CalPolyPomona

CS 4210 – Assignment #1

Maximum Points: 100 pts.

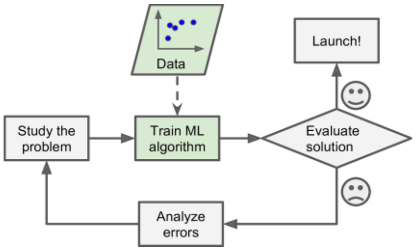
Bronco ID: |__|__|__|__|__|__|__|__|__|

Last Name: ________________________

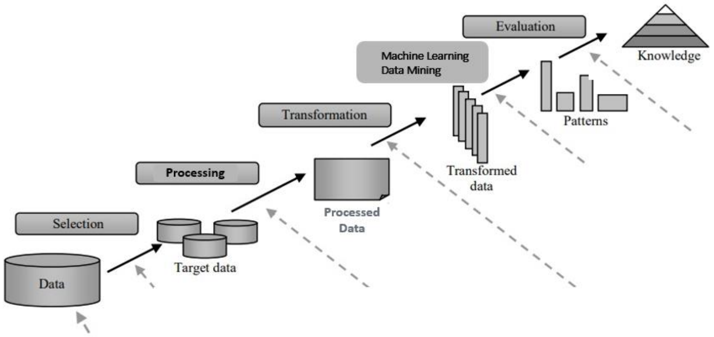
First Name: ________________________

Note 1: Your submission header must have the format as shown in the above-enclosed rounded rectangle.
Note 2: Homework is to be done individually. You may discuss the homework problems with your fellow students, but you are NOT allowed to copy – either in part or in whole – anyone else's answers.
Note 3: Your deliverable should be a .pdf file submitted through Gradescope until the deadline. Do not forget to assign a page to each of your answers when making a submission. In addition, source code (.py files) should be added to an online repository (e.g., github) to be downloaded and executed later.
Note 4: All submitted materials must be legible. Figures/diagrams must have good quality.
Note 5: Please use and check the Canvas discussion for further instructions, questions, answers, and hints.

1. [6 points] A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E (Mitchell, 1997). Explain this definition of a machine learning system including in your answer details about **E, T, P** and how you **correlate** them with the **components** of the image below.

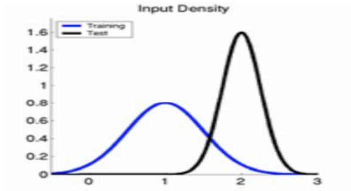


2. [6 points] Some authors present a machine learning/data mining pipeline process with only 3 main phases instead of those 6 shown in the image below (see the dashed arrows). **Explain** the reasons why they probably decided to do that including in your answer **what** are those 3 main phases and their **corresponding relevance** to build knowledge.

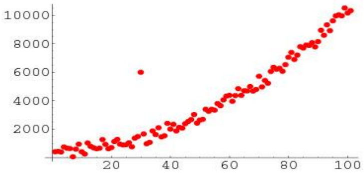


3. [10 points] Machine learning algorithms face multiple challenges while analyzing data, such as scalability, dimensionality, data distribution, sparsity, resolution, noise, outliers, missing values, and duplicated data. For **each** image below, **name** and **explain** what the corresponding challenge is from this list (you do not need to explain how to solve the challenge).

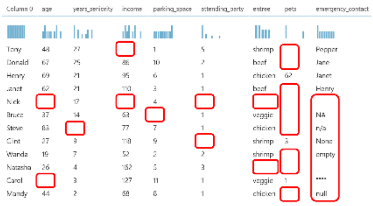
a.



b.

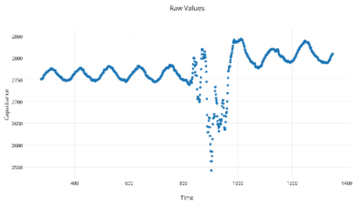


c.

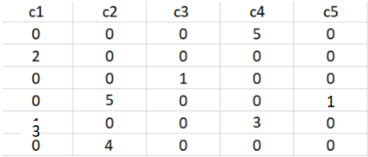


Column 0	age	years_seniority	income	parking_space	attending_party	entree	pets	emergency_contact
Tony	48	27		1	5	shrimp		Pepper
Donald	67	25	86	10	2	beef		Jane
Henry	69	21	95	6	1	chicken	62	Janet
Janet	62	21	110	3	1	beef		Henry
Nick		17		4				
Bruce	37	14	63		1	veggie		NA
Steve	83		77	7	1	chicken		n/a
Clint	27	9	118	9		shrimp	3	None
Wanda	19	7	52	2	2	shrimp		empty
Natasha	26	4	152	5	3			..
Carol		3	127	11	1	veggie	1	****
Mandy	44	2	68	8	1	chicken		null

d.

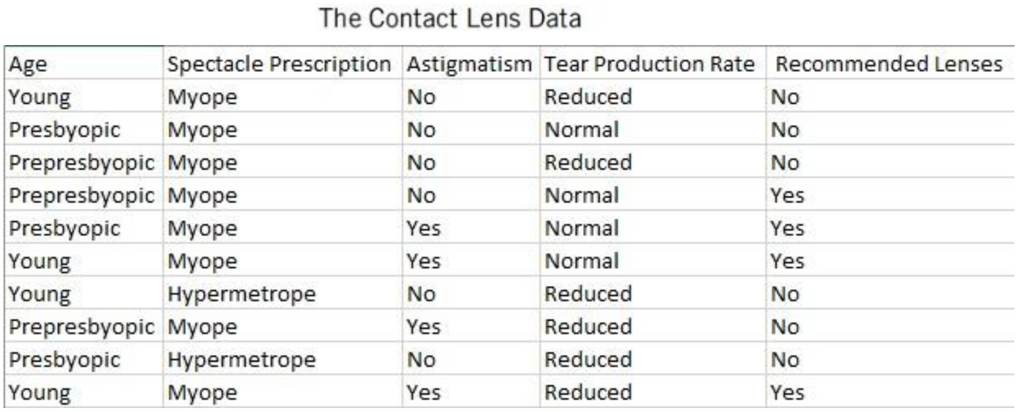


e.



c1	c2	c3	c4	c5
0	0	0	5	0
2	0	0	0	0
0	0	1	0	0
0	5	0	0	1
3	0	0	3	0
0	4	0	0	0

4. [12 points – 2 points each] Analyze the dataset below and answer the proposed questions:



The Contact Lens Data

Age	Spectacle Prescription	Astigmatism	Tear Production Rate	Recommended Lenses
Young	Myope	No	Reduced	No
Presbyopic	Myope	No	Normal	No
Prepresbyopic	Myope	No	Reduced	No
Prepresbyopic	Myope	No	Normal	Yes
Presbyopic	Myope	Yes	Normal	Yes
Young	Myope	Yes	Normal	Yes
Young	Hypermetrope	No	Reduced	No
Prepresbyopic	Myope	Yes	Reduced	No
Presbyopic	Hypermetrope	No	Reduced	No
Young	Myope	Yes	Reduced	Yes

a. What is the most likely task that data scientists are trying to accomplish?

b. **In general**, what is a feature and how would you **exemplify** it with **this data**?

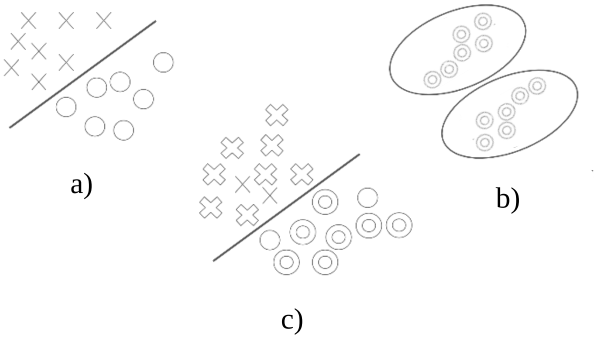
c. **In general**, what is a feature value and how would you **exemplify** it with **this data**?

d. **In general**, what is dimensionality and how would you **exemplify** it with **this data**?

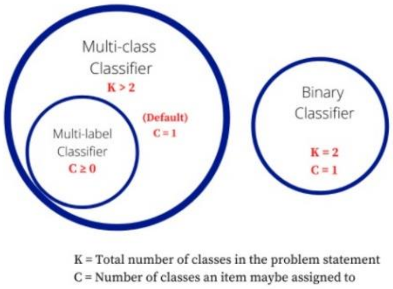
e. **In general**, what is an instance and how would you **exemplify** it with **this data**?

f. **In general**, what is a class and how would you **exemplify** it with **this data**?

5. [6 points] Identify and explain what **kind of machine learning** (supervised, unsupervised, semi-supervised, reinforcement) **system** should be used for each scenario below including in your answer **data labels** information. Hint: check the images to figure out which data sample is labelled.



6. [6 points] Explain the **tasks** addressed by each classifier below.


Multi-class Classifier
K > 2
Multi-label Classifier
C ≥ 0
(Default)
C = 1
Binary Classifier
K = 2
C = 1
K = Total number of classes in the problem statement
C = Number of classes an item maybe assigned to

7. [54 points] Regarding the training data shown in question 4:

   a. [12 points] Find a **maximally specific hypothesis** that fits the data **following** the strategy of **Find-S algorithm**. Hint: start from the hypothesis h ← (∅, ∅, ∅, ∅).

   b. [12 points] Complete the given python program (find_s.py) that will read the file contact_lens.csv and output the hypothesis of **Find-S algorithm** (the hypothesis you got in part a). The output should be in this format: [‘Sunny’, ‘?’, ‘Strong’, ‘?’]. Add the link to the online repository as the answer to this question.

   c. [15 points] Derive the decision tree produced by the standard ID3 algorithm. Show your calculations for entropy and information gain for all splits. Plot your final tree at the end.

   d. [15 points] Complete the given python program (decision_tree.py) that will read the file contact_lens.csv and output the decision tree of **ID3** (the tree you got in part c). PS: if this tree is different from yours shown in letter c), try to explain why. Add the link to the online repository as the answer to this question.

Important Note: Answers to all questions should be written clearly, concisely, and unmistakably delineated. You may resubmit multiple times until the deadline (the last submission will be considered).

NO LATE ASSIGNMENTS WILL BE ACCEPTED. ALWAYS SUBMIT WHATEVER YOU HAVE COMPLETED FOR PARTIAL CREDIT BEFORE THE DEADLINE!