Introduction to Scientific Computing Lab 5

Arrays

2017

1 Objectives

After completing these exercises you will be able to:

- Store data in arrays
- Manipulate data stored in arrays

2 Notes

Work individually.

Create a directory for each week so you can come back to your codes in the future. Create files for each of the different exercises and name them in a logical manner, so `exercise1.c` for example.

When changing the source code, ensure you have **saved it before compiling** otherwise the compiler will only see the old file

When you have completed all exercises, ask a demonstrator to assess your work. They will test your code and ensure it is formatted well with good commenting, structure and variable names. This is a useful feedback mechanism, so listen to what the demonstrator has to say and their recommendations for improving your code.

In case of an error, read the compiler error. This will often tell you the line (or close to the line) where the error is occurring. Fix it, test and repeat for the errors you have. If you are getting nowhere then it can often be useful to copy the error into google, or use some keyword searches. If you are really stuck on one error then call over an assistant who will be able to point you in the right direction.

3 Linear Interpolation

In this exercise you will read in a lift curve and store it in an array. You will then perform linear interpolation to find the lift at any chosen angle, and the angle needed for a chosen lift. The lift data is shown below.

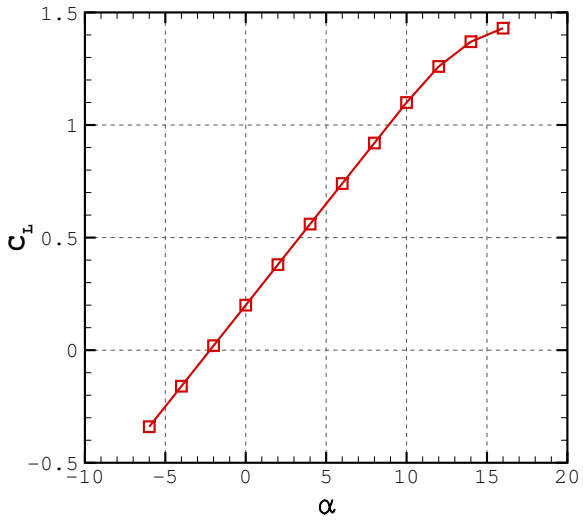

Figure 1: Lift data

In general, we are given a set of data points $(\mathbf{x}, \mathbf{y})$. Linear interpolation can be used to 'fill in the gaps' of data we have i.e. we are given a particular value x_q, which is not one of the data points and we need to find a value of y_q that corresponds to a linear fit of the data. The algorithm for linear interpolation is:

1. Loop over all of the data points until you find the two adjacent points either side of the requested value of x_q
2. Calculate $a = \frac{y_{i+1}-y_i}{x_{i+1}-x_i}$, and $b = y_i - ax_i$
3. Return $y_q = ax_q + b$

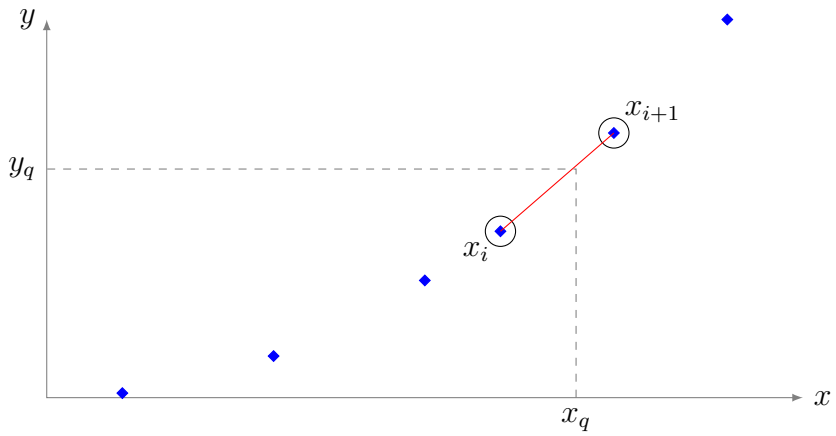

Figure 2: Linear interpolation

4 Exercises

Ensure you create a new directory for this week. From blackboard, download the file required for this week's exercises (the first column is angle of attack and the second column is lift coefficient).

You will need to write a `main` program with a number of functions.

1. Write a **function** that loads the data values from the file and stores them in an array (or arrays). Write a program that calls this function and then prints the data out to your screen (formatted neatly) to ensure you are reading and storing it correctly
    - You may use a fixed size array/arrays and fixed length files
2. Extend exercise 1 and write a **function** that uses linear interpolation to calculate the lift coefficient for a given angle of attack. Modify your `main` program to ask the user to input an angle of attack and output a corresponding lift coefficient (the basic algorithm is outlined on the previous page)