COE 328 - Lab 2
Prelab

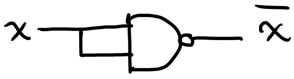
2 Pre-Lab Preparation

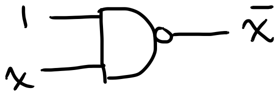
Implementation of the simple logic functions with NAND gates

1. Determine 2 ways to implement an inverter with a 2-input NAND gate.
2. Implement a 3-input NAND gate function using 2-input NAND gates only, draw schematics.
3. Implement a 2-input OR function using 2-input NAND gates only, draw schematics.
4. (A) Implement the function $Z = f(A, B) = (A + B)\overline{AB}$ using one 2-input OR gate, one 2-input AND gate and one 2-input NAND gate.
   (B) Implement the same function Z with only NAND gates.
   (C) Make up the truth table for the function. What is the common name of this function?
   (D) Expand and simplify the Boolean equation to express Z as a sum of products. Implement the sum of products using only NAND gates. Note: It is possible to do so with 4 NAND gates and no additional inverters.

1) Inverter

x	$\bar{x}$
0	1
1	0

① 

② 

2)

x_1	x_2	x_3	f
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

$f = \underbrace{\bar{x}_1 + \bar{x}_2}_{K} + \bar{x}_3$

general function of NAND

$= \overline{x_1 x_2}$

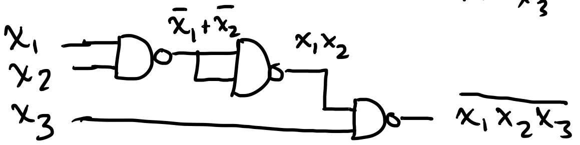
$K = \overline{\bar{x}_1 + \bar{x}_2}$

$\bar{K} = \overline{x_1 x_2}$

$f = K + \bar{x}_3$

$\bar{\bar{f}} = \overline{\overline{K + \bar{x}_3}}$

$f = \overline{\bar{K} \cdot x_3}$

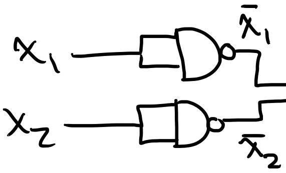


3)

x_1	x_2	f
0	0	0
0	1	1
1	0	1
1	1	1

$f = x_1 + x_2$

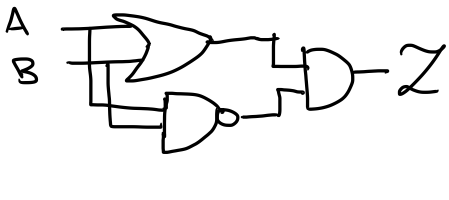
$f = \overline{x_1 x_2}$
$= \bar{x}_1 + \bar{x}_2$



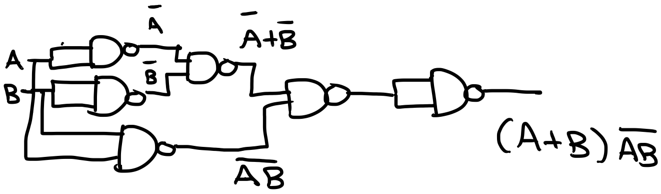
$\overline{\bar{x}_1 \cdot \bar{x}_2} = \bar{\bar{x}}_1 + \bar{\bar{x}}_2$

$= x_1 + x_2$

4) a) $Z = f(A,B) = (A+B)\overline{AB}$



b) Only using NAND gates



c)

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	0

XOR gate

d) $Z = (A+B)\,\overline{AB}$

$= (A+B)(\bar{A}+\bar{B})$

$= (\cancel{A\bar{A}} + A\bar{B} + B\bar{A} + \cancel{B\bar{B}})$

$= A\bar{B} + B\bar{A}$