Writing Assignment(5 pts)

1. What are the differences between Machine Learning and Deep Learning(0.5')? Why Deep Learning is useful(0.5')?

2. In deep learning, the function $f : X^m \to X^n$ is represented by neural network, m is the input dimension and n is output dimension. Each layer of neural network is made of neurons. The output value of a neuron is the input of next layer or directly the output of neural network.

   (a) Figure 1 is a diagram of a neuron. **Write the expression for the output of this neuron**(0.5').

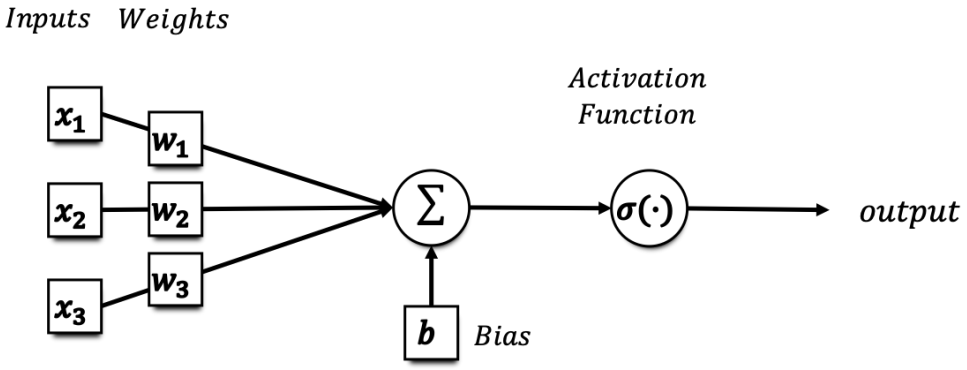

Figure 1

   (b) Figure 2 is a simplified diagram of neuron. The activation function is Sigmoid $\sigma(z) = \frac{1}{1+e^{-z}}$.

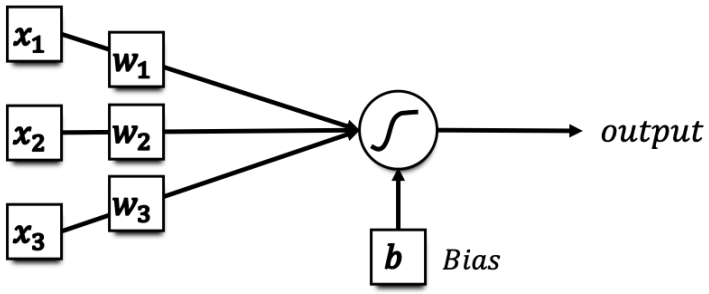

Figure 2

Figure 3 is an example of neural network, which is made by the neuron in Figure 2. **Calculate the value of y and write your calculating process as well(0.5').** Round your result to 2 decimal places.

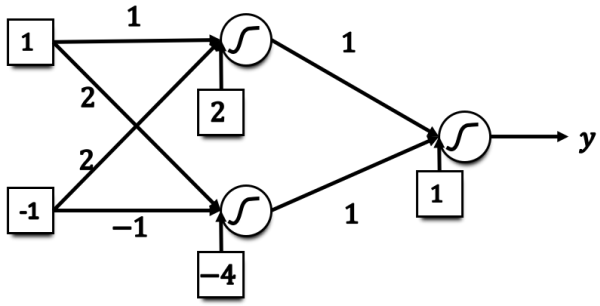

Figure 3

3. Dropout is a regularization method that approximates training a large number of neural networks with different architectures in parallel. During training, some neurons are randomly dropped out. In Figure 4, the neurons that marked with a red cross will be dropped out during training. For simplification, the bias of neuron is 0 and omitted in Figure 4. Assume dropout rate is 0.25. This network uses **ReLU** (max{0,x}) as activation function.

   (a) What are the values of outputs y_1, y_2 during **training**?(0.5')

   (b) What are the values of outputs y_1, y_2 during **testing**?(0.5')

   Write your **calculating process** of each question.

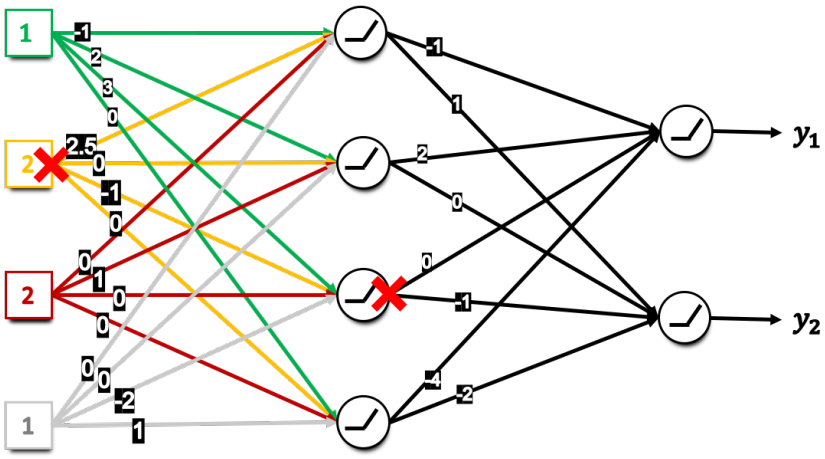

Figure 4

4. Figure 5 is the network used in this question. Sigmoid $\sigma(z) = \frac{1}{1+e^{-z}}$ is activation function. When the output $y > 0.999$, we approximate it to 1. When $y < 0.001$, we approximate it to 0.

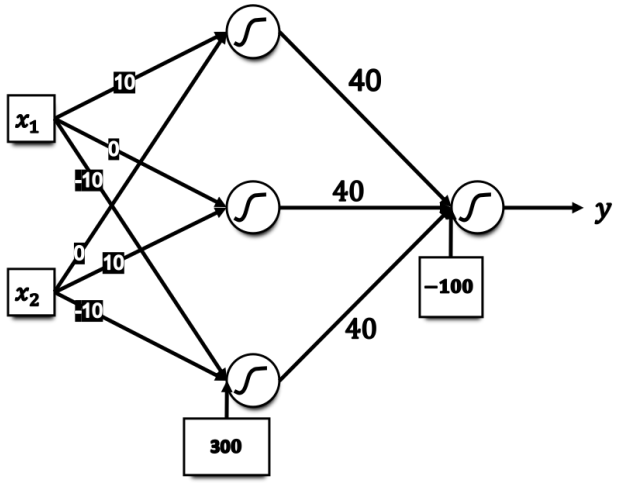

Figure 5

(a) A, B, C in Figure 6 are the inputs of the network in Figure 5. Calculate **the output values of them** respectively(1').

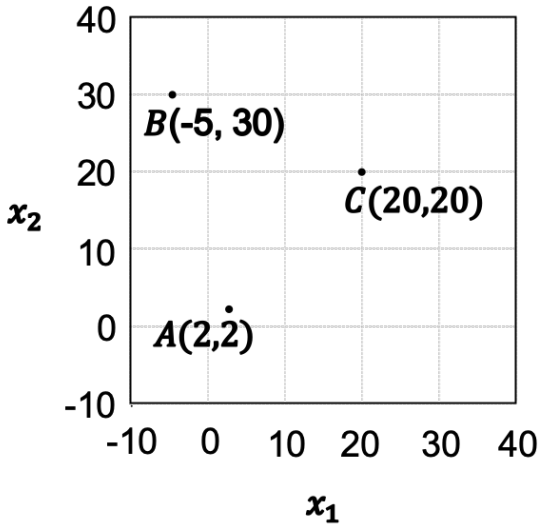

Figure 6

(b) In this question, the inputs for the network are shown in Figure 7. Assume the values of x_1 and x_2 are all integers. According to the output value of each input, try to **find the decision boundary that classifies the inputs into several classes.**(1'). Write the expression of decision boundary.

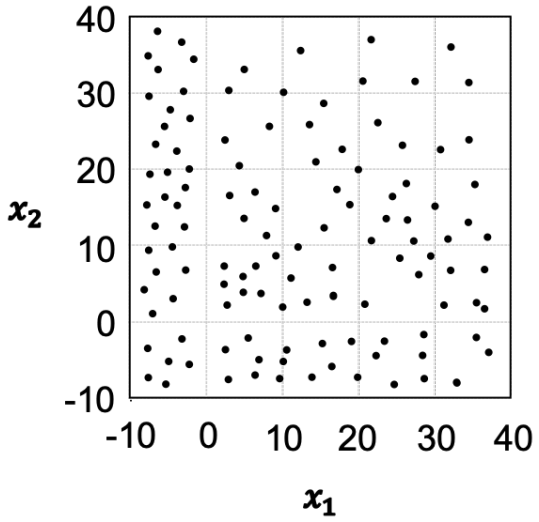

Figure 7

Important Notes:

- **Reference**: The class note of Lecture 16,17.
- Due: **2019/11/24 11:59pm**