Problem Statement

You are an electrical engineer performing a torque and speed experiment on a DC motor. You have data from the experiment in the file **APP_C29_1_motor.dat**. The file contains several thousand (but less than 12,000) lines of data in four columns. The first data column is the date, the second column is the time, the third column is the measured angular speed (rad/s), and the fourth column is the back EMF voltage (V). The sampling rate is 10 Hertz, which is one sample every 0.1 seconds.

You would like to know the torque experienced by the motor over the course of the test. The following equations relate the angular speed and the torque of a DC motor:

$$\omega = \frac{V_{in}}{K} - \frac{R_a I_a}{K}$$

$$I_a = \frac{T}{K}$$

where:

ω:	angular speed (rad/s)
V_{in}:	input voltage = 200 V
K:	constant describing magnetic flux and EMF voltage = 4 V*s
R_a:	armature resistance = 8 Ohms
I_a:	armature current (Amps)
T:	torque (N*m)

Instructions

Represent

- As a group/table, create a flowchart, algorithm, or pseudocode for solving the problem.

Plan

- Create a file named **APP_C29_1.cpp** or copy and rename the template file, **APP_C29_1_TEMPLATE.cpp**, to your working directory. You may write the program completely on your own or you may use the template file as a starting point. The directory where the template file is stored is the same as for the data file mentioned below.
- Outline the steps your program will take by adding comment statements to your file based on the flowchart, algorithm, or pseudocode.

Implement

- Copy the data file to your working directory. The file can be found here: **`/share/EED/class/engr1281/students/c/Class_29/Application/`**
- Write a complete C/C++ program **APP_C29_1.cpp** to perform the following tasks:
  - Open and read the data file and then close it when finished.
    - Read from the file, but do not store, the data in the first, second, and fourth columns. Store only the angular speed data from the third column in a one-dimensional array.
    - In order to ignore columns one, two, and four, the format specifiers for the **`fscanf()`** should be **`"%*s%*s%f%*f"`**. In this instance the **`"*"`** acts as an assignment suppression operator.
    - Your program will need to detect the end-of-file (**`EOF`**) to know when to stop reading data. Close the input file when you reach the **`EOF`**.
  - Process the data to determine:
    - the maximum and minimum angular speed values in the array

    - the elapsed time in seconds between the maximum and minimum speed values
    - the maximum and average torque
    - the maximum armature current
  - Display the well-labeled results to the screen, and write them to the output file **APP_C29_1_result.txt**.
- Compile, link, and run your program.

Evaluate

- Check the armature current calculation by hand to verify the program's current computation.

Document

- Create a single PDF that includes your code, the terminal window output, the output file, your flowchart/algorithm/pseudocode, and your verification.
- Submit the PDF to Carmen according to the DAL.

Include the standard comment and **`printf()`** statements indicating name, seat number, etc.