For the purpose of that exercise, the dataset ("data.txt") contains N = 10,000 rows and 11 columns. The first column in every row i gives the label (y_i), and the remaining 10 columns forms the vector (x_i) of features.

We are interested in predicting the dependent variable y using the following Linear Regression model

- $y* = w^T x + b$ where $x = (x^1, x^2, ..., x^{10})$ and $y*$ is our estimate of the label.

Question 1:

- Our goal is to determine the values of the estimators of w and b that minimize the L-infinity norm of the residuals. In other words, you want to choose w , b that minimize the following objective function:

$$\max_{i \in 1, ..., N} \{ |y_i - (w^T x_i + b)| \}$$

- Formulate the problem as a Linear Program, implement it, and solve it with Gurobi. Return the optimal value of the maximum absolute residual, the optimal value of the intercept (b) and the vector (w).

Hint: Try adding variables and constraints to find an equivalent LP formulation that allows you to remove the absolutes values and the max function. For example $z = |x|$ could be modeled by the following constraints: z >= x and z >= -x

Question 2:

- Our goal is to determine the values of the estimators of w and b that minimize the sum of the absolute values of the residuals. In other words, you want to choose w , b that minimize the following objective function:

$$\Sigma_{i = 1, ..., N} (|y_i - (w^T x_i + b)|)$$

- Formulate the problem as a Linear Program, implement it, and solve it with Gurobi. Return the optimal value of the sum of absolute residuals, the optimal value of the intercept (b) and the vector (w).

Instructions:

- Write your answers in "q1.py" and "q2.py" files in Vocareum. Please do not change the names of the file(s) and function(s) nor the format of the functions' outputs. Your code can be submitted at most 5 times.

- Whenever you need to use a fonction from one of the python libraries, please do not forget to import the library directly in your function. A list of the libraries that are available for Python 2 on vocareum is provided in the following website: https://www.vocareum.com/2017/08/24/installed-software-packages/#toggle-id-3

- For question 1, the **"construct_lp_model"** code has been provided to you to construct the Gurobi model of a Linear Program in the following form:

  $\max\{c^T x\}$
  subject to:
  $$Ax \leq d$$

where the inputs A, c and d must be matrix or vector numpy arrays. That method is not efficient from a memory point of view, so use loops to create the model for question 2.

- Please refer to the following website to help you implement your solution with Gurobi if you don't want to use the **"construct_lp_model"** function: https://www.gurobi.com/documentation/7.0/quickstart_mac/py_example_mip1_py.html

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Linear Regression (Gurobi)...