# Week 4 Tutorial 3

The purpose of this tutorial is to teach you how to read and write data from a text (ASCII) file.

```
% Always clear workspace variables before a new tutorial or program.
clear
clc
```

Edit the code below and update the variable named **name** with your name for this tutorial in the code below.

```
name="";
fprintf("Output for Tutorial_04_3 run by %s.\n", name)
```

## Input

### Importing From a .txt File

Refer to the lecture slides, book, or the help doc if you don't remember. Load the data from the file **NorthernHemTempIndex.txt** into **tempMatrix**.

```

```

## Data Manipulation

### Get the Years

Extract the values from the first column

```
years=
```

Get the number of year values in **years**, search the docs for "length of ...".

```
numYears=
```

Now that we've extracted the data, delete the first column. Remember that `variable(1,2)=[]` deletes a single value, if you want to delete an entire column you'll have to apply it to "all rows" in that column. Essentially the same as extracting the values above, but here you're assigning the values.

```
% Delete the first column (years)

```

If you look at your Workspace, you should see that your **tempMatrix** variable says it's a 28x12 where it was 28x13 array since we just deleted a column.

We're just removing the years so we can perform calculations on the remaining data as a whole, as the rest of the data is temperature values.

### Compute the Mean

Compute the mean of each column and row in **tempMatrix**. You'll have to check the doc to determine how to get the mean by column vs getting the mean by rows. That is, `mean()` of a matrix will return a vector containing the means for each column and row depending on which arguments you supply.

```
% Compute the mean by column (monthly temps)
meanMontlyTemps=

% Compute the mean by rows (yearly temps)
meanYearlyTemps=
```

## Output

### Open a .txt File

Output to a text file is slightly different than what we've seen with Excel or .mat files. In this case, a reference to the file is stored in a variable. Then we can `fprintf()` to that fileId. Remember, there is an optional first parameter to write to a file, by default it writes to the Command Window. Opening the file with **w**rite permissions will cause each `fprintf()` to append or, add to, the file so long as it is open. If the file is opened again later, it will overwrite the file entirely (starting from an empty file). There are other permissions options depending on how you want to open the file.

Don't forget the '\n' character.

```
% Open a file with 'w'rite permissions
fileId=fopen('TemperatureDataTable.txt','w');

% Print a title
fprintf(fileId,'Table of Northern Hemisphere Temperature Changes in Degrees Fahrenheit

% Print some table headings (the '\t' is a tab character which is generally 4 or 8 spa
fprintf(fileId,'Year      Jan\t Feb\t  Mar\t  Apr\t  May\t  Jun\t  Jul\t  Aug\t  Sep\t
```

You may have noticed, I didn't use a '\n' character, but that is for good reason. We're going to be using for loops to print the data to the file. If we add a new line at the end of each print statement in the for loop, we will end with one extra new line from the last for-loop iteration. One common way to avoid this is to set yourself up so you can put the '\n' at the start of your print statement. In this case it will move the cursor down one line, then print the statement in the for loop.

### Print the Temperature Data

Write a (nested) for-loop to print the year, followed by each month's temperature data. The data should look like the following.

2004  64  83  85  67  51  44  46  49  57  69  92  51  63.17

You have to think about the data you have and how you want it represented. So, we have the **years**, the **tempMatrix** data, and the **means**. Those are in three different variable arrays. The year and mean only show up once in each row so we will need a for loop to parse through each year. We should print the year (with a '\n' in the beginning), then we will need a for loop to parse each month's temp data. We will print those one by one but with these, we will begin with a '\t' because we want a tab of space between each value but again, we

don't want it on the end or we'll have an extra one. Then, after the months are parse, we want to print our mean value.

To summarize:

- Create a for loop to parse the NUMBER of years (we just want the values 1:n) you may find it easy to use r=1:n
- Print the year for the current iteration (with a '\n' to begin and use %4i for the format)
- Create a for loop to parse the columns in the month data, you may find it easy to use c=1:n where n is the number of columns in the **tempMatrix**. This way, when you are printing the temperature value, you can use **tempMatrix(r,c)** for the current **r**ow and **c**olumn based on the for loops. Print the temp value (with a '\t' to begin and use %3i for the format)
- Outside of the nested for-loop, print the mean value for that year (again, beginning with a '\t' and use %5.2f for the format)

Do not forget to `fprintf` to the **fileId**!

```
% For loop to parse the number of years in our dataset

    % Print the current year

    % For loop to parse the months in the current year (r from the outer for loop)
        % Print the current month (r,c)


    % Print the yearly mean at the end of each year's row
```

Now, while that file is still open, let's add a final row of information showing the mean from each column (months). Here we don't need to go for r=1:n, we can actually parse through the values so we can use `for mean=meanMontlyTemps` and then just print the value of `mean` rather than needing to use and index like `meanMonthlyTemps(r)`.

```
% Label the column "Mean" in place of where the Year would normally be


% For loop to step through each month in meanMonthlyTemps and print
% beginning with a \t and %5.2f format


% Finally, we need to always remember to close the file when we're done
fclose(fileId);
```

```
% Notify the user that the process is complete
fprintf('\n\nThe Output Data Table is in the file TemperatureDataTable.txt\n\n')
```

## Example output

If you were to run your tutorial (enter **Tutorial_04_03** into the command window) your output should appear as follows.

```
Output for Tutorial_04_3 run by Geoff Berl.

tempMatrix =
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1995 | 72 | 115 | 59 | 65 | 10 | 49 | 40 |
| 1996 | 36 | 53 | 36 | 17 | 30 | 19 | 27 |
| 1997 | 38 | 51 | 73 | 48 | 40 | 46 | 39 |
| 1998 | 59 | 97 | 65 | 83 | 62 | 68 | 79 |
| 1999 | 58 | 96 | 27 | 49 | 32 | 32 | 35 |
| 2000 | 31 | 89 | 84 | 83 | 53 | 38 | 39 |
| 2001 | 53 | 47 | 75 | 52 | 53 | 52 | 58 |
| 2002 | 97 | 103 | 108 | 52 | 45 | 61 | 59 |
| 2003 | 85 | 48 | 60 | 59 | 63 | 49 | 60 |
| 2004 | 64 | 83 | 85 | 67 | 51 | 44 | 46 |
| 2005 | 89 | 65 | 87 | 86 | 74 | 76 | 75 |
| 2006 | 61 | 84 | 76 | 50 | 70 | 71 | 60 |
| 2007 | 129 | 89 | 90 | 103 | 58 | 60 | 58 |
| 2008 | 22 | 43 | 106 | 55 | 54 | 53 | 53 |
| 2009 | 80 | 57 | 65 | 32 | 10 | 23 | 6 |
| 2010 | -13 | 16 | 0 | 8 | 4 | -1 | 4 |
| 2011 | 47 | 28 | 37 | 4 | -2 | 6 | 17 |
| 2012 | 28 | -1 | 16 | -12 | 16 | 6 | 6 |
| 2013 | 3 | -34 | -5 | -10 | 2 | -1 | -13 |
| 2014 | 32 | 33 | 21 | 14 | 14 | 8 | -5 |
| 2015 | 20 | 47 | 1 | 2 | 17 | 14 | 27 |
| 2016 | 55 | 38 | 43 | 39 | 35 | 36 | 36 |
| 2017 | 0 | 45 | 39 | 28 | 15 | 19 | 27 |
| 2018 | 40 | 41 | 111 | 68 | 46 | 44 | 32 |
| 2019 | 50 | 54 | 41 | 51 | 34 | 43 | 44 |
| 2020 | 54 | 42 | 41 | 1 | 12 | 0 | -11 |
| 2021 | 35 | 47 | 37 | 15 | 27 | 21 | 9 |
| 2022 | 37 | 0 | 40 | 45 | 34 | 34 | 32 |

```
years =

        1995
        1996
        1997
        1998
        1999
        2000
        2001
        2002
        2003
        2004
        2005
        2006
        2007
        2008
        2009
        2010
        2011
        2012
        2013
        2014
        2015
        2016
        2017
        2018
        2019
        2020
        2021
        2022


numYears =

    28
```

```
tempMatrix =

    72   115    59    65    10    49    40    51    40    60    54    34
    36    53    36    17    30    19    27    13     0     3    34    36
    38    51    73    48    40    46    39    43    48    64    54    49
    59    97    65    83    62    68    79    71    64    53    54    79
    58    96    27    49    32    32    35    32    39    41    52    72
    31    89    84    83    53    38    39    48    35    29    20    24
    53    47    75    52    53    52    58    61    48    53    96    63
    97   103   108    52    45    61    59    47    53    51    74    44
    85    48    60    59    63    49    60    75    74    93    66    95
    64    83    85    67    51    44    46    49    57    69    92    51
    89    65    87    86    74    76    75    67    89    94   102    73
    61    84    76    50    70    71    60    64    71    96    94   110
   129    89    90   103    58    60    58    67    61    79    74    73
    22    43   106    55    54    53    53    53    53    87    85    57
    80    57    65    32    10    23     6    13    13    20    33    51
   -13    16     0     8     4    -1     4   -10     3    -5   -19    32
    47    28    37     4    -2     6    17    22    24     8    47    11
    28    -1    16   -12    16     6     6    -2    -7     5   -17   -47
     3   -34    -5   -10     2    -1   -13    -3    -2    -1     1    12
    32    33    21    14    14     8    -5    -1    -4     1    -2     4
    20    47     1     2    17    14    27    23    36    18     3    49
    55    38    43    39    35    36    36    20    22    17    -4    40
     0    45    39    28    15    19    27    23    22    21     4    32
    40    41   111    68    46    44    32    37    37    45    48    38
    50    54    41    51    34    43    44    31    35    32    32    17
    54    42    41     1    12     0   -11   -10   -22   -17   -19    21
    35    47    37    15    27    21     9    -3    -9    13   -11     5
    37     0    40    45    34    34    32    29    28    55    38    30


meanMontlyTemps =

   48.6429   52.7143   54.2143   41.2143   34.2500   34.6429   33.5357   32.5000   32.4286   38.7
```

```
meanYearlyTemps =

   54.0833
   25.3333
   49.4167
   69.5000
   47.0833
   47.7500
   59.2500
   66.1667
   68.9167
   63.1667
   81.4167
   75.5833
   78.4167
   60.0833
   33.5833
    1.5833
   20.7500
   -0.7500
   -4.2500
    9.5833
   21.4167
   31.4167
   22.9167
   48.9167
   38.6667
    7.6667
   15.5000
   33.5000


The Output Data Table is in the file TemperatureDataTable.txt
```

## Additional Notes:

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