

Raizid Ahmed Homework 1 9/3/20

Problem 1:

Given:

M and P Neurons

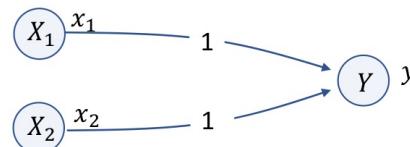
Find:

a) 3 input OR

b) 3 input And

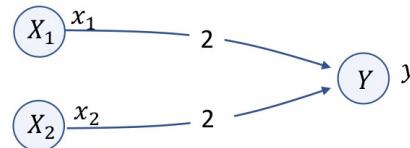
Source material:

Basic M-P neuron:
Logical AND



x_1	x_2	y
0	0	0
0	1	0
1	0	0
1	1	1

Basic M-P neuron:
Logical OR



x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	1

Analysis:

$$y; \theta = 1$$

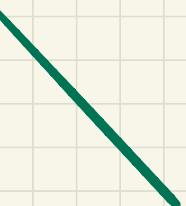
a)

$$kw \geq \theta > (k-1)w$$

$$(1)(w) \geq 1 > 0$$

w must be
at least 1

x_1



1

x_2



1

x_3



1

y

x_1	x_2	x_3	y
0	0	1	1
0	1	0	1
1	0	0	1
1	1	1	1
0	0	0	0
1	1	0	1
0	1	1	1

$\vee: x_1(t-1) \text{ or } x_2(t-1) \text{ or } x_3(t-1)$

b) $y: \theta = 3$

$$kw \geq \theta > (k-1)w$$

$$3w \geq 3 > (2)w$$

w can still be

1

x_1



x_2

1

1

1

x_3

y

$y: x_1(t-1) \text{ and } x_2(t-1) \text{ and } x_3(t-1)$

x_1	x_2	x_3	y
0	0	1	0
0	1	0	0
1	0	0	0
1	1	1	1
0	0	0	0
1	1	0	0
0	1	1	0

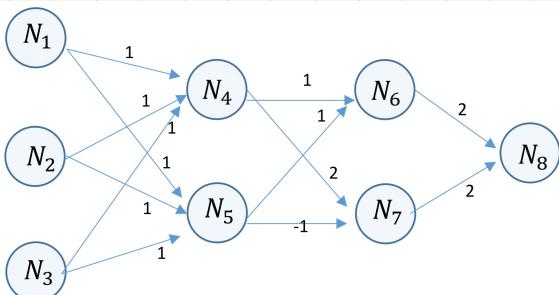
Problem 2:

Given:

$N_1 \Theta$ is 2

$N_5 \Theta$ is 3

Find:
response of output at
t based on input neuron
activation



Analys. 3:

a)

$$N_4(t-2) = N_1(t-3) \text{ or } N_2(t-3) \text{ and } N_3(t-3)$$

Or

$$N_1(t-3) \text{ and } N_2(t-3) \text{ or } N_3(t-3)$$

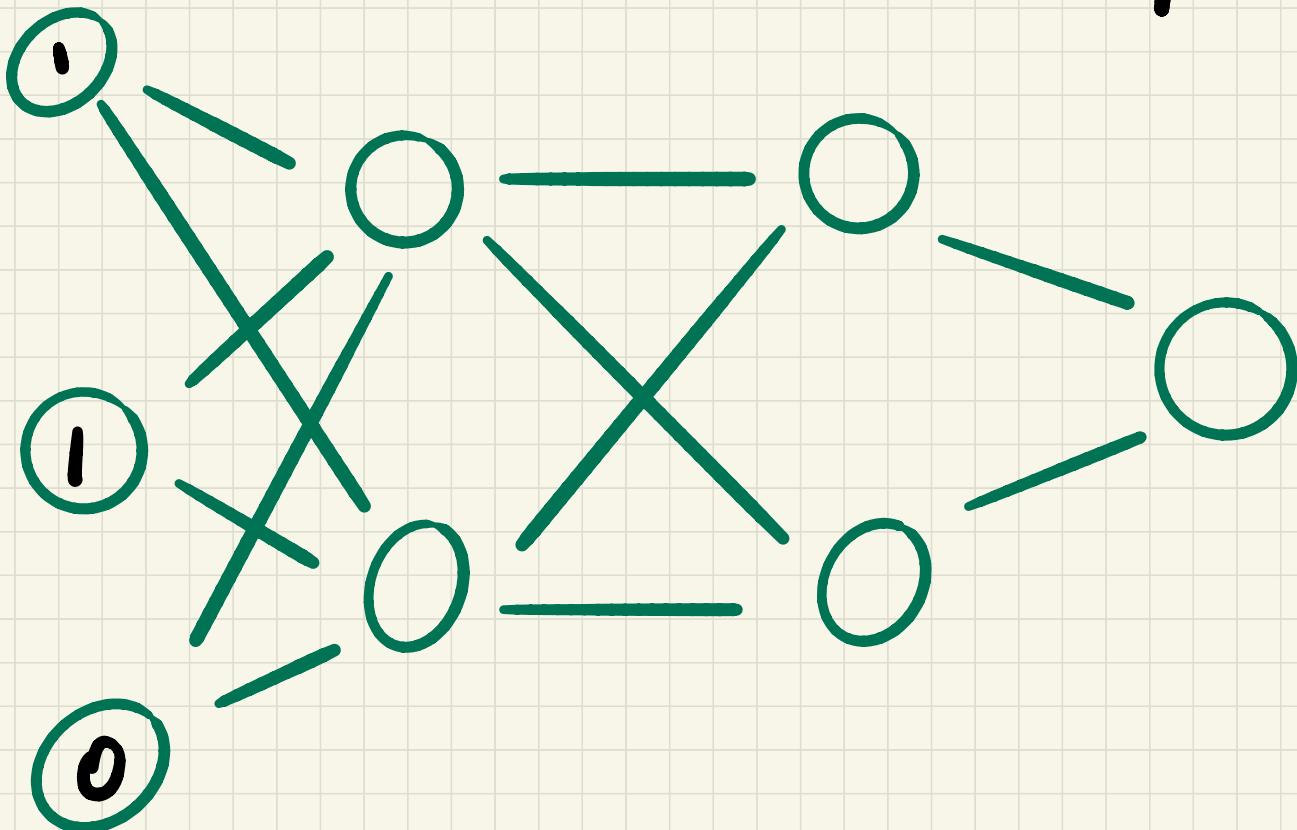
$$N_5(t-2) = N_1(t-3) \text{ and } N_2(t-3) \text{ and } N_3(t-3)$$

$N_6(t-1) = N_u(t-2)$ and $N_5(t-2)$

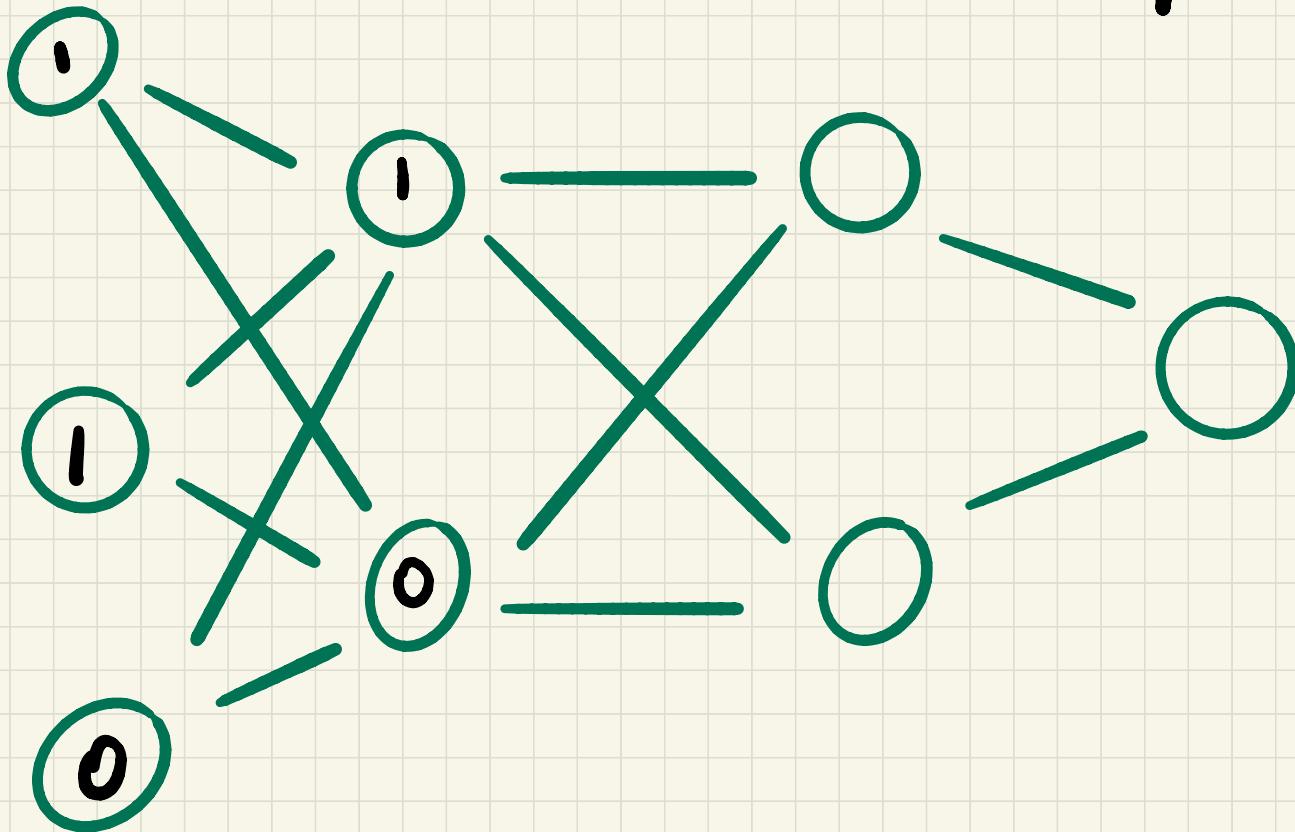
$N_7(t-1) = N_q(t-2)$ and not $N_5(t-2)$

$N_8(t) = N_6(t-1)$ or $N_7(t-1)$

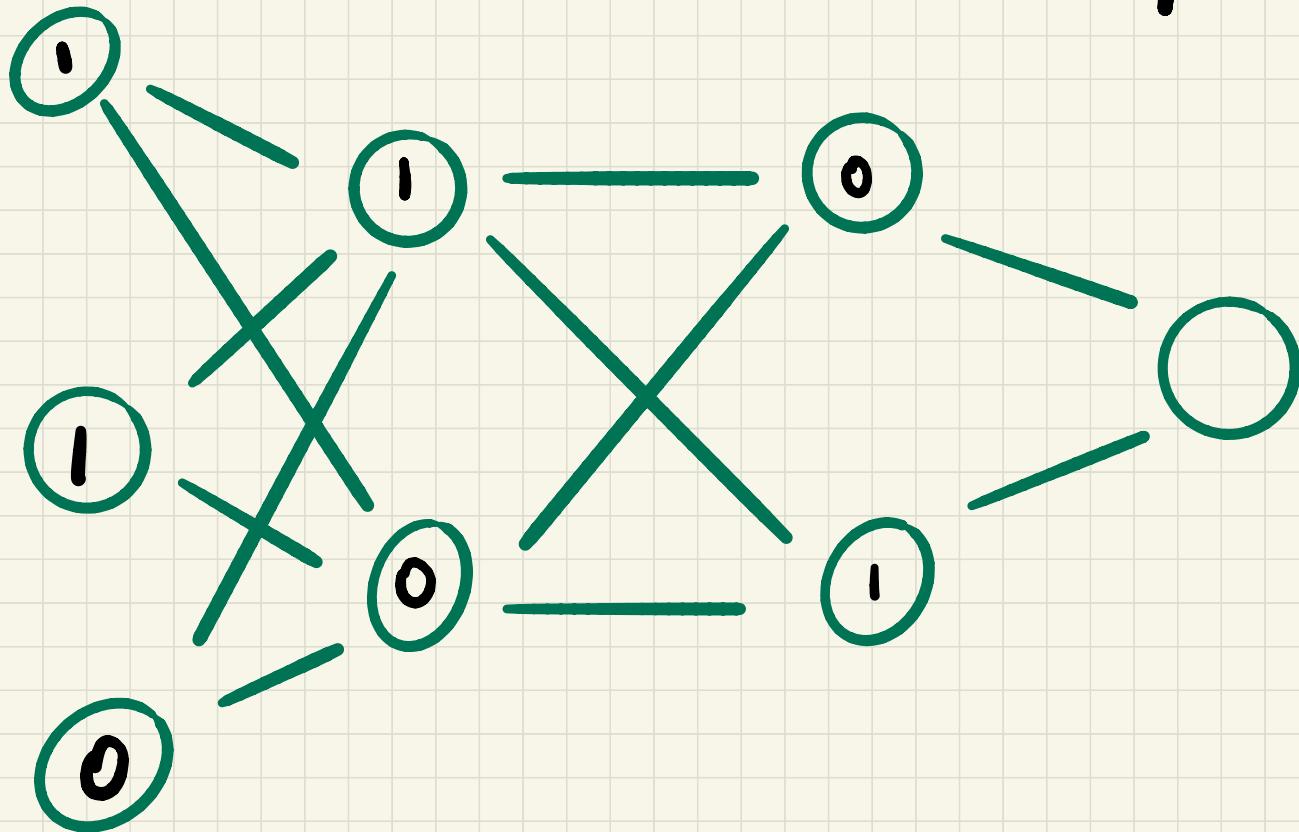
b)



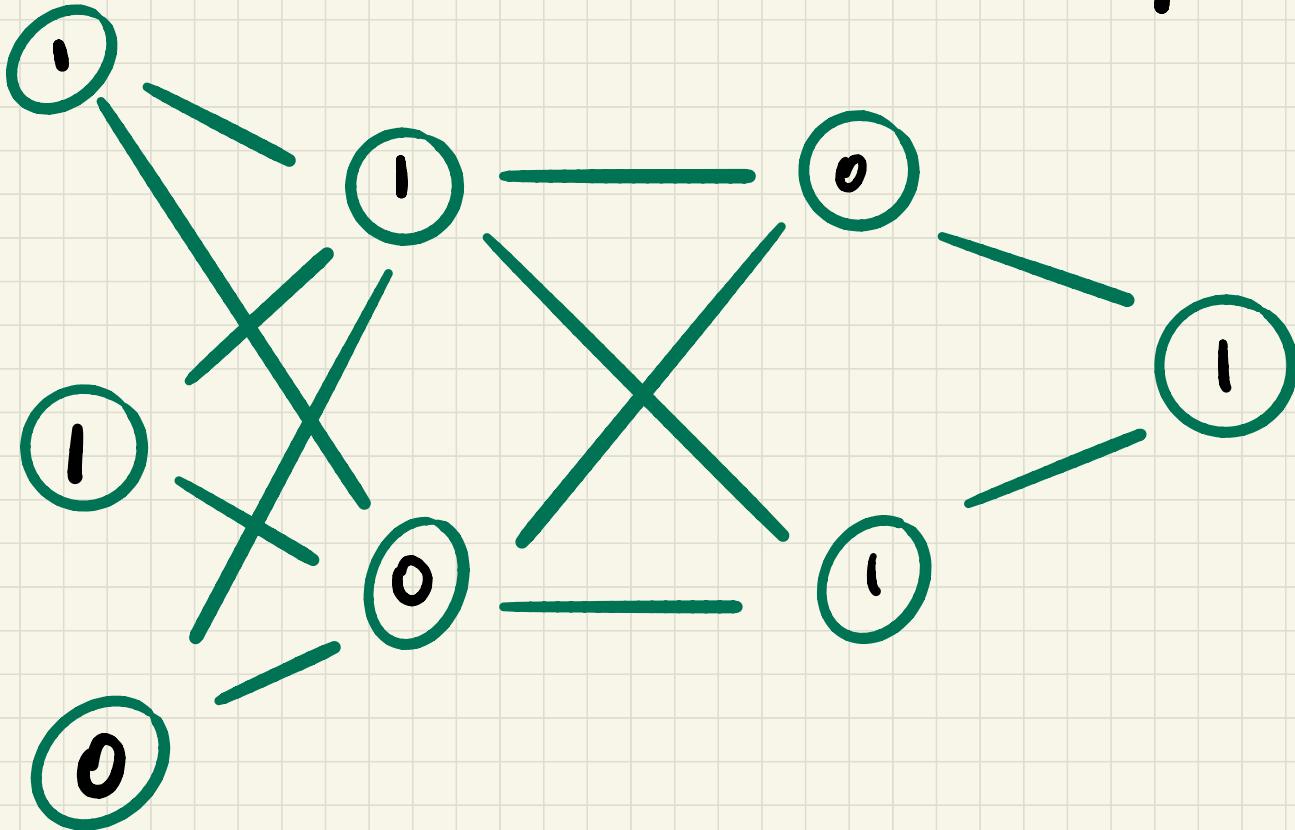
$t = 1$



$+ = 2$



$+ = 3$



Problem 3:

Given:

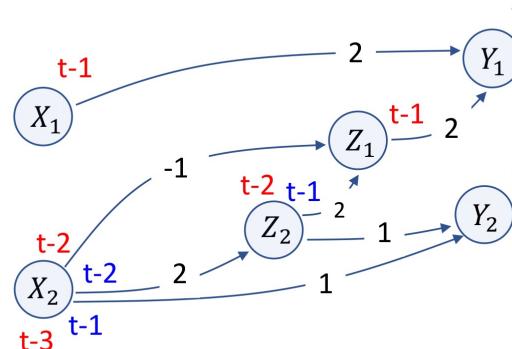
Hot and cold model

Cold stimulus must be there at $t-4$

Final:

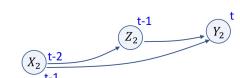
Model w/ these conditions

Source material:



Cold Y_2 : $x_2(t-1) \text{ AND } x_2(t-2) = x_1(t-1) \text{ AND } Z_2(t-1)$

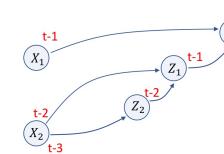
$x_2(t-2)$	$x_2(t-1)$	Y_2
1	1	1
1	0	0
0	1	0
0	0	0



Hot physiology

Heat Y_1 : $x_1(t-1) \text{ OR } \{x_2(t-2) \text{ AND } x_2(t-3)\} = x_1(t-1) \text{ OR } Z_1(t-1)$

$x_2(t-3)$	$x_2(t-2)$	$x_1(t-1)$	Y_1
1	1	1	1
1	0	1	1
0	1	1	1
0	0	1	1
1	1	0	0
1	0	0	1
0	1	0	0
0	0	0	0



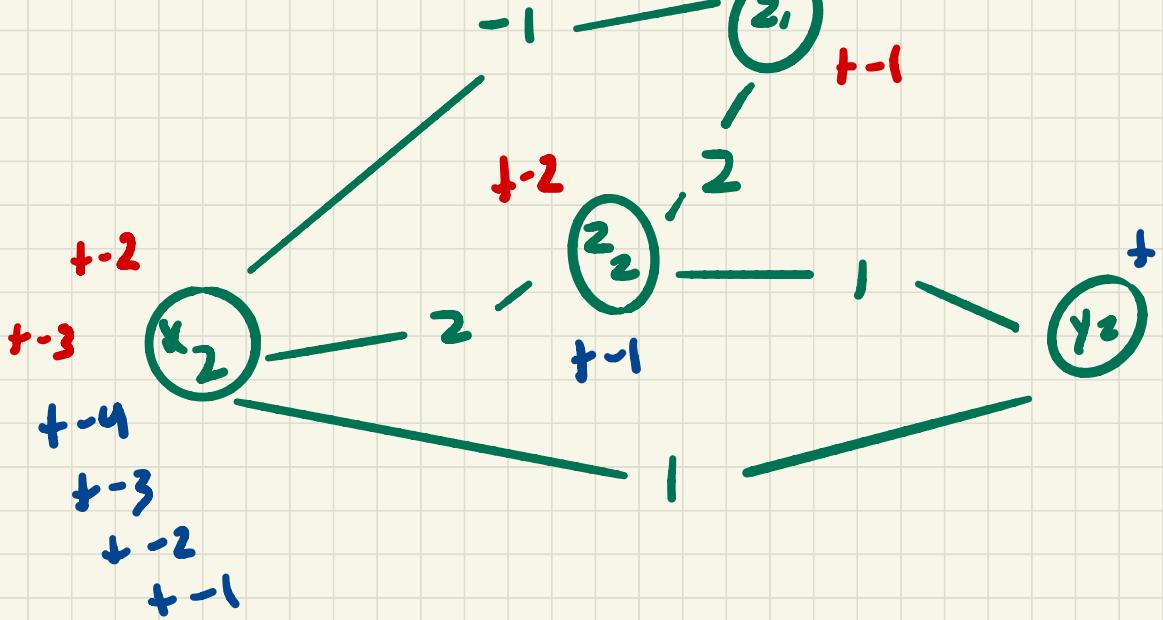
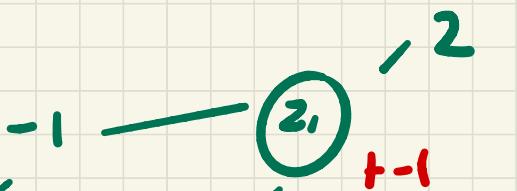
Analysis:

with current conditions cold is perceived
if stimulated for ≥ 2 time steps

changing it to ≥ 4 time steps

Necessary changes:

Z_2 activation must be dependent on
 $X_2 (+4, 3, 2, 1)$

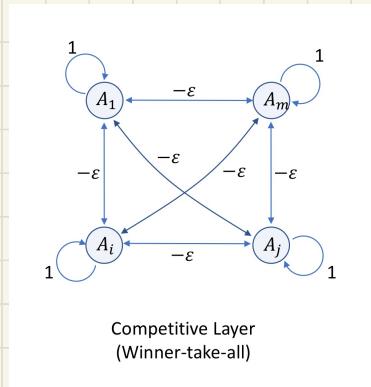


Z_2 : $x_2(t-4)$ and $x_2(t-3)$ and $x_2(t-2)$

Y_2 : $x_2(t-4)$ and $x_2(t-3)$ and $x_2(t-2)$ and
 $x_2(t-1) = x_1(t-1)$ and $z_2(t-1)$

Problem 3!

Given:



Find:

a) Update activation for $j = 1:4$
by

$$a_j(\text{new}) = f \left[a_j(\text{old}) - \epsilon \sum_{j \neq k} a_k(\text{old}) \right]$$

$$a_j(\text{old}) = a_j(\text{new}), j = 1:4$$

b) Stop if only one node has positive activation value, otherwise re update

$a_j(\text{new})$ = Activation of A_j

$a_j(0)$ = init value of node, $j = 1:4$

$$w_{i,j} = \begin{cases} 1 & \text{if } i=j \\ -\epsilon & \text{if } i \neq j \end{cases}$$

Nodes activate if

$$x > 0, \quad \epsilon = .2$$

$$a_1(0) = .3, a_2(0) = 1.2$$

$$a_3(0) = .6, a_4(0) = .9$$

Analyses:

$$a_1(\text{new}) = f \left(a_1(\text{old}) - \varepsilon \sum_{l \neq K} a_K(\text{old}) \right)$$

$$a_1(\text{new}) = f \left(.3 - .2 (1.2 + .6 + .9) \right)$$

$$a_1(\text{new}) = f(-.24)$$

$$a_1(\text{new}) = 0$$

$$a_2(\text{new}) = f(1.2 - .2(.3 + .6 + .9))$$

$$a_2(\text{new}) = f(.84) = .84$$

$$a_3(\text{new}) = f(.6 - .2(.3 + 1.2 + .9))$$

$$a_3(\text{new}) = f(.12) = .12$$

$$a_4(\text{new}) = f(.9 - .2(.3 + 1.2 + .6))$$

$$a_4(\text{new}) = f(-.48) = .48$$

a₁ node is dropped due to the negative value

b)

$$a_2(\text{new}) = f(.84 - .2(.12 + .48))$$

$$a_2(\text{new}) = f(.72) = .72$$

$$a_3(\text{new}) = f(.12 - .2(.84 + .48))$$

$$a_3(\text{new}) = f(-.164) = 0$$

$$a_4(\text{new}) = f(.48 - .2(.84 + .12))$$

$$a_4(\text{new}) = f(.288) = .288$$

a_3 node dropped

$$d_2(\text{now}) = f(.72 - .2(.288))$$

$$Q_2(\text{now}) = f(.6624) = .6624$$

$$Q_u(\text{now}) = f(.288 - .2(.72))$$

$$Q_u(\text{now}) = f(.144) = .144$$

No nodes dropped

$$a_2(\text{new}) = f(.6624 - .2(.144))$$

$$a_2(\text{new}) = f(.6336) = .6336$$

$$a_4(\text{new}) = f(.144 - .2(.6624))$$

$$a_4(\text{new}) = f(.01152) = .01152$$

No nodes dropped

$$a_2(\text{new}) = f(0.6336 - 2(0.01152))$$

$$a_2(\text{new}) = f(0.631296) = 0.631296$$

$$a_4(\text{new}) = f(0.01152 - 2(0.631296))$$

$$a_4(\text{new}) = f(-0.1147312) = -0.1147312$$

a_4 dropped

a_2 is the winner at $t=5$

$+ 1$	0	1	2	3	4	5
a_1	.3	0	0	0		
a_2	1.2	.84	.72	.6624	.6336	.631296
a_3	.6	.12	0	0		
a_4	.9	.48	.288	.144	.072	0

Problem 5:

Given:

XOR architecture

Find:

an alternate
representation

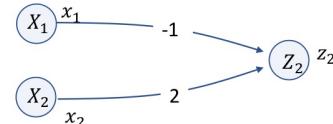
Source material:

MuCulloch & Pitts (M-P)

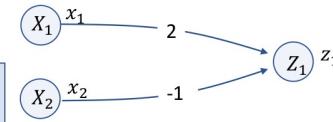
Applications (XOR)

$$\begin{aligned}
 y(t) &= x_1(t-2) \text{ XOR } x_2(t-2) \\
 &= z_1(t-1) \text{ OR } z_2(t-1) \\
 &= \{x_1(t-2) \text{ And NOT } x_2(t-2)\} \\
 &\quad \text{OR} \\
 &\quad \{x_2(t-2) \text{ And NOT } x_1(t-2)\}
 \end{aligned}$$

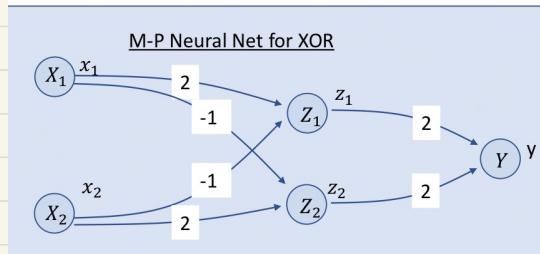
$$z_2(t) = x_2(t-1) \text{ AND } \overline{x_1(t-1)}$$



$$z_1(t) = x_1(t-1) \text{ AND } \overline{x_2(t-1)}$$



XOR		
x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	0

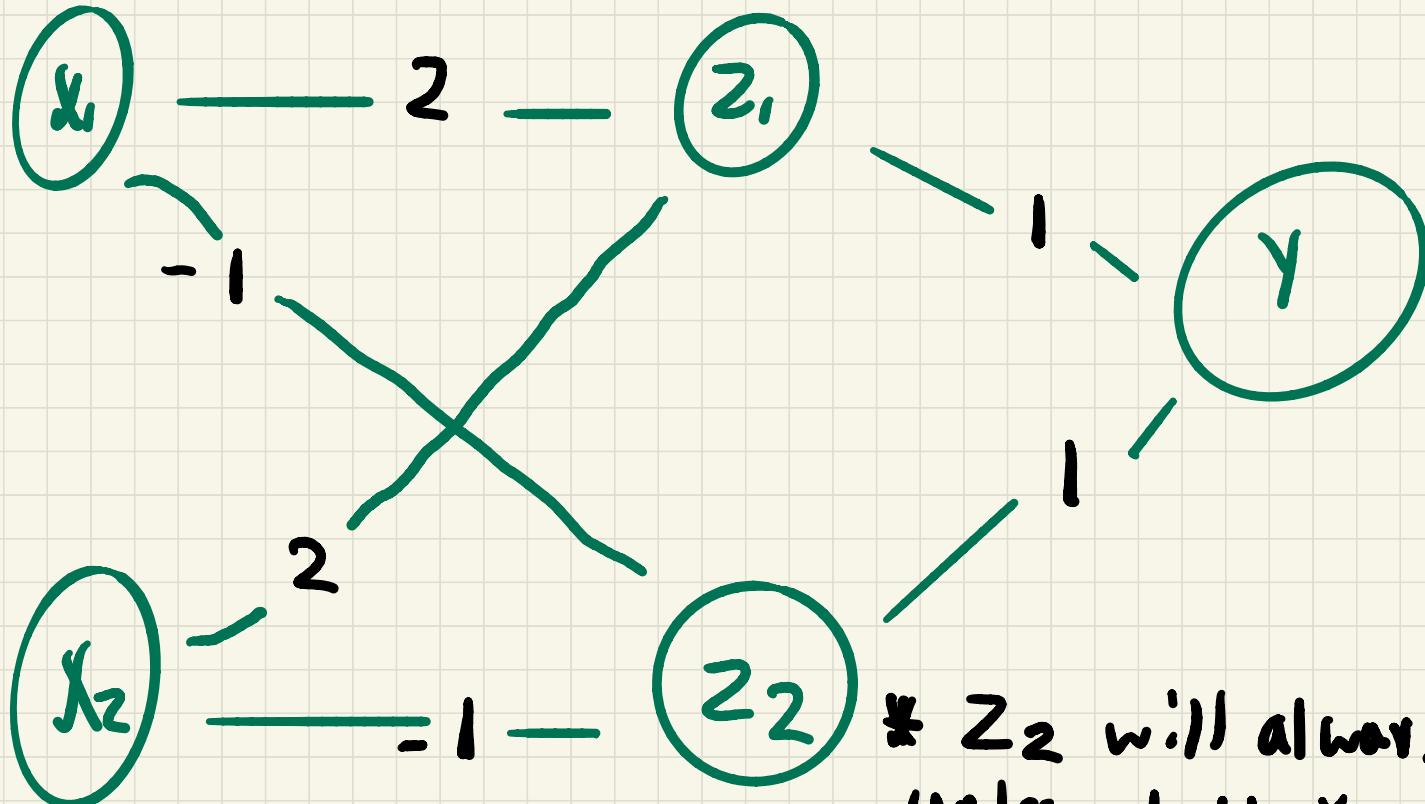


Analysis:

Need to construct architecture where either x_1 or x_2 can activate y , but not both

here $z_1 = x_1 \text{ or } x_2$ $\Theta \text{ for } z_1, y$
 $z_2 = x_1 \text{ not and } x_2$ is 2

$y = z_1 \text{ and } z_2$ $\Theta \text{ for } z_2 \text{ is}$
-2



* z_2 will always fire unless both x_2 and x_1 are triggered