Carnegie Mellon University in Qatar
AI for Medicine

15-182/282 - Spring 2021

Assignment 1

Name: _____

Andrew ID: _____

Due on: February 04, 2021 by midnight

Instructions:

- This assignment has a maximum score of 100 points.

- You should submit the assignment through Gradescope. Instructions on submissions will be provided through a Piazza announcement 1 day before the due date.

Question	Points	Score
Artificial Intelligence for Eye Care	45	
How to Read Articles That Use ML	55	
Total:	100	

Problem 1: Artificial Intelligence for Eye Care (45 Points)

Many people do not fully understand AI and its strengths and limitations. As such, there is a growing need to understand AI methods and develop an ability to rigorously evaluate AI applications in different domains, including medicine. A recent paper published by Rory Sayres, Naama Hammel, and Yun Liu (see below) acts as a primer on AI, focusing on eye care as an application. More precisely, it provides a non-technical overview of AI, Machine Learning (ML), and Deep Learning (DL). In addition, it walks readers through the typical processes of developing and validating AI models as well as deploying them in real-world settings. Finally, it describes the great potential and possible pitfalls of AI in medicine.

Here is the paper (you can download it from the course website under the resources tab):

Sayres, Rory Abbott, Naama Hammel, and Yun Liu. "Artificial intelligence, machine learning and deep learning for eye care specialists." (2020).

Read the paper carefully and answer the following questions:

5pts   (a) Explain what is AI in your own words.

5pts   (b) What is the difference between supervised learning and unsupervised learning?

3pts   (c) What is the difference between architectures, parameters, and hyperparameters in ML? Give an example of each.

6pts   (d) What is overfitting and how can we help protecting against it while training ML models?

6pts   (e) Explain how AI models that make binary predictions can be evaluated.

4pts   (f) Some ML models rely heavily on "hand-crafted" features while others (e.g., DL) can automatically learn such features and even more sophisticated hidden ones. Why is this important for AI applications in medicine?

6pts   (g) Describe very briefly the requirements for developing and deploying AI technology for medicine (e.g., eye care).

4pts   (h) What hinders AI from being broadly deployed in real-world clinical settings?

Problem 2: How to Read Articles That Use ML (55 Points)

Here is a paper that may help you read better articles or studies that use machine learning:

Liu, Yun, et al. "How to read articles that use machine learning: users' guides to the medical literature." Jama 322.18 (2019): 1806-1816.

The paper will provide you with a high-level overview of machine learning and how to assess its applications in medicine, especially upon reading corresponding published literature. In particular, it: (1) emphasizes the importance of proper validations of machine learning models in medical contexts, (2) reviews the basics of machine learning, and (3) suggests some considerations for clinical implementations of machine learning.

After reading this paper, you should be able to understand the general terminology associated with machine learning and assess the most crucial elements related to its validation.

You can download the paper from the course website under the resources tab. Read it carefully and answer the following questions:

20pts   (a) **Short Summary**:

Write a short objective summary of the paper in your own words (do not copy and paste). Be sure to address the following items:

- What was the paper's objective (1-2 sentences)?
- How did the paper fulfil that objective (1 short paragraph)?
- What were the main results or concepts conveyed by the paper (1 short paragraph)?
- What was the authors' main conclusion (2 sentences)?
- In your opinion, did the paper do well in fulfilling its stated objective (4-6 sentences)?

35pts   (b) **Critical Appraisal**:

Critical appraisal is a systematic evaluation of scientific research papers. In this question you will write a 2-page critical appraisal of the above given paper. In your appraisal, you should identify strengths and weaknesses of the paper, while specifically addressing the below items given in bullets.

We advise you to structure your appraisal around the usual chronology of the paper. The below items are only meant to guide you while preparing for and writing your appraisal; do not write your appraisal in a question/answer or bullet-point style. Also, you do not have to limit yourself to only the below points. Here are the items:

- Does the study address a clearly focused question?
- How does the authors' specific question fit into what is already known about the subject?
- Do the authors build a logical case and context for their hypothesis?
- How were the subjects selected?

- Was the selected clinical scenario defined clearly?
- Was the provided guide in the paper clear and adequate to soundly resolve the selected scenario?
- Is the provided guide in the paper generalizable (i.e., applicable to any other scenario)?
- Are there any results or analyses missing that you would have liked to see?
- What are the 2 or 3 major weaknesses in the paper?
- What are the 2 or 3 major strengths in the paper?
- Are the results of this paper important? What implications can they have?