# Lab 02 - Runtimes Function

## Instructions:

- **The moving average determines the long-term trends of a data series. It is a series of averages calculated for data over fixed time intervals called windows. Namely, given a dataset $(d_1, d_2, \ldots, d_n)$, its moving average for window size $t \leq n$ is the series $(a_1, a_2, \ldots, a_m)$ where $m = n - t + 1$ and**

$$a_i = \frac{\sum_{j=i}^{i+t-1} d_j}{t}$$

- **Your objective is to construct an algorithm that generates the moving average of an array of numerical data for a given window size, and determine its runtime function.**
- **Your source codes must compile and can only include the libraries '`iostream`', '`iomanip`', '`string`', and user-defined libraries from the lab to receive any credit.**
- **A cumulative task will not receive credit if the required previous tasks are not completed.**
- **Your submissions must be submitted to the GitHub repository in the Lab02 directory.**
- **Cheating of any kind is prohibited and will not be tolerated.**
- **Violating or failing to follow any of the rules above will result in an automatic zero (0) for the lab.**

## Grading

| Task | Maximum Points | Points Earned |
|---|---|---|
| 1 | 1 | |
| 2 | 1 | |
| 3 | 1 | |
| 4 | 1 | |
| 5 | 1 | |
| **Total** | 5 | |

**Note: solutions will be provided for tasks colored blue only.**

### Task 1

- Create a text file named '`pseudocode.txt`' that includes the pseudocode for your moving average algorithm using the pseudocode syntax instructions provided in class. The algorithm should take an array and a window size as inputs.

### Task 2

- Create a text file named '`runtime.txt`' that calculates the runtime function of your algorithm in '`pseudocode.txt`'. Initially, it must state the input size, then construct the runtime table assuming all costs are 1 (thus, the cost column can be omitted) with a statement column. Finally, it derives the runtime function.

### Task 3

- Create a header file named '`Algorithm.h`' that defines a C++ function of your pseudocode moving average algorithm from '`pseudocode.txt`'.

### Task 4

- Create a C++ file named '`test01.cpp`' that includes '`Algorithm.h`' and displays the test of the moving average on the sequence (1, 2, 3, 4, 5, 6) with a window size of 3. The display must begin with the message `"Test Case 1"` on its own line, followed by the message `"Dataset: [1, 2, 3, 4, 5, 6]"` on the next line. Last, on the following line, the message `"Moving Average:"` followed by the outcome of the moving average function as a list enclosed in square braces.

  **Example:** The expected display is

  Test Case 1
  Dataset: [1, 2, 3, 4, 5, 6]
  Moving Average: [2, 3, 4, 5]

### Task 5

- Create a C++ file named '`test02.cpp`' that includes '`Algorithm.h`' and displays the test of the moving average on a sequence of random numbers with a size in the range [5,10] with a window size of 2. The display must consist of four lines that must begin with the messages `"Test Case 2"`, `"Dataset:"`, `"Moving Average:"`, and `"Expected Value:"`, respectively. Additionally, the messages of the second, third, and fourth lines must be followed by the sequence, the outcome of the moving average function for the sequence, and the moving average of the sequence determined by hand, respectively, as a list enclosed in square braces.

## Extra Credit

- Create a text file and C++ file named '`extraPseudo.txt`' and '`extraTest.cpp`', respectively. The text file must define an algorithm (pseudocode) that determines the range of values in an array and then calculates the runtime function of the algorithm; ultimately, ensuring that the linear coefficient of the runtime function does not exceed 4 (assuming all costs are 1). The C++ must define a C++ function of the algorithm from '`extraPseudo.txt`' and test it. (1 point)