Question 1

Given:

- McCullogh-Pitts model
- Guidance system for vehicle
- 4 possible input states
- Internal conditions for movement
- 2bit inputs for the 4 lightstates
- Output will be 1 of 4 action states

Find:

- M and P network implementing input/output states and internal conditions
- Network should take action when a condition is met
- Test, analyze, and show logic for a random mix of 16 cases with runs of possible signal combos

Input / output States!

Inputs:

- red/yellow = [0, 0]
- green = [1, 1]
- right arrow green = [1, 0]
- left arrow green = [0, 1]

Outputs:

- Stop Y_1
- Straight Y_2
- right Y_3
- left Y_4

Conditions!

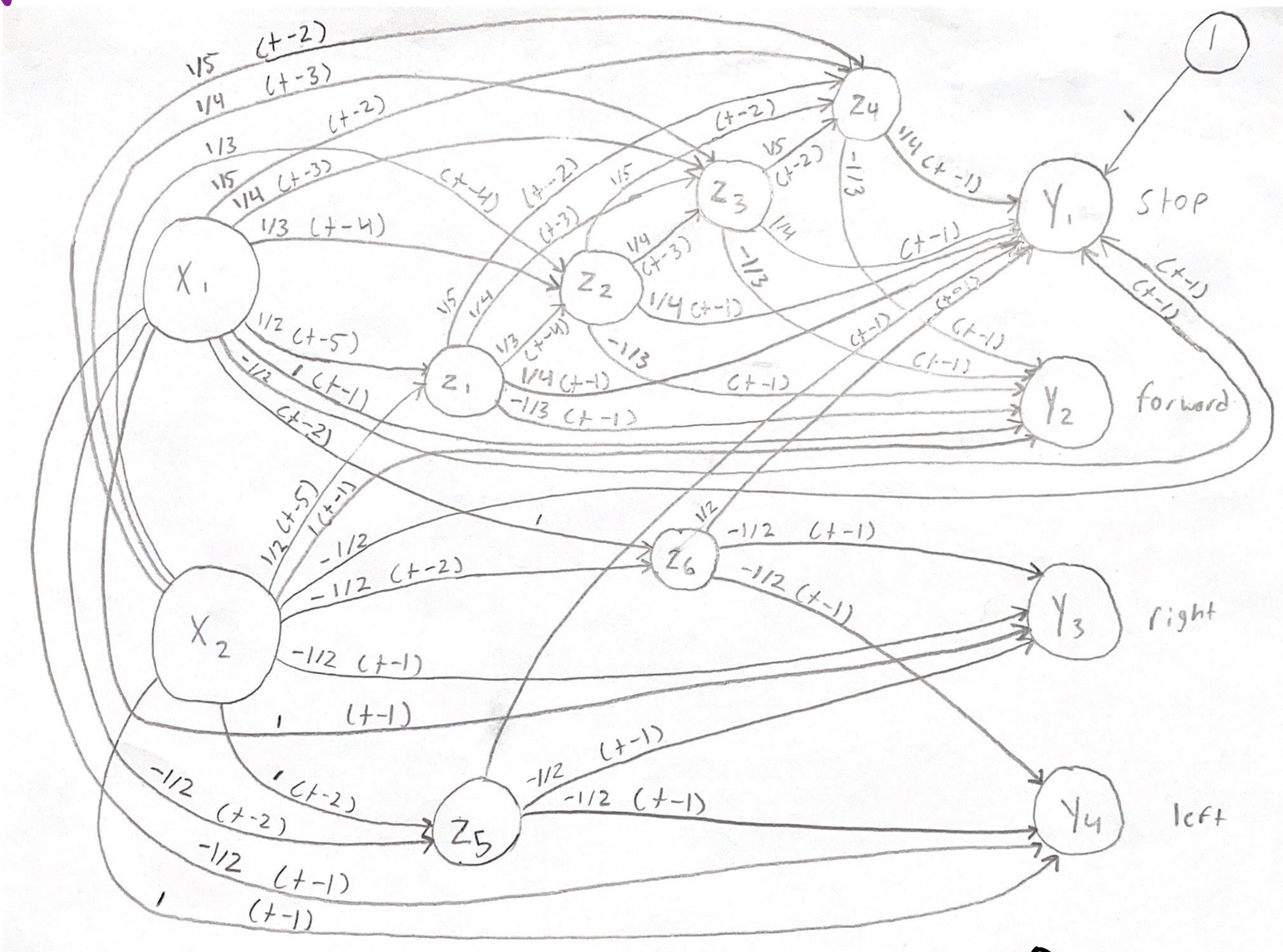
- Stop if car goes Straight 4 times in a row
- stop if car makes two left or right turns in a row

Net construction:

We would have 2 possible input nodes X_1 and X_2 to handle 2 bit inputs. There are 4 possible outputs, so we would have 4 output nodes Y_1, Y_2, Y_3, Y_4. Finally, the conditions will be reflected in the net. If we detect the [1,1] input 4 times in a row, the net should default to Y_1/stop for the next output.

If we detect either [1,0] or [0,1] then the not will also default to Y_1/stop for the next input if the input is not [1,1].

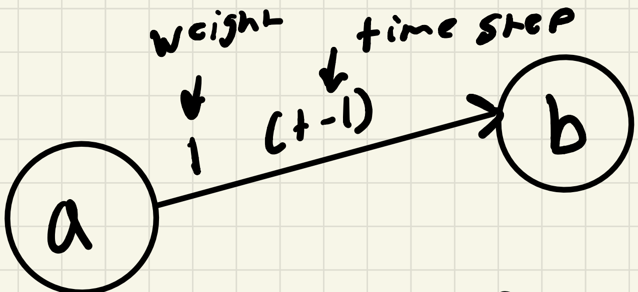
Net design:



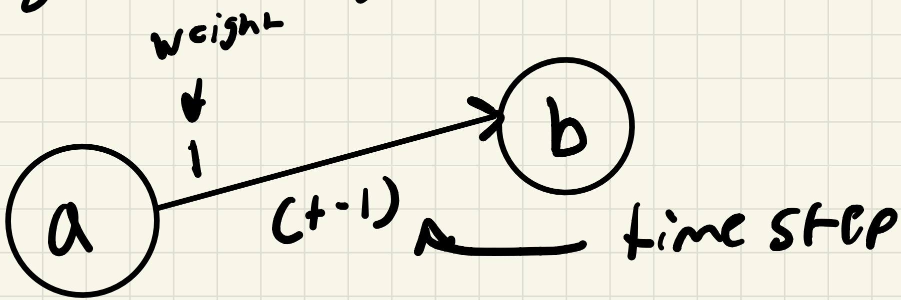
$\theta = 1$

Notes for net design!

The general labeling for the neurons here are



This is true for all neurons except for the pairs between adjacent z nodes ex! $[z_1, z_2]$, $[z_2 z_3]$ ...



Node Conditions:

Z_1: $X_1(t-5)$ and $X_2(t-5)$

Z_2: $Z_1(t-4)$ and $X_1(t-4)$ and $X_2(t-4)$

Z_3: $Z_1(t-3)$ and $Z_2(t-3)$ and $X_1(t-3)$ and $X_2(t-3)$

Z_4: $Z_1(t-2)$ and $Z_2(t-2)$ and $Z_3(t-2)$ and $X_1(t-2)$ and $X_2(t-2)$

Z_5: $X_2(t-2)$ and not $X_1(t-2)$

Z_6: $X_1(t-2)$ and not $X_2(t-2)$

Y_1: not $X_1(t-1)$ and not $X_2(t-1)$

or

$Z_1(t-1)$ and $Z_2(t-1)$ and $Z_3(t-1)$ and $Z_4(t-1)$

or

$Z_5(t-1)$

or

$Z_6(t-1)$

Y_2: $x_1(t-1)$ and $x_2(t-1)$ and not $(z_1(t-1)$ and $z_2(t-1)$ and $z_3(t-1)$ and $z_4(t-1))$

Y_3: $X_1(t-1)$ and not $X_2(t-1)$ and not $z_5(t-1)$ and not $z_6(t-1)$

Y_4: $X_2(t-1)$ and not $x_1(t-1)$ and not $z_5(t-1)$ and not $z_6(t-1)$

Case	x1(t-5)	x1(t-4)	x1(t-3)	x1(t-2)	x1(t-1)	x2(t-5)	x2(t-4)	x2(t-3)	x2(t-2)	x2(t-1)	Y1	Y2	Y3	Y4	Input Sequence	Result
1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	Straight, Straight, Straight, Straight, Straight	Stop
2	0	1	1	1	1	0	1	1	1	1	0	1	0	0	Stop, Straight, Straight, Straight, Straight	Straight
3	0	0	0	1	1	0	0	0	0	0	1	0	0	0	Stop, Stop, Stop, Right, Right	Stop
4	0	0	0	0	0	0	0	0	1	1	1	0	0	0	Stop, Stop, Stop, Left, Left	Stop
5	0	0	0	0	1	0	0	0	0	0	0	0	1	0	Stop, Stop, Stop, Stop, Right	Right
6	0	0	0	0	0	0	0	0	0	1	0	0	0	1	Stop, Stop, Stop, Stop, Left	Left
7	1	1	1	1	0	1	1	1	1	0	1	0	0	0	Straight, Straight, Straight, Straight, Stop	Stop
8	1	0	1	0	1	1	0	1	0	1	0	1	0	0	Straight, Stop, Straight, Stop, Straight	Straight
9	1	1	1	0	1	0	0	0	1	0	1	0	0	0	Right, Right, Right, Left, Right	Stop
10	0	0	0	1	0	1	1	1	0	1	1	0	0	0	Left, Left, Left, Right, Left	Stop
11	1	0	1	0	1	0	1	0	1	0	1	0	0	0	Right, Left, Right, Left, Right	Stop
12	0	1	0	1	0	1	0	1	0	1	1	0	0	0	Left, Right, Left, Right, Left	Stop
13	1	1	0	1	1	1	1	1	1	0	0	0	1	0	Straight, Straight, Left, Straight, Right	Right
14	1	1	1	1	0	1	1	0	1	1	0	0	0	1	Straight, Straight, Right, Straight, Left	Left
15	1	1	1	1	1	0	1	0	1	0	0	0	1	0	Right, Straight, Right, Straight, Right	Right
16	0	1	0	1	0	1	1	1	1	1	0	0	0	1	Left, Straight, Left, Straight, Left	Left