CS 31 Homework 2

Due on Friday, September 23^{rd} 2016

The basic gates `AND`, `OR`, and `NOT` are a *universal gate set*, meaning that we can construct any combinational circuit using only these gates. By solving problems 1–3, you will demonstrate that `NAND` constitutes a universal gate set by itself.

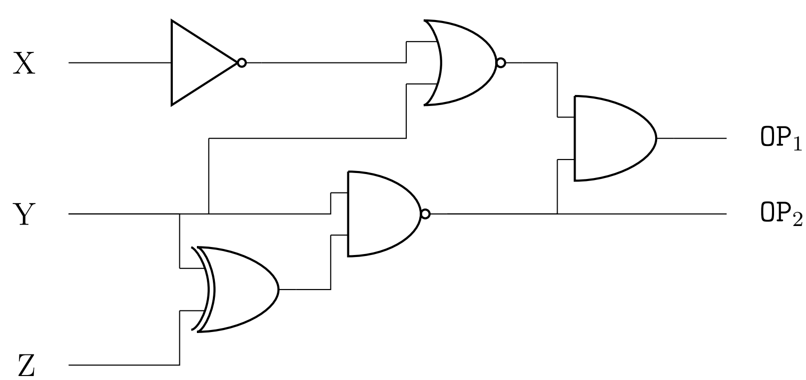
1. Construct a `NOT` gate using only `NAND` gate(s).

2. Construct an `AND` gate using only `NAND` gate(s).

3. Construct an `OR` gate using only `NAND` gate(s).
   Hint: by De Morgan's law, $X \mid Y \equiv \neg(\neg X \,\&\, \neg Y)$.

4. Fill in the truth table for the following circuit.

x	y	z	$\mathtt{OP}_1$(x, y, z)	$\mathtt{OP}_2$(x, y, z)
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		



5. Construct a circuit that implements the following truth table. You may use any of the following one- or two-input gates: `NOT`, `AND`, `OR`, `XOR`, `NAND`, `NOR`, `XNOR`.

x	y	z	$\texttt{OP}_1$(x, y, z)	$\texttt{OP}_2$(x, y, z)
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	0
1	0	1	0	1
1	1	0	0	1
1	1	1	0	1