**Notes**

Mark the top sheet with your name and the names of any students with whom you collaborated. If you didn't collaborate with anyone, mark your collaborators as "None." Begin each problem on a new sheet of paper.

Remember, your goal is to communicate. Full credit will be given only to correct solutions which are described clearly. Convoluted and obtuse descriptions will receive low marks.

To complete your homework, you may ONLY consult the following material:

1. lecture slides posted on the class webpage
2. course notes you or others took during lecture
3. the required text (CLRS)
4. websites that may clarify the concepts covered in the material

Please stop by my office for any question.

**Name:**

**ID:**

**Problem Set 1 (25 pts)**

Assume the following dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x1 | x2 | x3 | x4 | y(Class) |
| 2 | 1 | 1 | 100 | -1 |
| 100 | 1 | 1 | 2 | -1 |
| 100 | 0 | 1 | 2 | -1 |
| 2 | 0 | 0 | 100 | 1 |
| 100 | 0 | 1 | 2 | 1 |

* (5 points) Define the optimization formulation without slack variables and without vector notation For instance, given W=[w1,w2,w3,w4]T and b, the constraint for the first example without vector notation is 2\*w1+1\*w2+1\*w3+100\*w4+b<=-1. Please note that also the optimization function should be defined without vector notation.
* (5 points) Please provide the formulation with the slack variables always without vector notation.
* (5 points) Is the formulation with the slack variables needed in this case? If Explain why in both the cases (yes or no)?
* (5 point) Assume you have only these linear separators
  + -2\*x2-x3+2
  + -2\*x2+1
  + 10\*x1+10\*x2+100\*x3+100\*x4 -1000
  + -4\*x2-x3+3

What is the best one according the dataset? Explain why the others are not the best one.

* (5 points) Write a python code to
  + Plot in 2D the dataset,
  + Find a way to obtain the definition (the expression) of the new 2 dimensions in the 2D plot (print them).
  + For each new dimension discuss the relevance of the original dimensions (x1, x2, x3, and x4).
  + Comment the results.