Lab 0
CS 135

By: your friendly CAs :p

Scheme Lab Rules

01

No copying/
sharing code.

02

Make sure your code compiles before submitting! Otherwise that's a big fat 0.

03

Only work on extra credit after all regular functions are finished!

04

Make sure to participate while we go over practice problems.

Practice Problems

Don’t just wait for the solution, try them out yourself!

Truth Tables

p	q	$\neg q$	$p \vee q$	$p \wedge q$	$p \rightarrow q$	$p \oplus q$	$p \leftrightarrow q$
T	T						
T	F						
F	T						
F	F						

Truth Tables

p	q	$\neg q$	$p \vee q$	$p \wedge q$	$p \rightarrow q$	$p \oplus q$	$p \leftrightarrow q$
T	T	F	T	T	T	F	T
T	F	T	T	F	F	T	F
F	T	F	T	F	T	T	F
F	F	T	F	F	T	F	T

Truth Tables

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

Truth Tables

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

Truth Tables

How many rows appear in a truth table for each of these compound propositions?

a. $(p \vee q) \wedge (r \vee \neg t)$
b. $a \vee b \vee c \vee d \vee e \vee f$

Challenge: can you provide the truth table for the following compound propositions?

a. $\neg(a \vee \neg(b \vee \neg(c \wedge d)))$
b. $((\neg a \vee (a \wedge b)) \rightarrow (c \wedge b)$

Truth Tables

How many rows appear in a truth table for each of these compound propositions?

a. $(p \vee q) \wedge (r \vee \neg t)$ 4 variables so 2^4 = 16 rows

b. $a \vee b \vee c \vee d \vee e \vee f$ 6 variable so 2^6 = 64 rows

Truth Tables

Challenge: can you provide the truth table for the following compound propositions?

a. $\neg(a \lor \neg(b \lor \neg(c \land d)))$
b. $(\neg a \lor (a \land b)) \to (c \land b)$

Truth Tables

Challenge: can you provide the truth table for the following compound propositions?

a. ¬(a∨¬(b∨¬(c∧d)))

*final answer provided but table should include intermediate steps like c∧d, ~(c∧d), etc

a	b	c	d	¬(a∨¬(b∨¬(c∧d)))
F	F	F	F	T
F	F	F	T	T
F	F	T	F	T
F	F	T	T	F
F	T	F	F	T
F	T	F	T	T
F	T	T	F	T
F	T	T	T	T
T	F	F	F	F
T	F	F	T	F
T	F	T	F	F
T	F	T	T	F
T	T	F	F	F
T	T	F	T	F
T	T	T	F	F
T	T	T	T	F

Truth Tables

Challenge: can you provide the truth table for the following compound propositions?

b. $((\neg a \lor (a \land b)) \to (c \land b)$

a	b	c	$((\neg a \lor (a \land b)) \to (c \land b)$
T	T	T	T
T	T	F	F
T	F	T	T
T	F	F	T
F	T	T	T
F	T	F	F
F	F	T	F
F	F	F	F

Logic

Translate this argument to propositions using logical connectives. Then solve to see if they're equivalent.

If I attend lectures then I will do well in CS 135 or if I do my homework then I will do well in CS 135.

If I attend lectures and do my homework then I will do well in CS 135.

Logic

Translate this argument to propositions using logical connectives. Then solve to see if they're equivalent.

(If I attend lectures, then I will do well in CS 135), or (if I do my homework, then I will do well in CS 135).

$(A \rightarrow W) \vee (H \rightarrow W)$

Key:
attend lectures = A
do well in 135 = W
do my HW = H

(If I attend lectures and do my homework), then I will do well in CS 135.

$(A \wedge H) \rightarrow W$

Logic

Translate this argument to propositions using logical connectives. Then solve to see if they're equivalent.

$A \Rightarrow W \vee (H \Rightarrow W)$	
$\equiv \neg A \vee W \vee (\neg H \vee W)$	Conditional Identity Law (applied twice)
$\equiv \neg A \vee W \vee (W \vee \neg H)$	Commutative Law
$\equiv \neg A \vee W \vee W \vee \neg H$	Associative Law
$\equiv \neg A \vee W \vee W \vee \neg H$	Associative Law
$\equiv (\neg A \vee W) \vee \neg H$	Idempotent Law
$\equiv \neg A \vee (W \vee \neg H)$	Associative Law
$\equiv \neg A \vee (\neg H \vee W)$	Commutative Law
$\equiv (\neg A \vee \neg H) \vee W$	Associative Law
$\equiv \neg(A \wedge H) \vee W$	De Morgan's Law
$\equiv (A \wedge H) \Rightarrow W$	Conditional Identity

Key:
attend lectures = A
do well in 135 = W
do my HW = H

Intro to Racket

No need to understand everything right now, more practice to come in the following weeks!

Download Dr Racket

https://download.racket-lang.org

Documentation:
https://docs.racket-lang.org/eopl/index.html

Evaluating List of Expressions

Given the list

(f x y z)

The interpreter will:

- Check if the first atom is a function.
  - (x + y) or (x y z) will throw an error
- Evaluate the remaining atoms in the list
  - If any of the arguments are undefined the interpreter will throw an error
- Apply the function “f” to the values passed through it

How can we replicate a function?

Given the mathematical function

$$f(x,y) = (x^2+y^2)/2$$

We can define the function in Racket as

```
(define (f x y) (/ (+ (* x x) (* y y)) 2))
```

Function name and parameters

Function body

To test your function with x = y = 3 pass in `(f 3 3)`

5 Laws The Little Schemer

1. The Law of Car
   a. The primitive *car* is defined only for non-empty lists.
2. The Law of Cdr
   a. The primitive *cdr* is defined only for non-empty lists. The *cdr* of any non-empty list is always another list
3. The Law of Cons
   a. The primitive *cons* takes two arguments. The second argument to *cons* must be a list. The result is a list.
4. The Law of Null?
   a. The primitive *null?* Is defined only for lists.
5. The Law of Eq?
   a. The primitive *eq?* takes two arguments and checks if they are the same object.

Logic

Solve the following.

1. Show that $p \rightarrow q$ is equivalent to $\neg q \rightarrow \neg p$

2. Use De Morgan’s law to find the negation of each of these statement.
   a. Elon is rich and happy.
   b. Attila runs or walks around campus.
   c. You will not eat that cookie and walk away.

Logic

Solve the following.

1. Show that $p \rightarrow q$ is equivalent to $\neg q \rightarrow \neg p$

$p \rightarrow q$

$\neg p \vee q$ conditional identity law

$q \vee \neg p$ commutative law

$\neg\neg q \vee \neg p$ double negation

$\neg q \rightarrow \neg p$ conditional identity

Logic

Solve the following.

1. Use De Morgan's law to find the negation of each of these statement.
   a. Elon is rich and happy.

      Key: is rich = R   is happy = H   so sentence is $R \wedge H$

      $\neg(R \wedge H) \equiv \neg R \vee \neg H \equiv$ elon is not rich or not happy

   b. Attila runs or walks around campus.

      Key: runs = R   walks = W   so $R \vee W$

      $\neg(R \vee W) \equiv \neg R \wedge \neg W \equiv$ Attila doesn't run and doesn't walk around campus

   c. You will not eat that cookie and walk away.

      Key: eat cookie = C   walk away = W $\neg C \wedge W$

      $\neg(\neg C \wedge W) \equiv \neg\neg C \vee \neg W \equiv C \vee \neg W \equiv$ You will eat that cookie or you won't walk away