CS1802-HON Fall 2021
Recitation Problem Set #2
September 20-23, 2021

--Submit on Gradescope at the end of your recitation section--

The problems in this recitation are based on the course material covered in the CS1800 lecture videos and are meant to prepare you for upcoming homework assignments. You earn full credit for a recitation by using your time well and demonstrating effort on the assignment. Submit your solution on Gradescope by uploading images of hand-written work, or uploading a PDF.

Submit your work in real-time at the end of your section. The final deadline for recitation submissions is ***Thursday at 8pm eastern.***

Question #1

Consider the statements S, T, and U below.

S = Grizz naps
T = Grizz is hungry
U = Grizz plays fetch

Now consider the dog we're referring to:

Grizz Strange :)

Translate each of the following English sentences into logical statements, using negation, conjunction and/or disjunction symbols.

A. Grizz naps but is not hungry.

B. Grizz doesn't nap or play fetch.

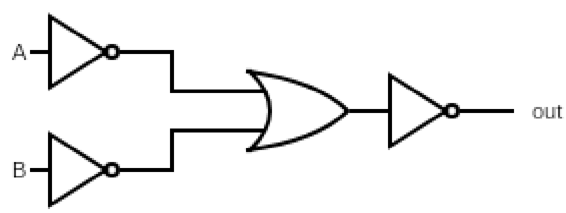
C. Grizz naps or maybe doesn't nap, and he plays fetch.

D. Grizz naps and plays fetch, or else he does not get hungry.

****Bonus Question**** Is Grizz the cutest thing ever? Or what? (not mathematical)

Question #2 (already done last week, but write it down)

Back in Recitation 1, you drew a circuit with the same behavior as an AND gate, using only NOT and OR. Any circuit that works is acceptable; here's the one from our sample solution:



Is it really the same as an AND gate? Prove it, using...

A. **A truth table**. One of your columns should be $A \wedge B$, the goal of the circuit. Each column in your truth table represents ONE step; don't combine multiple logic transformations, because that makes your truth table harder to follow and less convincing.

B. **The laws of logical equivalence**. Start by writing a logical expression for the circuit above. Apply one law of logical equivalence at a time, and make sure you identify the law so your reader can follow along -- all part of making your proof convincing!

Question #3

For this problem, the domain is the set of all the characters on the *legendary* Netflix show Cobra Kai. Consider the following two predicates:

- *johnny(x)*, meaning "Johnny fights x"
- *karate(x)*, meaning "x studies karate"

Using only variables, logic symbols $(\neg, \wedge, \vee, \Rightarrow, \exists, \forall)$ and the predicates *johnny()* and *karate()*, formulate the following statements:

A. Johnny doesn’t fight everyone who studies karate.

B. The only people Johnny fights are people who study karate.

Question #4

Picture a 6x5 tic-tac-toe board, something like this:

Each object on the board is either a cross (X) or a nought (O). Each object can be colored red or blue, no other options. Finally, each object can be above another object. We define these properties as follows:

- red(x) = x is colored red
- cross(x) = x is a cross (X)
- nought(x) = x is a nought (O)
- above(x, y) = object x is in a row that’s above object y

Using the predicates above, logical symbols $\vee, \wedge, \neg, \Rightarrow$ and quantifiers $\forall, \exists$ translate the following statements about our tic-tac-toe board into formal logic.

A. All crosses are colored red.

B. At least two noughts are colored blue. (*Hint:* What does it mean to have “at least two” blue noughts? For sure two blue noughts exist. More *could* exist, but don’t have to.)

C. There is a nought that is colored blue and is above every cross.

Question #5

The following English statements can be represented in formal logic using only $\Rightarrow$ and/or $\neg$. For each of them, write out the truth table specified, compare the two implications listed, and explain which implication best respects the original statement and why.

A. Nate can go climbing only if he has paid the entrance fee.

P = Nate can go climbing

Q = Nate has paid the entrance fee

Write out truth tables for $P \Rightarrow Q$ and $Q \Rightarrow P$. Which one better respects the original statement?

B. Nate can't get in the building, unless he remembers his Husky card.

P = Nate can't get in the building

Q = Nate remembers his Husky card

Write out truth tables for: $P \Rightarrow \neg Q$, $\neg Q \Rightarrow P$. Which one better respects the original statement?

Question #6 (HON) Required parts 1-4

6-1

A	**= 0 1 1 1 0 1**		**A**	**= 0 1 1 1 0 1**
B	**= 1 0 1 0 0 0**		**B**	**= 1 0 1 0 0 0**
$A \vee B$	=		**C**	**= 0 1 1 1 1 0**
$A \wedge B$	=		$A \vee B \vee C$	=
$A \oplus B$	=		$A \wedge B \wedge C$	=
			$A \oplus B \oplus C$	=

6-2 XOR operation order

A = 0 1 1 1 0 1
B = 1 0 1 0 0 0
C = 0 1 1 1 1 0
D = 1 0 1 0 1 0

$A \vee B \vee C \vee D$ =
$A \wedge B \wedge C \wedge D$ =
$A \oplus B \oplus C \oplus D$ =
$A \oplus B$ =
$C \oplus D$ =
$(A \oplus B) \oplus (C \oplus D)$ =
$B \oplus C \oplus D$ =
$A \oplus (B \oplus C \oplus D)$ =

6-3 Solve for XOR argument

A	**= 0 1 1 1 0 1**	**A**	**= 0 1 1 1 0 1**
B	**= 1 0 1 0 0 0**	**B**	**= 1 0 1 0 0 0**
C	**= 0 1 1 1 1 0**	**C**	**= 0 1 1 1 1 0**
D?	=	**D?**	=
$A \oplus B \oplus C \oplus D$	**= 0 1 0 1 0 1**	$A \oplus B \oplus C \oplus D$	**= 0 0 0 0 0 0**

6-4 Solve for AND, OR argument – can you?

A	**= 0 1 1 1 0 1**	**A**	**= 0 1 1 1 0 1**
B	**= 1 0 1 0 0 0**	**B**	**= 1 0 1 0 0 0**
C	**= 0 1 1 0 0 0**	**C**	**= 0 1 1 0 0 0**
D?	=	**D?**	=
other D?	=	**other D?**	=
other D?	=	**other D?**	=
$A \vee B \vee C \vee D$	**= 1 1 1 1 0 1**	$A \wedge B \wedge C \wedge D$	**= 0 0 1 0 0 0**

6-5 ★Solve for XOR proof (optional)

A,B,C sequences of n bits each. Then $A \oplus B = A \oplus C \iff B = C$

Question #7(HON) Optional

★ 10 wise men live in a village.
Each man has a color dot on the forehead either R or B not known to him; knowing his color means immediate death. But everyone knows the other men's colors, i.e. a B person sees 5R and 4B.
The men dont speak/communicate to each other, but each morning they meet in a circle and they can see if anyone died. They are extremely smart (can infer anything) and know when someone dies its because he must have figured out his color.

For quite a few days this goes unchanged, until one day a stranger passes to the village and remarks #the number of B colors is not 10#.
Prove that eventually everyone in the village will #gure out his color and die.