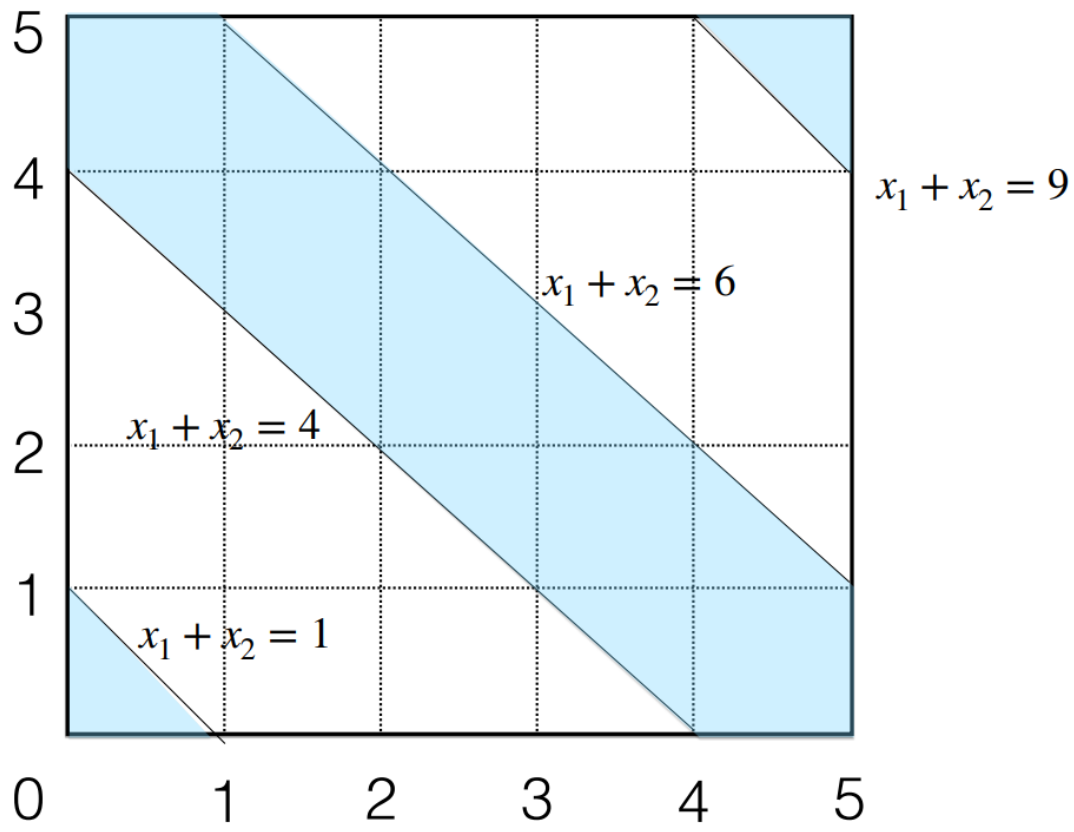
PART - 2

Solution:

Bands of blue

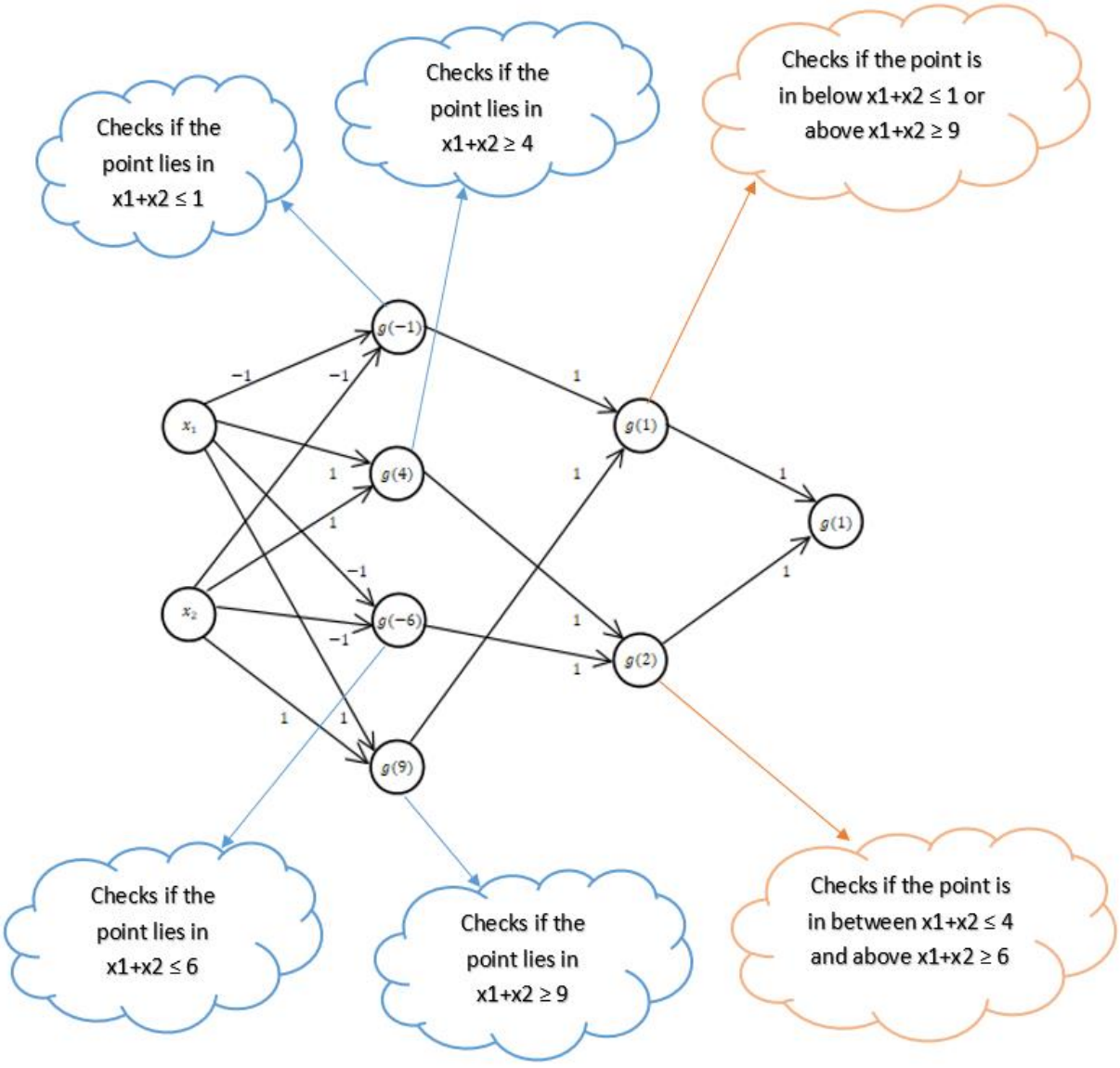
Dataset:



Let g be the step activation function, which we will use as the default activation function for all the neurons. Formally, it is defined as

$$g(x;T) = \begin{cases} 1 & \text{If } x \geq T \\ 0 & \text{Otherwise} \end{cases}$$

Then the optimal neural network for the dataset specified above looks as follows:



Hidden Layer 1: Geometrically, these neurons are determining whether the combinations of points (x1 and x2) are lies below or above the given lines which in the part of shaded region.

Hidden Layer 2: Checks if the point (x1, x2) lies in two specific shades of region between the lines.

Output layer: This is just the OR of the two cases from hidden layer 2. That is, it gets activated only when the point lies in the shaded region.

1st Hidden Layer (4 Neurons)

Neurons	Neuron	Weights	Threshold	Computation	Purpose
1	$g(-1)$	$[-1, -1]$	-1	$g(-x_1 - x_2, -1)$	Checks if $x_1 + x_2 \leq 1$
2	$g(4)$	[1, 1]	4	$g(x_1 + x_2, 4)$	Checks if $x_1 + x_2 \geq 4$
3	$g(-6)$	$[-1, -1]$	-6	$g(-x_1 - x_2, -6)$	Checks if $x_1 + x_2 \leq 6$
4	$g(9)$	[1, 1]	9	$g(x_1 + x_2, 9)$	Checks if $x_1 + x_2 \geq 9$

2nd Hidden Layer (2 Neurons)

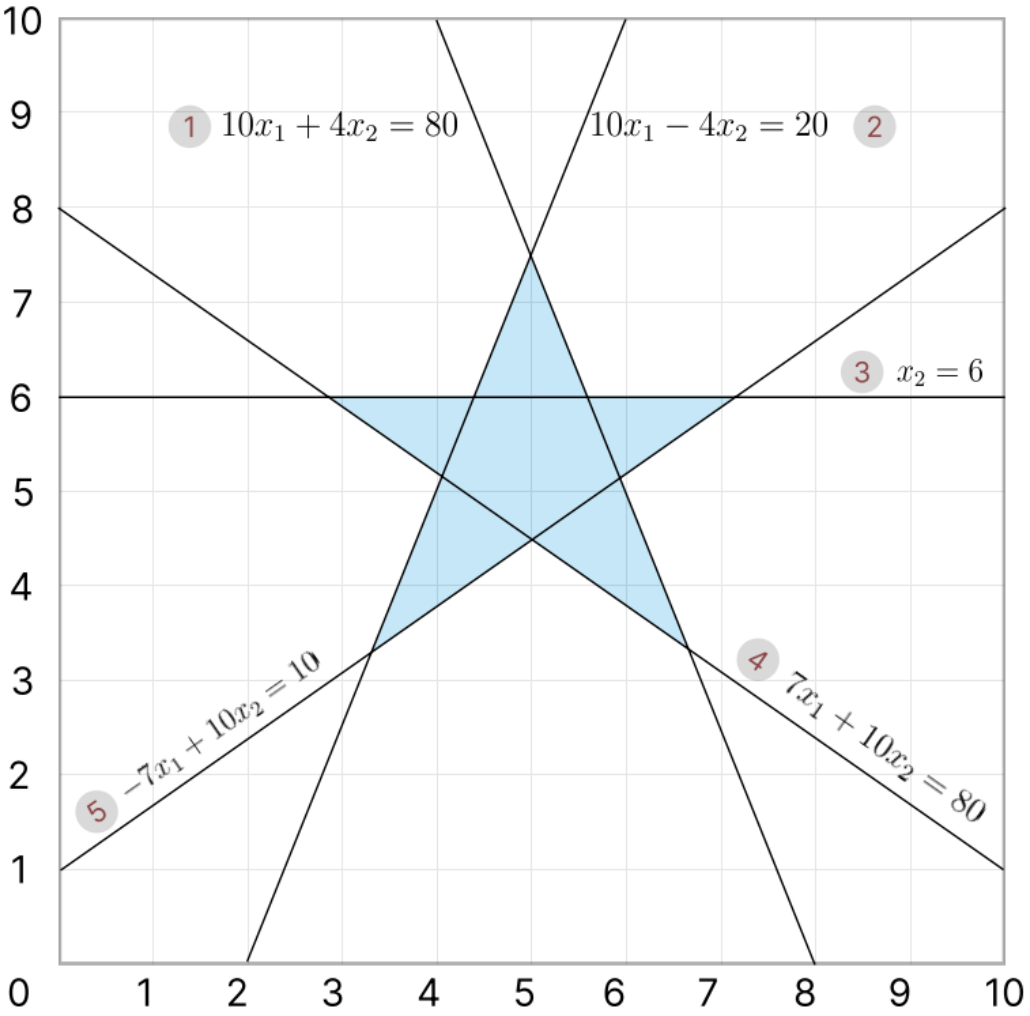
Neurons	Neuron	Inputs	Weights	Threshold	Purpose
1	$g(1)$	Outputs of $g(-1), g(9)$	[1, 1]	1	Activates if either $g(-1)$ or $g(9)$ is 1
2	$g(2)$	Outputs of $g(4), g(-6)$	[1, 1]	2	Activates only if both $g(4)$ and $g(-6)$ are 1

Output Layer

Neuron	Inputs	Weights	Threshold	Purpose
Output	Outputs of $g(1), g(2)$	[1, 1]	1	Activates if at least one of $g(1)$ or $g(2)$ is 1

Catch the star

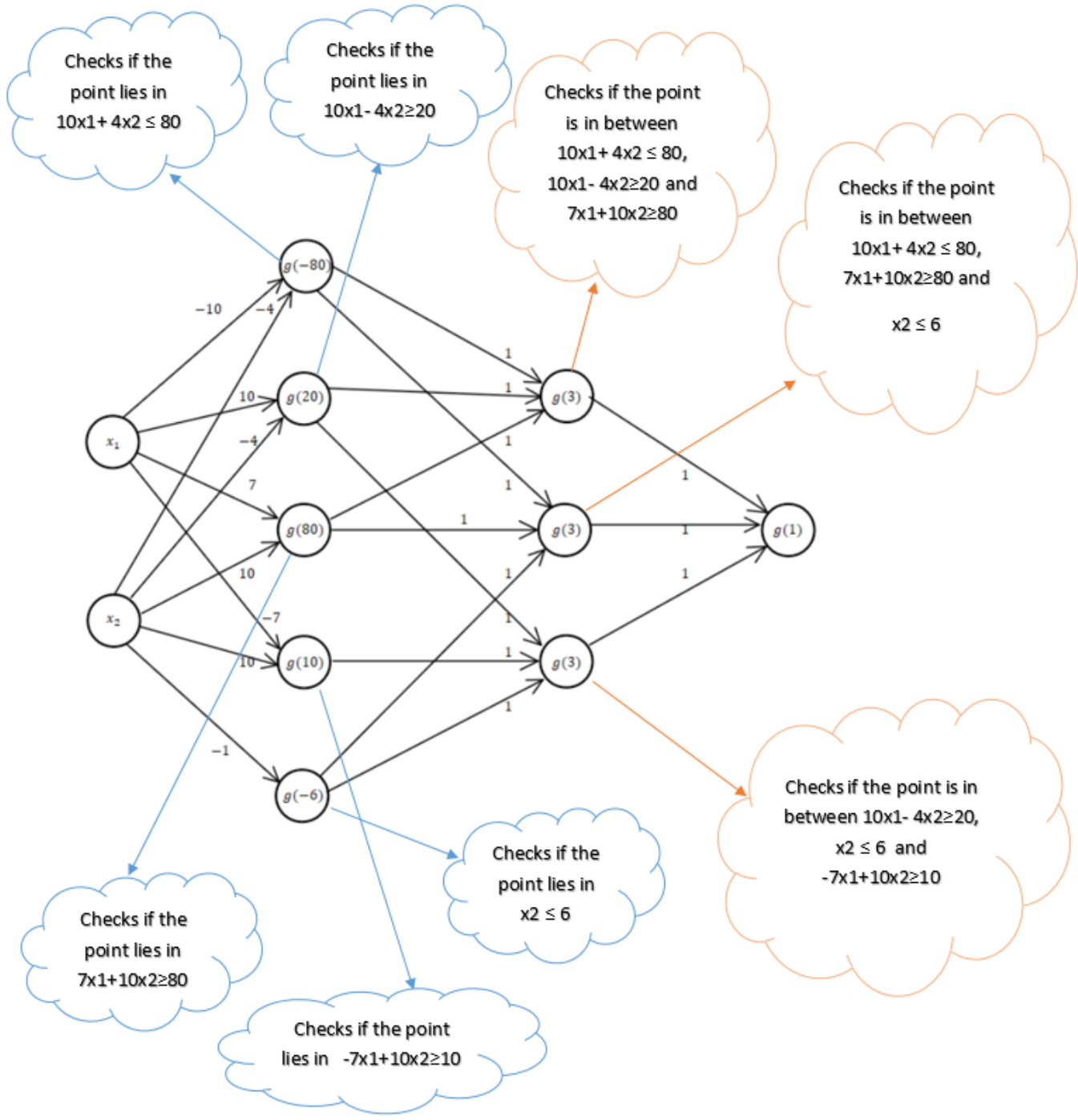
Dataset:



Let g be the step activation function, which we will use as the default activation function for all the neurons. Formally, it is defined as

$$g(x;T) = \begin{cases} 1 & \text{If } x \geq T \\ 0 & \text{Otherwise} \end{cases}$$

Then the optimal neural network for the dataset specified above looks as follows:



Hidden Layer 1: Geometrically, these neurons are determining whether the combinations of points (x1 and x2) are lies below or above the given lines which in the part of shaded region.

Hidden Layer 2: Checks if the point (x1, x2) lies in two specific shades of region between the lines.

Output layer: This is just the OR of the three cases from hidden layer 2. That is, it gets activated only when the point lies in the shaded region.

1st Hidden Layer (5 Neurons)

Neurons	Neuron	Weights	Threshold	Computation	Purpose
1	*g(–80)*	[-10, -4]	-80	$g(-10x_1 - 4x_2, -80)$	Checks if $10x_1 + 4x_2 \leq 80$
2	*g(20)*	[10, -4]	20	$g(10x_1 - 4x_2, 20)$	Checks if $10x_1 - 4x_2 \geq 20$
3	*g(80)*	[7, 10]	80	$g(7x_1 + 10x_2, 80)$	Checks if $7x_1 + 10x_2 \geq 80$
4	*g(10)*	[-7, 10]	10	$g(-7x_1 + 10x_2, 10)$	Checks if $-7x_1 + 10x_2 \geq 10$
5	*g(-6)*	[0, -1]	-6	$g(-x_2, -6)$	Checks if $x_2 \leq 6$

2nd Hidden Layer (3 Neurons)

Neurons	Neuron	Inputs	Weights	Threshold	Purpose
1	*g(3)*	Outputs of *g(–80)*, *g(20)*, *g(80)*	[1, 1, 1]	3	Activates if all of *g(–80)*, *g(20)*, *g(80)* are 1
2	*g(3)*	Outputs of *g(–80)*, *g(80)*, *g(-6)*	[1, 1, 1]	3	Activates if all of *g(–80)*, *g(80)*, *g(-6)* are 1
3	*g(3)*	Outputs of *g(20)*, *g(10)*, *g(-6)*	[1, 1, 1]	3	Activates if all of *g(20)*, *g(10)*, *g(-6)* are 1

Output Layer

Neuron	Inputs	Weights	Threshold	Purpose
Output	Outputs of *g*(3), *g*(3) and g(3)	[1, 1, 1]	1	Activates if at least one of *g*(3) or *g*(3) or g(3) is 1