

# CSE445.2 – SP21 – Final Assignment

Due: 11:59PM, May 27<sup>th</sup>, 2021 (Thursday)

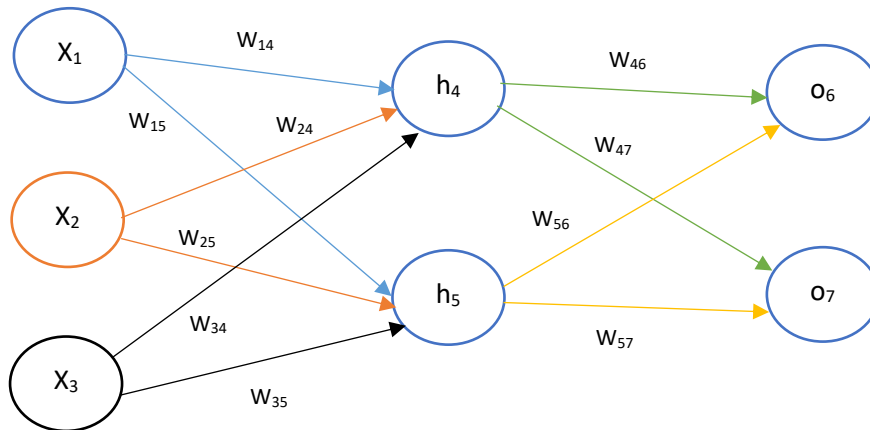
## INSTRUCTIONS:

The assignment provided should be completed by **hand**, neatly written with the final answers for each problem **underlined/boxed**, and submitted on Google Classroom as a single **pdf** file prior to deadline. The total for this assignment is **30 points**. Plagiarized submissions will receive a **straight 0** – kindly turn in **your own work**.

### Problem I

10 points

- a) Consider the following fully connected feedforward neural network shown in the figure below:



Initial input, weight, bias values, and target outputs																		
$x_1$	$x_2$	$x_3$	$w_{14}$	$w_{15}$	$w_{24}$	$w_{25}$	$w_{34}$	$w_{35}$	$w_{46}$	$w_{47}$	$w_{56}$	$w_{57}$	$b_4$	$b_5$	$b_6$	$b_7$	$t_6$	$t_7$
A	B	C	0.2	0.5	0.4	-0.5	-0.1	-0.8	0.9	-0.5	0.2	0.3	-0.2	-0.1	0.1	0.4	D	E

Use the **backpropagation** algorithm to train this network for a **single** iteration, using a **sigmoid activation** function and a **squared error loss** function.

The **inputs, weights, biases, and target outputs** that should be used has been provided in the table below the figure.

The input values **A, B, and C** should correspond to the **first three digits** of your student ID each divided by **10** (e.g. '172' should become A=0.1, B=0.7, C=0.2).

The target outputs **D and E** should correspond to the **last two digits** of your student ID divided by 10 (e.g. '42' should become D=0.4, E=0.2).

Your answer should provide a **diagram** of the network with **updated** values for **weights and biases**.

You must derive and show all **relevant** equations at least once per layer for the **forward** pass as well as the **backward** pass in order to obtain full credit.

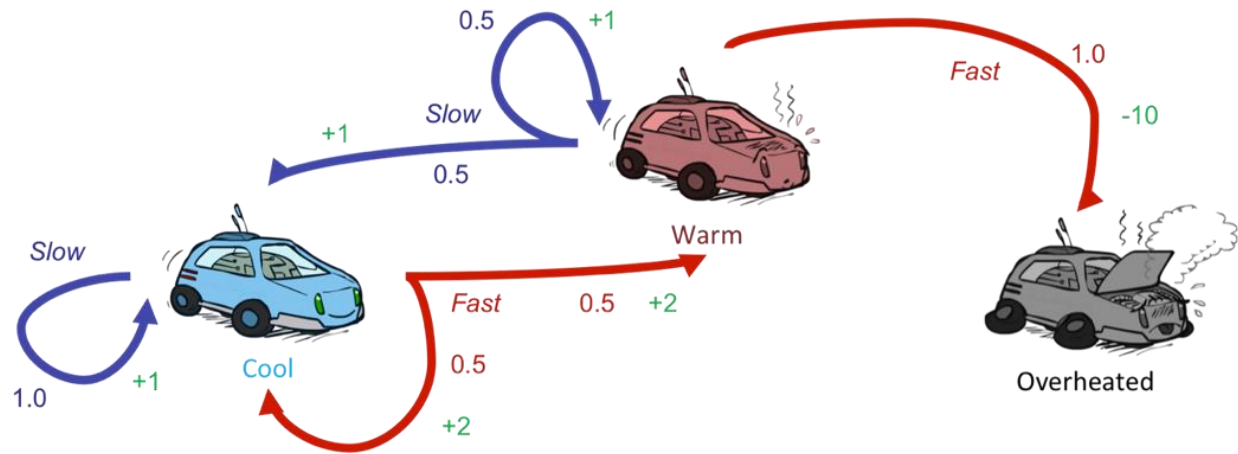
You are encouraged to write a script to automate this calculation and provide it with your answer.

- b) In your own words (300 or less), explain what a **Generative Adversarial Network (GAN)** is composed of, and provide different use cases for this type of network in present day research/application.

## Problem II

10 points

- What is a **Markov Decision Process**? Explain in your own words (200 words or less).
- Consider the **state diagram** provided in the figure below. Clearly state the **states**, **actions**, **transition probabilities**, **rewards**, and **terminal states** present in the diagram.



- Use **Value Iteration** to find the value for each of the states after  $k=3$  timesteps, assuming a discount fraction of i)  $\gamma = 1.0$ , and ii)  $\gamma = 0.9$
- Briefly explain why **Policy Iteration** may converge sooner than **Value Iteration** for the same MDP (200 words or less).

## Problem III

10 points

In your own words, provide brief answers (100 words or less for each) to the following short questions:

- What is **regularization**?
- What is the **Bias/Variance** tradeoff?
- What is a **"Support Vector"**?
- What is the difference between **Stochastic Gradient Descent**, and **Batch Gradient Descent**?
- What is **ensemble learning**?