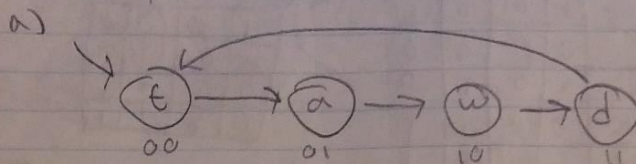


Hw #5

1. $t = \text{time}$, $w = \text{stopwatch}$
 $a = \text{alarm}$, $d = \text{date}$



b) This is a Moore because the output only depends on the current state, not the input value

c)

p1	p0	B	N1	N0
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	1	0
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

~~seg~~ B

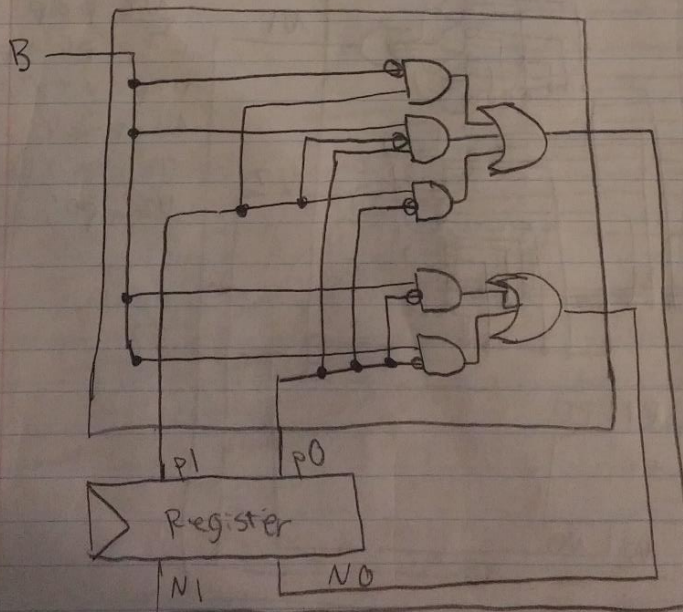
N1	p0	p1
0	0	0
0	0	1
0	1	0
0	1	1

N0

N1	p0	p1
0	0	0
0	0	1
0	1	0
0	1	1

$$N1 = p1b' + p1p0' + p1'p0b$$

$$N0 = p0'b' + p1'b$$



2. a)

PZ	P1	P0	u	nZ	n	n0
0	0	0	0	1	1	1
0	0	0	1	0	0	1
0	0	1	0	0	0	0
0	0	1	1	0	1	0
0	1	0	0	0	0	1
0	1	0	1	0	1	1
0	1	1	0	0	1	0
0	1	1	1	1	0	0
1	0	0	0	0	1	1
1	0	0	1	1	0	1
1	0	1	0	1	0	0
1	0	1	1	1	1	0
1	1	0	0	1	0	1
1	1	0	1	1	1	1
1	1	1	0	1	1	0
1	1	1	1	0	0	0

NZ

1	0	1	0
0	0	1	1
0	1	0	1
0	1	1	1

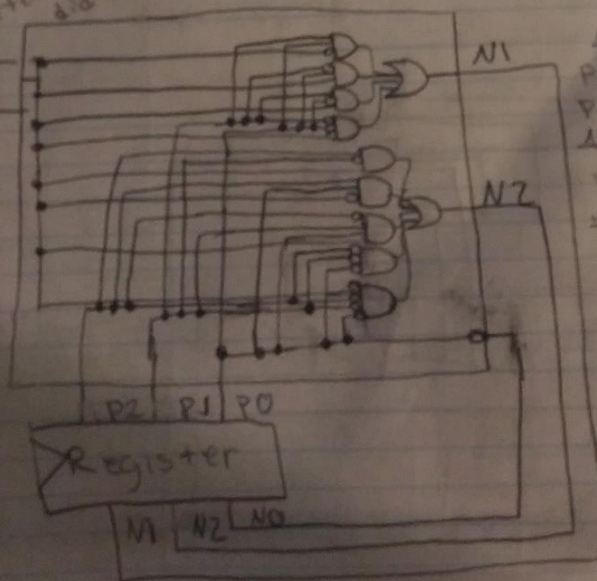
N1

1	0	0	1
0	1	1	0
1	0	0	1
0	1	1	0

N0

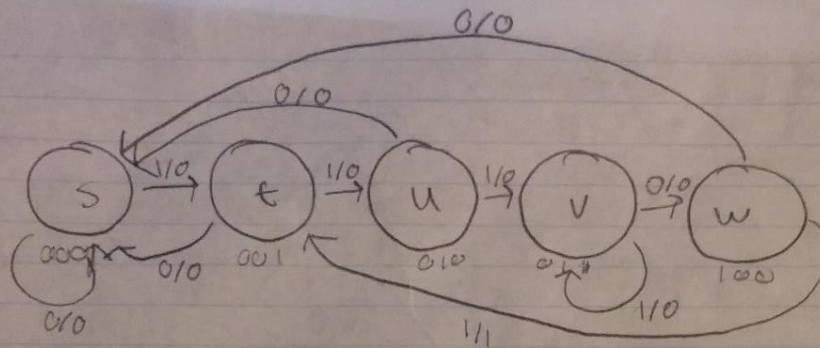
1	1	1	1
1	1	1	1
0	0	0	0
0	0	0	0

N1 and NZ are switches because I want to redraw



$$\begin{aligned}
 NZ &= pZ'p1'p0'u + pZ'p1'p0 + pZ'p1p0u + pZp1'u + pZp0u \\
 N1 &= p1'p0'u + p1p0'u + p1'p0u + p1p0u \\
 NZ &= p0'
 \end{aligned}$$

3.



P2	P1	P0	x	NZ	N1	N0	Z
0	0	0	0	0	0	0	0
0	0	0	1	0	0	1	0
0	0	1	0	0	0	0	0
0	0	1	1	0	1	0	0
0	1	0	0	0	0	0	0
0	1	0	1	0	1	1	0
0	1	1	0	0	1	1	0
0	1	1	1	1	0	0	0
1	0	0	0	0	0	0	0
1	0	0	1	0	0	1	1

N2

POX

PZP1

0	0	x	0
0	0	x	0
0	1	x	x
0	0	x	x

N1

0	0	x	0
0	0	x	0
1	0	x	x
0	1	x	x

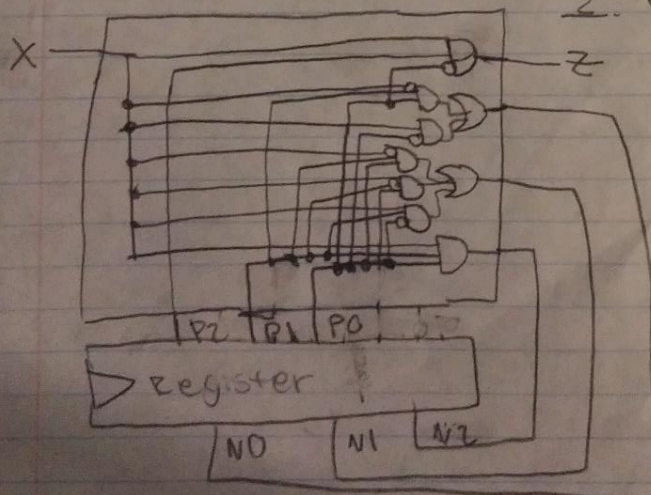
N0

0	0	x	0
1	1	x	1
0	0	x	x
0	1	x	x

Z

0	0	x	0
0	0	x	1
0	0	x	x
0	0	x	x

$NZ: p1p0x$
 $N1: p1p0'x + p1'p0x + p1p0x'$
 $N0: p0'x + p1p0x'$
 $Z: p2p0'x$



4. a) ~~1. ~~15 + 20 + 30 = 65~~~~ p

$$pd = 25 + 20 + 30 = 75 \text{ ps}$$

$$\text{setup} = 30 \text{ ps}$$

$$pcq = 35 \text{ ps}$$

$$75 + 30 + 35 = 140 \text{ ps}$$

$$f_T = 7.14 \text{ GHz}$$

b) 166 ps is total

$$166 - 140 = 26 \text{ ps clock skew needed}$$

c) ~~skew + 15 + 10 + 21 = 46 ps~~

$$\text{skew} + 15 + 10 + 21 = 46 \text{ ps}$$

$$15 - 10 + 21 = 26$$

$$\text{Hold} \leq cd + ccq - \text{skew}$$

$$\text{skew} > (15 + 22) + 21 - 10$$

$$\text{skew} > 48 \text{ ps}$$