UNIVERSITY OF CALIFORNIA, DAVIS
DEPARTMENT OF COMPUTER SCIENCE

ECS 171: Sample Midterm

Instructor: Ilias Tagkopoulos
TAs: Ameen Eetemadi and Minseung Kim
{eetemadi, msgkim}@ucdavis.edu

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General Instructions: The midterm will consist of three sections. In the first section, multiple choice questions will test your understanding of the ML methods that we have discussed in class. The second part is proofs and/or derivations. Note that just writing down an equation will give you only partial credit, if any at all. What we care most is for you to understand how the various formulas are derived and why. The third part is problem solving and it might require you to follow a particular method, as well as go through some simple calculations. This part might also have a programming exercise, although it will never be more than 10% of the total grade. The total duration of the midterm is 80 minutes. No calculator or electronics of any sort is needed or allowed.

STUDENT NAME:
STUDENT ID:

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1 PART I: MULTIPLE CHOICE QUESTIONS [20PT]

Pick only one answer for each question below.

1. Logistic regression is:
   a) A classification method where the output is a linear function of the inputs
   b) A clustering method where the logistic function is used as a metric to form clusters
   c) A regression method similar to logistic regression where our goal is to find the value of a continuous variable, given the inputs
   d) None of the above
2. Question 2 and so on (10 questions)

2 PART II: PROOFS AND DERIVATIONS [30PT]

3. Derive the maximum likelihood estimator for linear regression. You need to consider what would be the parameter values that maximize the likelihood of the data and then plug in the conditional probabilities. Assume normal distribution of the noise/error and i.i.d. samples. [If you are wondering what I am talking about, see lecture 2, slides 10-13]

3 PART III: PROBLEM SOLVING [50PT]

4. You are given the following dataset with the price of diamonds (in $) as a function of their length and width (in mm). Your task is to build a predictive tool that when given the measurements of a new diamond that comes in, it can return its predicted value.

Sample ID	Length	Width	Price
1	1	1	$100
2	2.5	0.5	$150
3	2	1.5	$300

   a) Formulate the problem as a linear regression problem and propose how to solve it (objective function, finding the weights, initialization, etc.) [5pt]
   b) Find the optimal weights by using Ordinary Least Squares [10pt]
   c) Find the optimal weights by using gradient descend (3 iterations total). Assume the weights are initialized at $(w_1, w_2) = (1, 1)$[20pt]
   d) What is the value of a diamond with length of 3mm and width of 1 mm?[5pt]
5. How would you code for gradient descent? Provide pseudocode with remarks. What termination clause did you put there and why? [10pt]

GOOD LUCK!