Research

To program a Plotter, Salter, and Smoother in MATLAB; there are many functions and conventions to become familiar with.

First, it is imperative to know how to read and write files. In this case, the focus is on reading and writing tables within files. This is very simple to do using MATLAB. Since “table” is a popular data type for MATLAB, readtable[[1]](#footnote-1) and writetable[[2]](#footnote-2) functions are included, and do not need to be re-created. The readtable function retrieves a table from a file, when given a specific file path. The writetable function, similarly, writes a table to a file, when given a specific file path. Here is how both functions can be used in practice:





Although storing the results from readtable in a variable is one way of creating a table in MATLAB, it is also useful to know how to create a table[[3]](#footnote-3) the traditional way. Simply create two arrays for x and y values:



Next, create a table using the table function, taking both arrays as input:



Now that the table is created, it is possible to work with specific rows, columns, or single values. Selecting a row from a table is easy. Here is how to select the ith row of a table with   
i = 1:



Similarly, here is how to select the jth column of a table with j = 1:



To store a single value from a table, T, there are multiple ways. Here is one example in the case where the desired value is in the y-column and ith row (i = 1):



Learning the basics of using tables is not enough to program a salter and smoother. There are additional functions that must be mastered.

For a salter, some randomization is needed. A random integer can be generated using the randi[[4]](#footnote-4) function, which takes a range of integers as input. The following code will return a random integer between 0 and 60:



In order to include negative values, subtract by a constant. The following code will return a random integer between -30 and 30:



The randi function is being used for the salter, however there is another built-in function that can be used for the smoother, the movmean[[5]](#footnote-5) function. Given an array, y; and a window size of 2, the movmean function will compute and return an array of the mean values between each 2 consecutive y-values. Here is how this can be used:



These mean values are:



After using the above functions to read, write, and manipulate data in a table, it is important to be able to visualize the data. This can be obtained using the plot[[6]](#footnote-6) function, with which it is possible to input multiple x, y values and be given a neat graph of your data points:



The graph can also be customized in many ways by adding special parameters such as the legend:



Salter

Using all of the functions and conventions researched, a salter was programmed. Here is a snapshot of the code used:

Text

Description automatically generated

This program reads in a table from a file named “data.txt”. Then, the number of rows is determined using the size function, taking the stored table as input. Next, a for loop is used to manipulate y values row-by-row. The y-values are incremented or decremented by a random integer from [-30,30] (achieved by using randi(60) – 30). Then, values from both the original table and the altered table are graphed using the plot function. Lastly, the salted data is output into a new text file named “salteddata.txt”.

The following data was salted using this program:

|  |  |
| --- | --- |
| **x** | **y** |
| 1 | 100 |
| 2 | 104 |
| 3 | 109 |
| 4 | 116 |
| 5 | 125 |
| 6 | 136 |
| 7 | 149 |
| 8 | 164 |
| 9 | 181 |
| 10 | 200 |
| 11 | 221 |
| 12 | 244 |
| 13 | 269 |
| 14 | 296 |
| 15 | 325 |
| 16 | 356 |
| 17 | 389 |
| 18 | 424 |
| 19 | 461 |
| 20 | 500 |

The salted data was exported to a new file:

|  |  |
| --- | --- |
| **x** | **y** |
| 1 | 100 |
| 2 | 123 |
| 3 | 134 |
| 4 | 94 |
| 5 | 150 |
| 6 | 144 |
| 7 | 125 |
| 8 | 151 |
| 9 | 184 |
| 10 | 228 |
| 11 | 249 |
| 12 | 224 |
| 13 | 298 |
| 14 | 324 |
| 15 | 325 |
| 16 | 375 |
| 17 | 368 |
| 18 | 420 |
| 19 | 486 |
| 20 | 518 |

The graph was generated by MATLAB, comparing data from both tables:

Chart, line chart

Description automatically generated

Smoother

After the salter was programmed, the smoother was next. Here is a snapshot of the code used:

Text, letter

Description automatically generated

This program reads in a table from a file named “salteddata.txt”. Then, the first column, storing the x-values of the table, is stored in array x. Next, the second column, storing the y-values of the table, is stored in array y\_intial. Then, the movmean function is take the original data and generate smoothed data. The result is stored in array y. Next, a table is created with the new, smoothed data. The original and new tables are then plotted. Lastly, the smoothed data is output into a new text file named “smootheddata.txt”.

The following data was smoothed using this program:

|  |  |
| --- | --- |
| **x** | **y** |
| 1 | 100 |
| 2 | 123 |
| 3 | 134 |
| 4 | 94 |
| 5 | 150 |
| 6 | 144 |
| 7 | 125 |
| 8 | 151 |
| 9 | 184 |
| 10 | 228 |
| 11 | 249 |
| 12 | 224 |
| 13 | 298 |
| 14 | 324 |
| 15 | 325 |
| 16 | 375 |
| 17 | 368 |
| 18 | 420 |
| 19 | 486 |
| 20 | 518 |

The salted data was exported to a new file:

|  |  |
| --- | --- |
| **x** | **y** |
| 1 | 100 |
| 2 | 111.5 |
| 3 | 128.5 |
| 4 | 114 |
| 5 | 122 |
| 6 | 147 |
| 7 | 134.5 |
| 8 | 138 |
| 9 | 167.5 |
| 10 | 206 |
| 11 | 238.5 |
| 12 | 236.5 |
| 13 | 261 |
| 14 | 311 |
| 15 | 324.5 |
| 16 | 350 |
| 17 | 371.5 |
| 18 | 394 |
| 19 | 453 |
| 20 | 502 |

The graph was generated by MATLAB, comparing data from both tables:

Chart, line chart

Description automatically generated

1. <https://www.mathworks.com/help/matlab/ref/readtable.html> [↑](#footnote-ref-1)
2. <https://www.mathworks.com/help/matlab/ref/writetable.html> [↑](#footnote-ref-2)
3. <https://www.mathworks.com/help/matlab/tables.html> [↑](#footnote-ref-3)
4. <https://www.mathworks.com/help/matlab/ref/randi.html> [↑](#footnote-ref-4)
5. <https://www.mathworks.com/help/matlab/ref/movmean.html> [↑](#footnote-ref-5)
6. <https://www.mathworks.com/help/matlab/ref/plot.html> [↑](#footnote-ref-6)