
DSC 40A Fall 2024 - Group Work Session 9
due Monday, Dec 2nd at 11:59PM

Write your solutions to the following problems by either typing them up or handwriting them on another piece of paper. **One person** from each group should submit your solutions to Gradescope and **tag all group members** so everyone gets credit.

This worksheet won't be graded on correctness, but rather on good-faith effort. Even if you don't solve any of the problems, you should include some explanation of what you thought about and discussed, so that you can get credit for spending time on the assignment.

In order to receive full credit, you must work in a group of two to four students for at least 50 minutes in your assigned discussion section. You can also self-organize a group and meet outside of discussion section for 80 percent credit. You may not do the groupwork alone.

Problem 1.

Determine whether each of the following functions is **convex**, **concave**, or **neither** on \mathbb{R} . If your answer is **neither**, find all values of x such that the function is convex at x . Explain your answer.

a) $f(x) = xe^{-x}$

b)

$$f(x) = \begin{cases} \frac{1}{2}(1-x^2) & \text{if } x \leq 1 \\ -\ln x & \text{if } x > 1 \end{cases}$$

Problem 2.

a) Assume f is a convex function on \mathbb{R} that is twice differentiable and satisfies $f(x) \geq 0$ for each $x \in \mathbb{R}$. Let g be given by $g(x) = f(x)^2$. Prove that g is convex.

b) Use part (a) to prove that $f(x) = (1 + x^2 - \ln(x))^8$ is convex on $(0, \infty)$

Problem 3.

You are hired by Santa's Workshop (TM), LLC, Ltd. to build a model which will be used to predict when a toy train is defective, based on the following two features: chassis color and engine color. Consider the training data obtained from five trains below, where r indicated red, b indicated blue, and y indicates yellow.

chassis color	engine color	quality
r	r	good
r	b	good
b	r	good
b	y	defective
y	y	defective

a) Suppose a train has chassis color A and engine color B . Explain how to use a Naive Bayes classifier, based on the training data above, to find a prediction for the quality of the train.

b) Use (a) to fill out the predicted qualities for each of the test trains below:

chassis color	engine color	quality
b	y	
y	b	
r	b	
r	r	