CS251 homework 2

name:_____

Due: 10/15/19

1. last week we showed that nand $\odot$ is a universal operator. That is, we can write all operators in terms of nand. Show that $\rightarrow$ is a universal operator by writing $\neg, \wedge$, and $\vee$ with only $\rightarrow$.

2. Convert the following into CNF

   (a) $(c \wedge a) \vee (b \wedge c)$

   (b) $(a \wedge \neg a) \vee (b \wedge \neg b)$

   (c) $a \rightarrow (b \equiv c)$

   (d) $(a \rightarrow b) \wedge (b \rightarrow c)$

(e) $\neg(a \vee b)$

(f) $(a \equiv b) \equiv c$

3. Prove the following theorems using inference rules from lecture 3. After you're done proving these, check them with the proof checker from class.
   `https://github.com/slibby05/proofs`
   Put these proof in hw2.py file, and turn that in on D2L.

   (a) $a \vee b \vdash b \vee a$:

(b) $(a \vee b), \neg b \vdash a$:

(c) $\neg a \vee \neg b \vdash \neg(a \wedge b)$:

(d) DL1: $\neg(\neg a \vee \neg b) \vdash a$

(e) $\neg(a \wedge b) \vdash \neg a \vee \neg b$:
(Hint: you can use the previous problem, and a theorem from class.

$$\frac{\neg(\neg a \vee \neg b)}{a}\, DL1 \quad \frac{\neg(\neg a \vee \neg b)}{b}\, DL2 \quad \frac{\neg\neg a}{a}\, \neg\neg E$$