Objectives of this assignment:

- to explore time complexity and "real time"
- to "dust off" programming skills

What you need to do:

1. Implement a simple algorithm to transpose an nxn matrix *M*
2. Collect the execution time T(n) as a function of n
3. Plot the functions T(n)/n, T(n)/n^2, and T(n)/n^3 on the same graph (if possible).
4. Refer to the analysis of the time complexity your performed for your Module 1 and discuss it in light of the graph you plotted above.

Objective:

1. The objective of this programming assignment is to implement in your **preferred**[*] language an algorithm to compute the transpose of an nxn matrix. We are interested in exploring the relationship between the time complexity and the "real time". For this exploration, you will collect the execution time T(n) as a function of n and plot T(n)/n, T(n)/n^2, and T(n)/n^3 on the same graph. Finally, discuss your results.

Program to implement

```
collectData()
      Generate an LxL matrix G with a HUGE L (as huge as your language and
      machine allow) with random values // This must be done once
      for n = 100 to L (with step 100)
            copy in an nxn Matrix A the nxn upper left matrix from Matrix G

            Start timing // We time the transposition of Matrix A
            for i = 1 to n-1
                  for j = i+1 to n
                              // swap A[i] and A[j]
                              buffer = A[i][j]
                              A[i][j] = A[j][i]
                              A[j][i] = buffer
            Store the value n and the values T(n)/n, T(n)/n^2, and T(n)/n^3 in a
            file F where T(n) is the execution time.
```

Data Analysis

Use any plotting software (e.g., Excel) to plot the values T(n)/n, T(n)/n^2, and T(n)/n^3 in File F as a function of n (on the same graph). File F is the file produced by the program you implemented. Discuss your results based on the plot. (**Hint**: is T(n) closer to K.n, K.n^2, or K. n^3.$\log_2(n)$ where K is a constant?)

How to Plot?

I suggest to store the values in File F following the csv format used by Excel. Once the file F is in csv format, you can use Excel to plot.

If you do not know the csv format, google "csv format". Do not hesitate to ask for help if you need.

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[*] You can use any language as long as it is already installed on Engineering Unix Tux machines.

Report

- Write a report that will contain, explain, and discuss the plot(s). The report should not exceed one page.
- In addition, your report must contain the following information:
  - whether the program works or not (this must be just ONE sentence)
  - the directions to compile and execute your program
- Good writing is expected.
- Recall that answers must be well written, documented, justified, and presented to get full credit.
- Make sure that the TA has complete instructions/directions to compile and execute your program.

What you need to turn in:

- Electronic copy of your source program
- Electronic copy of the report (including your answers) (standalone). Submit the file as a Microsoft Word or PDF file.

Grading

- Program is worth 30% if it works and provides data to analyze (Recall that your program must compile and execute on Engineering Unix Tux machines)
- Quality of the report is worth 70% distributed as follows: good plots (25%), explanations of plots (10%), discussion and conclusion (35%).

Login on Engineering Unix Machines,

Log in remotely on the Engineering Tux machines to implement, compile and execute. To log in remotely, you must use an **ssh** client such as SecureCRT (Windows).

On Windows 10, you may use from the command prompt the following command (if ssh is available):

ssh username@gate.eng.auburn.edu

where username is your Auburn University username (**without** @auburn.edu).

On Mac or any Unix machine (Ubuntu...), use the same command (see above) on a terminal.