

# Quiz 1 - Artificial Intelligence, CS 541A

February 28, 2022

## 1 Calculate gradient descent [4 pts]

Perform a single gradient descent step and compute  $w_1$ , given  $w_0 = -1$ ,  $\eta = 0.1$  and  $L(w) = \frac{1}{2}(wx - y)^2$  when,

i)  $x = 1, y = 1$

ii)  $x = 1, y = -1$

**Note:** Gradient descent equation is  $w_{i+1} = w_i - \eta \cdot \frac{dL(w)}{dw}$

## 2 Calculate entropy [4+2 pts]

You are given the following frequency table where each cell represent the number of times these observations occurred. For example, the number of times the temperature was ‘Mild’ and people went out to play was 4 and did not go out was 2. Compute the following:

i)  $Entropy(Play, Temperature)$

ii)  $Entropy(Play)$

		Play	
		Yes	No
Temperature	Mild	2	4
	Cool	3	1
	Hot	2	2

**Note:**  $Entropy(p) = -1 * \sum_{i=1}^N p_i \log(p_i)$

### 3 Draw a neural network [3 pts]

Draw a small neural network. It should have 3 neuron in the input layer, two hidden layers each with 4 neuron and a final output layer with 2 neuron.

### 4 Shape of network weights [4 pts]

Given a neural network with 3 input layer neurons, 4 hidden layer 1 neurons, 4 hidden layer 2 neurons, and 2 output layer neurons (same as in previous question), what will be the shape of the following:

- i.  $w^{(0)}$  without bias
- ii.  $w^{(0)}$  with bias
- iii.  $w^{(1)}$  without bias
- iv.  $w^{(2)}$  without bias

### 5 Compute forward pass [1.5+1.5 pts]

Given neural network with only input and output layers and  $w = [1, 1]$ , compute output when,

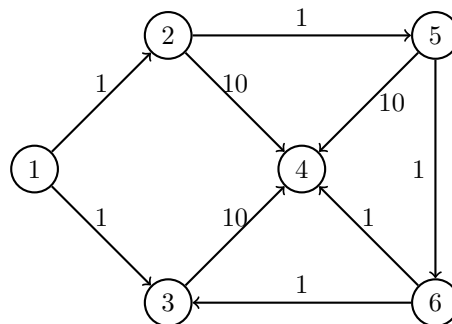
- i.  $x = [1, 1]$  and output layer has linear activation function
- ii.  $x = [-1, -1]$  and output layer has relu activation function

### 6 Formulate a search problem [3 pts]

Consider a simple  $4 \times 4$  maze with no walls. The player starts at the top left corner and the goal is the bottom right.

- i) What is the size of the search space? (total number of possible states)
- ii) What are the possible actions a player can make?
- iii) What is a possible way to represent the maze in code?

### 7 Search graph [2+2+3 pts]



Given the following search tree with 1 as the start state and 4 as the goal, what will be the sequence in which the nodes are explored from start to goal using:

- 1) Depth First Search
- 2) Breadth First Search
- 3) Uniform Cost Search

**Note:** All ties must be broken in numerical order