	T	F
F	T	F	F	F	T
F	F	T	T	F	F
F	F	F	T	T	T