# Question 1:

The neural network will look as follows:

First, we will define the functions with ReLU activation functions, and with identity function. All the weights are 1.

The loss function is RSS.

In backpropagation, we want to derive the loss function w.r.t the weights.

# Question 2

Code attached in zip file.

# Question 3

Given a set of points in general positions in the plane , and a real vector .

Fitting X to Y is as regressions problem. Basically, we want a neural network that for each will fit a so that .

We will build a network with input layer that consists of 3 neurons (), we need neurons in the hidden layer. Each tower can be modeled by subtracting two step functions. Each step function can be represented by a single neuron in the hidden layer.

We build the neurons in the following way: for two points , the line connecting them will be:

. Because of the general position, we know this line will capture only two points.

For each line, we will create two parallels, with space of :

, so that the only two points in the strip between are . Each of these lines is a linear combination, and therefore can be represented by a single neuron: one neuron for and another for .

We have a finite number of points, so we can do this process for each set of points in the input matrix .

Using the activation step function, we define:

So that if the sum of is 0 for all the points out of the strip, and 1 for all the points inside the strip (like we did in class).

From the hidden layer to the output layer, which consists of a single neuron, we will define:

Because there are only two strips containing each we will get the equation: .

We do this process for each input. For we will use the line connecting them.

Because the all the are known, we get a matrix of N\*N which looks:

This matrix needs to be of full dimension to support N equations.

# Question 4

Code attached in zip file.