

Carnegie Mellon University in Qatar

AI for Medicine

15-182 - Spring 2023

Assignment 5

Name: _____

Andrew ID: _____

Due on: April 18, 2023 by midnight

Instructions:

- This assignment consists of two problems. Solve them both.
- Submit your solution through Gradescope.

Question	Points	Score
Predict Medical Conditions Using NNs	35	
AI, Society, and Jobs	65	
Total:	100	

Problem 1: Predict Medical Conditions Using NNs (35 Points)

The table below represents a dataset of patient information that includes their weights, ages, and blood pressures, along with whether or not they have certain medical conditions. We want to build a model that can predict the likelihood of a patient having a medical condition based on their weight, age, and blood pressure.

	Weight	Age	Blood Pressure	Condition
Patient 1	80	34	100	Unaffected - 1
Patient 2	65	44	130	Affected - 0
Patient 3	60	25	140	Affected - 0
Patient 4	73	60	120	Unaffected - 1

To perform the predictions, let us use a Neural Network which involves calculating a weighted sum of the input features and passing it through a sigmoid activation function to obtain a probability estimate. At some point during training, you freeze the current parameter values and observe the following:

$$\text{Weight matrix for the first hidden layer} \begin{bmatrix} w_{1,1} & w_{1,2} \\ w_{2,1} & w_{2,2} \\ w_{3,1} & w_{3,2} \\ b_1 & b_2 \end{bmatrix} = \begin{bmatrix} 0.02 & 0.025 \\ -0.05 & 0.015 \\ 0.015 & -0.02 \\ 0.5 & 0.5 \end{bmatrix}$$

$$\text{Weight matrix for the second hidden layer} \begin{bmatrix} w_{1,1} \\ w_{2,1} \\ b_1 \end{bmatrix} = \begin{bmatrix} 0.2 \\ 1.5 \\ -1 \end{bmatrix}$$

Here, $w_{i,j}$ denotes the weight connecting the i -th input to the j -th output for a particular layer, and b_i denotes the bias in the linear combination at the i -th perceptron.

Answer the following questions, and make sure to show and submit all your work:

4pts

- (a) Calculate the z-values (values obtained after doing linear combination of input features and weights) after forward propagation through the first layer.

3pts

- (b) Calculate the y-values (values obtained after passing the linear combination through an activation function) after forward propagation through the first layer for the given features.

4pts

- (c) Calculate the z-values (values obtained after doing linear combination of input features and weights) after forward propagation through the second layer.

3pts

- (d) Calculate the y-values (values obtained after passing the linear combination through an activation function) after forward propagation through the second layer for the given features.

4pts

- (e) Calculate the loss assuming the metric of choice is MSE.

12pts

- (f) Calculate the updated weights after one iteration of backward propagation, assuming a learning rate of 0.05.

5pts

- (g) How does the loss change after one iteration of updates? Do you recommend training for more epochs or stopping here?

Problem 2: AI, Society, and Jobs (65 Points)

Whether or not AI will eventually take over all jobs is a question that has been debated by experts for many years.

There are a number of factors that will affect the answer to this question, including the rate of technological progress, the ability of humans to adapt to new technologies, and the willingness of society to accept AI-driven changes.

On the one hand, AI is advancing at a rapid pace and is already being used to automate a wide range of tasks. For example, AI is now being used to automate tasks in manufacturing, customer service, and even healthcare. As AI continues to advance, it is likely that it will be able to automate even more tasks, which could lead to significant job losses.

On the other hand, humans are also capable of adapting to new technologies. For example, when the Industrial Revolution led to the automation of many manual tasks, humans adapted by developing new skills and finding new jobs. It is possible that humans will be able to do the same thing in the face of AI-driven automation.

Ultimately, the answer to the question of whether or not AI will eventually take over all jobs is not clear. It will depend on a number of factors as you can imagine.

Conduct research on this subject and present your opinion on the matter in 3-6 pages. In your write-up, make sure to cite all the references that you have gone through during your research. The main questions that you may want to try to form opinions about are:

9pts

(a) What are the different types of jobs that AI is currently being used to automate in the medical domain?

5pts

(b) What are the skills that humans will need to adapt to a world in which AI is increasingly automating tasks?

16pts

(c) What are the ethical implications of AI-driven automation?

16pts

(d) What are the policy implications of AI-driven automation?

10pts

(e) How can Large Language Models (LLMs) like ChatGPT and Bard be leveraged to improve our lives in general and healthcare in particular?

5pts

(f) How are LLMs different from other AI systems that are being used in healthcare?

4pts

(g) What are the potential risks of using LLMs in healthcare?