

CPS 118- Term Project

Section: 9

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Introduction:

This report will display and discuss all the data pertaining to the analysis of the average temperature for each day of the year of each of the five major great lakes: Ontario, Erie, Huron, Michigan, and Superior, and how their temperatures compare to one another as total averages and as averages for specific time periods. All computations performed to obtain the data were done in MATLAB, and all charts and graphs presented within the report were also made in MATLAB and exported as images.

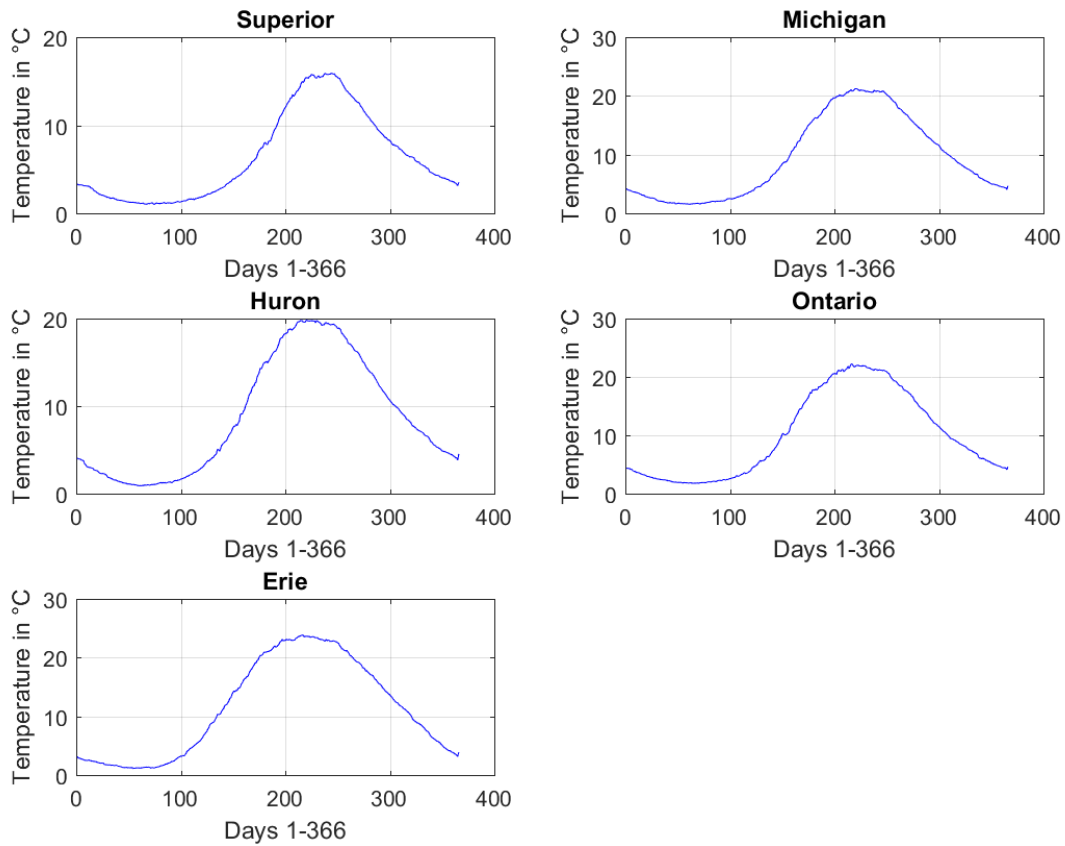
The team that worked on this report consists of Adam Malcewski, who did a large component of the coding and calculations, Paul Ycay, who worked on the coding and calculations as well as the report, and Graeme Bond, who did a large component of the report.

Observations and Analysis

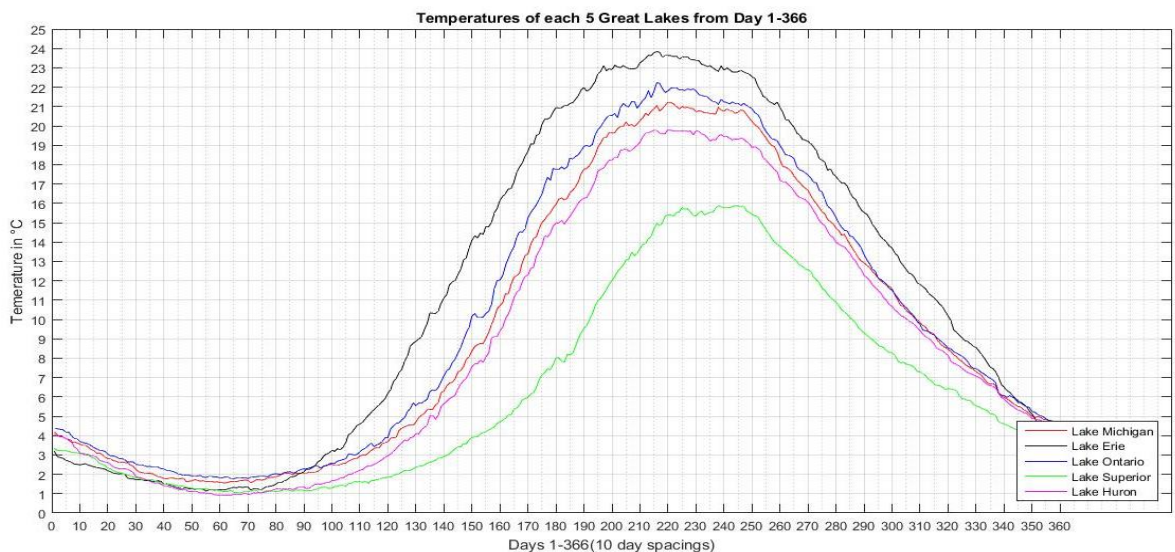
1. As shown in the Table below the yearly average temperature for the lakes are as follows: Erie: 11.3°C, Ontario: 10.0°C, Michigan: 9.5°C, Huron: 8.7°C, Superior: 6.4°C, and the global yearly average for all five of the great lakes: 9.2°C.

	Annual Mean Temp. in °C
Erie	11.2851
Ontario	9.9919
Michigan	9.4516
Superior	6.3522
Huron	8.7306
Global Yearly	9.1623

2. Of all the 5 Great Lakes, Lake Erie is the warmest with an average temperature of 11.2851271 °C and Lake Superior is the coldest with an average temperature of 6.3522299 °C. 3 of the 5 lakes, being Lake Erie, Lake Ontario, and Lake Michigan, have temperatures above the global yearly average.
3. The graphs of the daily averages for each lake. By examining the graphs, we can see that all the lakes reach their peak Temperature at about day 230 (august 18) and their lowest temperature occurs at about day 80 (march 21). We can also see that even on the coldest day the temperature does not dip below freezing for any of the lakes.

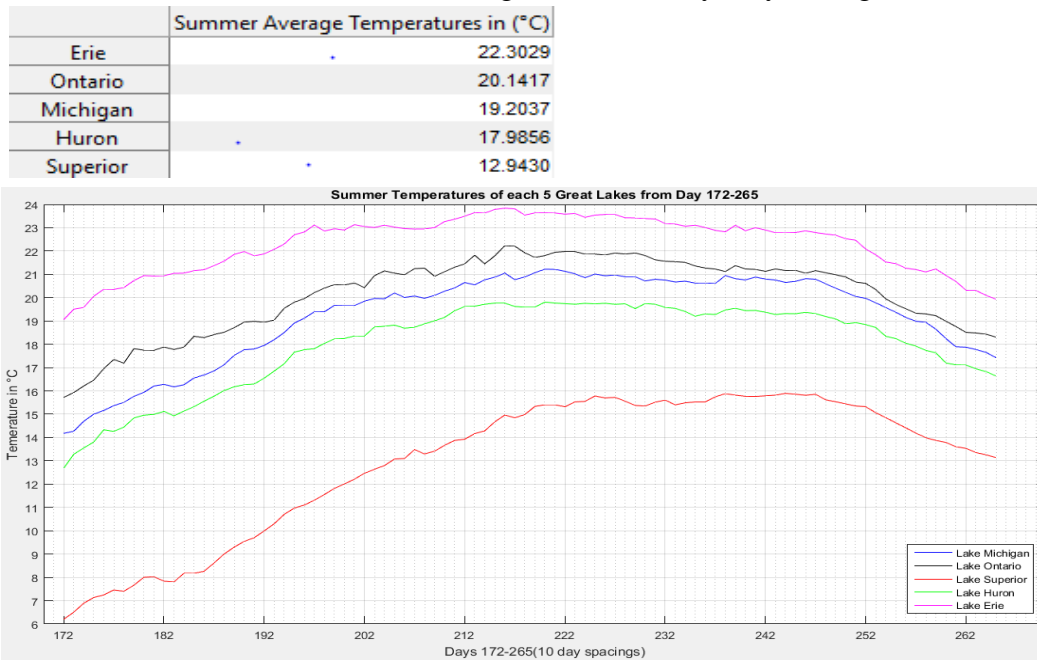


4. The combined graph displaying the daily average temperature for each lake. When examining this graph it is significantly easier to compare the different daily averages for each lake. We can now easily identify Lake Erie as having a higher peak temperature than

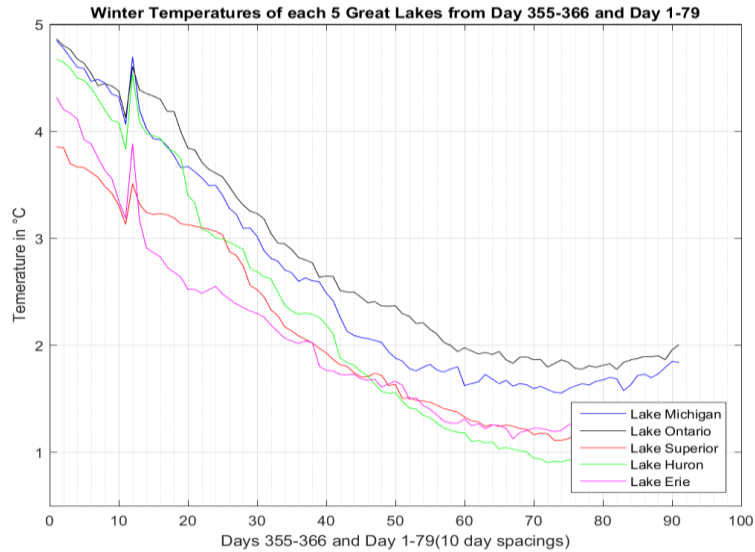


all the other lakes, and Lake Superior having the lowest peak temperature. We can also see that despite Lake Erie having the highest peak temperature, its lowest temperature is below that of Lake Michigan and Lake Ontario. It is also visible that Lake Superior's peak temperature occurs significantly later than all the other lakes.

- The summer temperature for all five great lakes is displayed in the graph below, and the summer average temperature is displayed in the table below. We can clearly see that Lake Erie is the warmest, followed by Lake Ontario, then Lake Michigan, Then Lake Huron, and finally Lake superior being the coldest. This trend matches the order for warmest to coldest when dealing with the total yearly average.

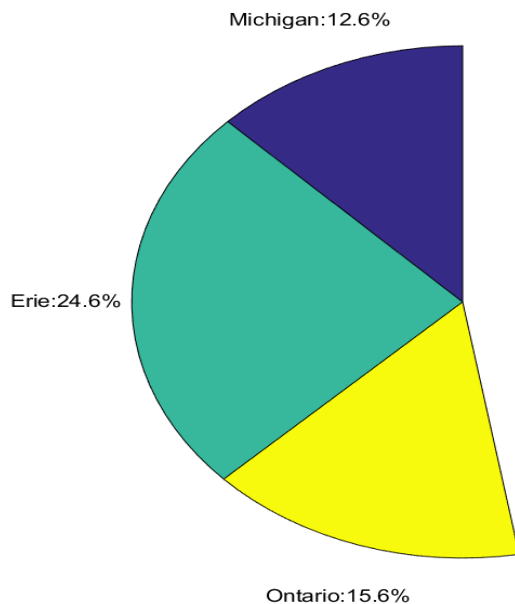


6. The order from warmest to coldest lake for the winter average is the same as the order for the summer average, being Erie, Ontario, Michigan, Huron, and finally Superior with their respective winter average temperatures being: 2.0110°C, 2.8068°C, 2.5890°C, 2.1812°C, and 2.5890°C.



	Winter Mean Temp. in °C
Erie	2.0110
Ontario	2.8068
Michigan	2.5890
Huron	2.1812
Superior	2.5890

7. The percent of days in each year in which you can swim in each lake is displayed in the pie chart below. There are 90 days that are comfortable for swimming in Lake Erie, 57 days in Lake Ontario, and 46 days in Lake Michigan. There are no days suitable for swimming in Lake Superior or Huron as they never reach temperatures above 20 °C



8. It is possible to infer some fit between the days and the water temperature and it is possible to create an equation that approximates the results. However, each lake has its own fit and equation that is different from the other lakes. The equations for the fit for each lake is as follows (all equations have been generated using MATLAB, with each equation specifying a line for summer, winter, and annual mean for each lake).:

Michigan yearly average equation: $y = -0.0004054x^2 + 0.1815654x^1 + -5.6890801x^0$

Ontario yearly average equation: $y = -0.0004387x^2 + 0.1937309x^1 + -5.8865863x^0$

Superior yearly average equation: $y = -0.0002205x^2 + 0.1063286x^1 + -3.2732024x^0$

Huron yearly average equation: $y = -0.0003718x^2 + 0.1692785x^1 + -5.6614097x^0$

Erie yearly average equation: $y = -0.0005642x^2 + 0.2445843x^1 + -8.3008915x^0$

Michigan summer average equation: $y = -0.0023614x^2 + 1.0726025x^1 + -$

$100.6832246x^0$ Ontario summer average equation: $y = -0.0021927x^2 + 0.9862122x^1$

$+ -89.0447062x^0$ Superior summer average equation: $y = -0.0024993x^2 +$

$1.1821323x^1 + -124.1917606x^0$ Huron summer average equation: $y = -0.0022332x^2$

$+ 1.0174473x^1 + -96.0659064x^0$ Erie summer average equation: $y = -$

$0.0017673x^2 + 0.7807956x^1 + -62.6262957x^0$

Michigan winter average equation: $y = 0.0006225x^2 + -0.0943740x^1 + 5.1836162x^0$

Ontario winter average equation: $y = 0.0005045x^2 + -0.0825562x^1 + 5.1887017x^0$

Superior winter average equation: $y = 0.0003705x^2 + -0.0674997x^1 + 4.1126863x^0$

Huron winter average equation: $y = 0.0006192x^2 + -0.1014384x^1 + 5.1097749x^0$

Erie winter average equation: $y = 0.0005832x^2 + -0.0839212x^1 + 4.2350510x^0$

Conclusion

Overall, it can be concluded that Lake Erie is the warmest of the Great Lakes, while Lake Superior is the coldest of the great lakes. The yearly averages for the lakes are: Erie: 11.3°C, Ontario: 10.0°C, Michigan: 9.5°C, Huron: 8.7°C, Superior: 6.4°C, and the global yearly average for all five of the great lakes: 9.2°C. We can see that Lakes Erie, Ontario, and Michigan all have temperatures above the global yearly average for the great lakes. We can also conclude that Lake Erie gets the hottest and Lake Huron gets the coldest. Because of this Lake Erie is the most comfortable to swim in, while Huron and Superior are equally uncomfortable to swim in. We can also conclude that each of the Lakes have an equation that approximates the results that is different from all the other lakes. There is a fairly large difference between the equation of some of the lakes, especially Erie and Superior, which are the warmest and coldest lakes respectively.

Our teams experience with the project was not as smooth or as easy as we wanted it to be. We left most of the project till a later date and did not divide up the work in an organized fashion, leaving some team members with nothing to work on until others had finished. Communication was also something of an issue, as not everyone knew exactly what needed to be done. If we were to do this project again we would properly divide the work load very early, so that everyone would know exactly what their job was, and was not reliant on anyone else in order to do their own work.

Appendix A

References:

- "Is There a Substring Funct in Matlab?" *MATLAB Central* -. Web. 6 Dec. 2015.
<http://www.mathworks.com/matlabcentral/newsreader/view_thread/100236/>.
- "Custom Grid on a Plot." *MATLAB Central* -. Web. 6 Dec. 2015.
<http://www.mathworks.com/matlabcentral/newsreader/view_thread/170691/>.
- "Documentation." *Sort Array Elements*. Web. 6 Dec. 2015.
<<http://www.mathworks.com/help/matlab/ref/sort.html?refresh=true>>.
- "Creating a Matrix of Strings?" *MATLAB Central* -. Web. 6 Dec. 2015.
<https://www.mathworks.com/matlabcentral/newsreader/view_thread/279596/>.
- "How to Display Regression Equation without Use of Toolbox? - MATLAB Answers - MATLAB Central." *How to Display Regression Equation without Use of Toolbox? - MATLAB Answers - MATLAB Central*. Web. 6 Dec. 2015.
<<http://www.mathworks.com/matlabcentral/answers/5310-how-to-display-regression-equation-without-use-of-toolbox>>.
- "Documentation." *Programmatic Fitting*. Web. 6 Dec. 2015.
<http://www.mathworks.com/help/matlab/data_analysis/programmatic-fitting.html>.

Appendix B

Code:

Number 1

```
1. [~,~,lmichigan]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\Michigan.xlsx'));
2. lmichigan=lmichigan';
3. michagany=1:366;
4. for r=1:366
5.     d=strsplit(char(lmichigan(r)));
6.     michigany(r)=str2double(d(3));
7. end
8. sumavg(1)=mean(michigany(1:366));
9.
10. [~,~,lontario]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\ontario.xlsx'));
11. lontario=lontario';
12. ontarioy=1:366;
13. for r=1:366
14.     d=strsplit(char(lontario(r)));
15.     ontarioy(r)=str2double(d(3));
16. end
17. sumavg(2)=mean(ontarioy(1:366));
18.
19.
20. [~,~,lsuperior]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\superior.xlsx'));
21. lsuperior=lsuperior';
22. superiory=1:366;
23. for r=1:366
24.     d=strsplit(char(lsuperior(r)));
25.     superiory(r)=str2double(d(3));
26. end
27. sumavg(3)=mean(superiory(1:366));
28.
29.
30. [~,~,lhuron]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\huron.xlsx'));
31. lhuron=lhuron';
32. hurony=1:366;
33. for r=1:366
34.     d=strsplit(char(lhuron(r)));
35.     hurony(r)=str2double(d(3));
36. end
37. sumavg(4)=mean(hurony(1:366));
38.
39.
40. [~,~,lerie]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\erie.xlsx'));
41. lerie=lerie';
42. eriey=1:366;
```

```

43. for r=1:366
44.     d=strsplit(char(lerie(r)));
45.     eriey(r)=str2double(d(3));
46. end
47. sumavg(5)=mean(eriey(1:366));
48.
49. sumavg(6)=mean(sumavg(1:5))
50.
51. names = {'Michigan','Ontario','Superior','Huron','Erie'};
52.
53. %http://www.mathworks.com/help/matlab/ref/sort.html?refresh=true
54. sortavg = sort(sumavg,'descend');
55. fprintf('From warmest to coldest \n');
56. for n=1:5
57.     for x=1:5
58.         if sortavg(n)==sumavg(x)
59.
60.             fprintf('%s' yearly average temperature is %.7f\n',names{x},sortavg(n));
61.
62.
63.         end
64.     end
65. end
66. %https://www.mathworks.com/matlabcentral/newsreader/view\_thread/279596
67. figure
68.
69. rowname = {'Erie','Ontario','Michigan','Superior','Huron','Global Yearly'};
70. columnname={'Annual Mean Temp. in °C'};
71.
72. d=[sortavg(1),sortavg(2),sortavg(3),mean(superiory),sortavg(5),sumavg(6)];
73.
74. t = uitable('Data',d,...
75.             'ColumnName', columnname,...
76.             'RowName',rowname);

```

Number 2.

```

1. [~,~,lmichigan]=xlsread(fullfile('Michigan.xlsx'));
2. lmichigan=lmichigan';
3. michagany=1:366;
4. for r=1:366
5.     d=strsplit(char(lmichigan(r)));
6.     michigany(r)=str2double(d(3));
7. end
8. sumavg(1)=mean(michigany(1:366));
9.

```

```

10. [~,~,lontario]=xlsread(fullfile('Ontario.xlsx'));
11. lontario=lontario';
12. ontarioy=1:366;
13. for r=1:366
14.     d=strsplit(char(lontario(r)));
15.     ontarioy(r)=str2double(d(3));
16. end
17. sumavg(2)=mean(ontarioy(1:366));
18.
19.
20. [~,~,lsuperior]=xlsread(fullfile('Superior.xlsx'));
21. lsuperior=lsuperior';
22. superiory=1:366;
23. for r=1:366
24.     d=strsplit(char(lsuperior(r)));
25.     superiory(r)=str2double(d(3));
26. end
27. sumavg(3)=mean(superiory(1:366));
28.
29.
30. [~,~,lhuron]=xlsread(fullfile('Huron.xlsx'));
31. lhuron=lhuron';
32. hurony=1:366;
33. for r=1:366
34.     d=strsplit(char(lhuron(r)));
35.     hurony(r)=str2double(d(3));
36. end
37. sumavg(4)=mean(hurony(1:366));
38.
39.
40. [~,~,lerie]=xlsread(fullfile('Erie.xlsx'));
41. lerie=lerie';
42. eriey=1:366;
43. for r=1:366
44.     d=strsplit(char(lerie(r)));
45.     eriey(r)=str2double(d(3));
46. end
47. sumavg(5)=mean(eriey(1:366));
48.
49. sumavg(6)=mean(sumavg(1:5));
50.
51. names = {'Michigan','Ontario','Superior','Huron','Erie'};
52. maxtemp = max(sumavg(1:5));
53. mintemp = min(sumavg(1:5));
54. %http://www.mathworks.com/matlabcentral/newsreader/view\_thread/269569
55.

```

```

56. fprintf('%s is the warmest lake with a temp of %.7f °C\n',names{find(sumavg ==
maxtemp)}),maxtemp)
57. fprintf('%s is the coldest lake with a temp of %.7f °C\n',names{find(sumavg ==
mintemp)}),mintemp)
58.
59. for j = 1:5
60.     if(sumavg(j) > sumavg(6))
61.         fprintf('%s is above the average\n',names{j})
62.     end
63. end

```

Number 3.

[%http://www.mathworks.com/matlabcentral/newsreader/view_thread/100236/](http://www.mathworks.com/matlabcentral/newsreader/view_thread/100236/)

```

[~,~,preSuperior] = xlsread(fullfile('Superior.xlsx'));
preSuperior = preSuperior';
Superior = 1:366;
for i=1:366
    k = strsplit(char(preSuperior(i)));
    Superior(i) = str2double(k(3));
end
[~,~,preMichigan] = xlsread(fullfile('Michigan.xlsx'));
preMichigan = preMichigan';
Michigan = 1:366;
for i=1:366
    k = strsplit(char(preMichigan(i)));
    Michigan(i) = str2double(k(3));
end
[~,~,preHuron] = xlsread(fullfile('Huron.xlsx'));
preHuron = preHuron';
Huron = 1:366;
for i=1:366
    k = strsplit(char(preHuron(i)));
    Huron(i) = str2double(k(3));
end
[~,~,preOntario] = xlsread(fullfile('Ontario.xlsx'));
preOntario = preOntario';
Ontario = 1:366;
for i=1:366
    k = strsplit(char(preOntario(i)));
    Ontario(i) = str2double(k(3));
end

```

```
[~,~,preErie] = xlsread(fullfile('Erie.xlsx'));
preErie = preErie';
Erie = 1:366;
for i=1:366
    k = strsplit(char(preErie(i)));
    Erie(i) = str2double(k(3));
end
```

```
subplot(3,2,1)
plot(1,1,1:366,Superior,'b')
title('Superior')
xlabel('Days 1-366')
ylabel('Temperature in °C')
grid on
subplot(3,2,2)
plot(1:366,Michigan,'b')
title('Michigan')
xlabel('Days 1-366')
ylabel('Temperature in °C')
grid on
subplot(3,2,3)
plot(1:366,Huron,'b')
title('Huron')
xlabel('Days 1-366')
ylabel('Temperature in °C')
grid on
subplot(3,2,4)
plot(1:366,Ontario,'b')
title('Ontario')
xlabel('Days 1-366')
ylabel('Temperature in °C')
grid on
subplot(3,2,5)
plot(1:366,Erie,'b')
title('Erie')
xlabel('Days 1-366')
ylabel('Temperature in °C')
grid on
```

```
Global = [Superior,Michigan,Huron,Ontario,Erie];
Global_Names = ['Superior','Michigan','Huron','Ontario','Erie'];
```

```
Global_Mean = mean(Global)
```

```
Superior_Mean = mean(Superior)
Michigan_Mean = mean(Michigan)
Huron_Mean = mean(Huron)
Ontario_Mean = mean(Ontario)
Erie_Mean = mean(Erie)
fg
```

Number 4.

```
[~,~,lmichigan]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\Michigan.xlsx'));
lmichigan=lmichigan';
michagany=1:366;
for r=1:366
    d=strsplit(char(lmichigan(r)));
    michigany(r)=str2double(d(3));
end
```

```
[~,~,lerie]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\erie.xlsx'));
lerie=lerie';
eriey=1:366;
for r=1:366
    d=strsplit(char(lerie(r)));
    eriey(r)=str2double(d(3));
end
```

```
[~,~,lontario]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\ontario.xlsx'));
lontario=lontario';
ontarioy=1:366;
for r=1:366
    d=strsplit(char(lontario(r)));
    ontarioy(r)=str2double(d(3));
end
```

```
[~,~,lsuperior]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\superior.xlsx'));
lsuperior=lsuperior';
superiory=1:366;
for r=1:366
    d=strsplit(char(lsuperior(r)));
    superiory(r)=str2double(d(3));
end
```

```
[~,~,lhuron]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\huron.xlsx'));
lhuron=lhuron';
hurony=1:366;
for r=1:366
    d=strsplit(char(lhuron(r)));
```

```

    hurony(r)=str2double(d(3));
end

x=[1:1:366];
plot(x,michigany,'r',x,erley,'-k',x,ontarioy,'-b',x,superiory,'-g',x,hurony,'-m')
title('Temperatures of each 5 Great Lakes from Day 1-366')
xlabel('Days 1-366(10 day spacings)')
ylabel('Temperature in °C')
legend('Lake Michigan','Lake Erie','Lake Ontario','Lake Superior', 'Lake Huron','Location','southeast')
grid on
set(gca,'XGrid','on','YGrid','on','XMinorGrid','on');
set(gca,'YTick', 0:1:25);
set(gca,'XTick',0:10:366);
http://www.mathworks.com/matlabcentral/newsreader/view\_thread/170691

```

Number 5.

```

[~,~,lmichigan]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\Michigan.xlsx'));
lmichigan=lmichigan';
michagany=1:366;
for r=1:366
    d=strsplit(char(lmichigan(r)));
    michigany(r)=str2double(d(3));
end
sumavg(1)=mean(michigany(172:265));

[~,~,lontario]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\ontario.xlsx'));
lontario=lontario';
ontarioy=1:366;
for r=1:366
    d=strsplit(char(lontario(r)));
    ontarioy(r)=str2double(d(3));
end
sumavg(2)=mean(ontarioy(172:265));

[~,~,lsuperior]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\superior.xlsx'));
lsuperior=lsuperior';
superiory=1:366;
for r=1:366
    d=strsplit(char(lsuperior(r)));
    superiory(r)=str2double(d(3));
end
sumavg(3)=mean(superiory(172:265));

```

```

[~,~,lhuron]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\huron.xlsx'));
lhuron=lhuron';
hurony=1:366;
for r=1:366
    d=strsplit(char(lhuron(r)));
    hurony(r)=str2double(d(3));
end
sumavg(4)=mean(hurony(172:265));

```

```

[~,~,lerie]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\erie.xlsx'));
lerie=lerie';
eriey=1:366;
for r=1:366
    d=strsplit(char(lerie(r)));
    eriey(r)=str2double(d(3));
end
sumavg(5)=mean(eriey(172:265));

```

```

names = {'Michigan','Ontario','Superior','Huron','Erie'};
%http://www.mathworks.com/help/matlab/ref/sort.html?refresh=true
sortavg = sort(sumavg,'descend');
fprintf('From warmest to coldest \n');
for n=1:5
    for x=1:5
        if sortavg(n)==sumavg(x)

            fprintf('%s" summer average temperature is %.7f\n',names{x},sortavg(n));

        end
    end
end
%https://www.mathworks.com/matlabcentral/newsreader/view\_thread/279596

fprintf('%s" is the warmest lake with a temp of %.7f\n °C',names{5},max((sumavg(n))))
f = figure('Position',[100 100 400 150]);

```

```

rowname = {'Erie','Ontario','Michigan','Superior','Huron'};
columnname={'Summer Average Temperatures in °C'};

d=[sortavg(1),sortavg(2),sortavg(3),sortavg(4),sortavg(5)];

```



```
t = uitable('Data',d ,...  
           'ColumnName', columnname,...
```

Number 6.

```
[~,~,lmichigan]=xlsread(fullfile('Michigan.xlsx'));  
lmichigan=lmichigan';  
michagany=1:366;  
for r=1:366  
    d=strsplit(char(lmichigan(r)));  
    michigany(r)=str2double(d(3));  
end  
wdmichigany=[michigany(355:365),michigany(1:79)];  
sumavg(1)=mean(wdmichigany);
```

```
[~,~,lontario]=xlsread(fullfile('Ontario.xlsx'));  
lontario=lontario';  
ontarioy=1:366;  
for r=1:366  
    d=strsplit(char(lontario(r)));  
    ontarioy(r)=str2double(d(3));  
end  
wdontarioy=[ontarioy(355:end),ontarioy(1:79)];  
sumavg(2)=mean(wdontarioy);
```

```
[~,~,lsuperior]=xlsread(fullfile('Superior.xlsx'));  
lsuperior=lsuperior';  
superiory=1:366;  
for r=1:366  
    d=strsplit(char(lsuperior(r)));  
    superiory(r)=str2double(d(3));  
end  
wdsuperiory=[superiory(355:end),superiory(1:79)];  
sumavg(3)=mean(wdsuperiory);
```

```
[~,~,lhuron]=xlsread(fullfile('Huron.xlsx'));  
lhuron=lhuron';  
hurony=1:366;  
for r=1:366  
    d=strsplit(char(lhuron(r)));  
    hurony(r)=str2double(d(3));  
end  
wdhurony=[hurony(355:end),hurony(1:79)];  
sumavg(4)=mean(wdhurony);
```

```
[~,~,lerie]=xlsread(fullfile('Erie.xlsx'));
lerie=lerie';
eriey=1:366;
for r=1:366
    d=strsplit(char(lerie(r)));
    eriey(r)=str2double(d(3));
end
wderiey=[eriey(355:end),eriey(1:79)];
sumavg(5)=mean(wderiey);
```

```
names = { 'Michigan' , 'Ontario' , 'Superior' , 'Huron' , 'Erie' };
%http://www.mathworks.com/help/matlab/ref/sort.html?refresh=true
sortavg = sort(sumavg,'descend');
fprintf('From warmest to coldest \n')
for n=1:5
    for x=1:5
        if sortavg(n)==sumavg(x)

            fprintf('%s's winter average temperature is %.7f\n',names{x},sortavg(n))
        end
    end
    %https://www.mathworks.com/matlabcentral/newsreader/view\_thread/279596
End
```

figure

```
rowname = { 'Erie','Ontario','Michigan','Superior','Huron','Global Yearly' };
columnname={'Winter Mean Temp. in °C'};

d=[sortavg(1),sortavg(2),sortavg(3),mean(wdsuperiory),sortavg(5),sumavg(6)];

t = uitable('Data',d ,...
    'ColumnName', columnname,...
    'RowName',rowname);
```

```
days=[355:1:366,1:1:79];
dayssize = size(days);
x = 1:1:dayssize(2);
eriey;
plot(x,michigany(days(x)),'-b',x,ontarioy(days(x)),'-k',x,superiory(days(x)),'-r',x,hurony(days(x)),'-g',x,eriey(days(x)),'-m')
title('Winter Temperatures of each 5 Great Lakes from Day 355-366 and Day 1-79')
```

```

xlabel('Days 355-366 and Day 1-79(10 day spacings)')
ylabel('Temperature in °C')
legend('Lake Michigan','Lake Ontario','Lake Superior','Lake Huron', 'Lake Erie','Location','southeast')
grid on
set(gca,'XGrid','on','YGrid','on','XMinorGrid','on');
set(gca,'YTick', 0:1:25);
set(gca,'XTick',0:10:100);
http://www.mathworks.com/matlabcentral/newsreader/view\_thread/170691

```

Number 7

```

[~,~,lmichigan]=xlsread(fullfile('Michigan.xlsx'));
lmichigan=lmichigan';
michagany=1:366;
for r=1:366
    d=strsplit(char(lmichigan(r)));
    michigany(r)=str2double(d(3));
end

```

```

[~,~,lerie]=xlsread(fullfile('Erie.xlsx'));
lerie=lerie';
eriey=1:366;
for r=1:366
    d=strsplit(char(lerie(r)));
    eriey(r)=str2double(d(3));
end

```

```

[~,~,lontario]=xlsread(fullfile('Ontario.xlsx'));
lontario=lontario';
ontarioy=1:366;
for r=1:366
    d=strsplit(char(lontario(r)));
    ontarioy(r)=str2double(d(3));
end

```

```

[~,~,lsuperior]=xlsread(fullfile('Superior.xlsx'));
lsuperior=lsuperior';
superiory=1:366;
for r=1:366
    d=strsplit(char(lsuperior(r)));
    superiory(r)=str2double(d(3));
end

```

end

```
[~,~,lhuron]=xlsread(fullfile('Huron.xlsx'));  
lhuron=lhuron';  
hurony=1:366;  
for r=1:366  
    d=strsplit(char(lhuron(r)));  
    hurony(r)=str2double(d(3));  
end
```

```
michigany>20;  
a=sum(michigany>20);  
eriey>20;  
b=sum(eriey>20);  
ontarioy>20;  
c=sum(ontarioy>20);  
superiory>20;  
d=sum(superiory>20);  
hurony>20;  
e=sum(hurony>20);
```

```
k = [];  
for i=[a b c d e];  
    k(end+1) = (i/366);
```

end

```
lakes = { strcat('Michigan:',  
num2str(round(k(1)*100,1)), '%'), strcat('Erie:', num2str(round(k(2)*100,1)), '%'), strcat('Ontario:', n  
um2str(round(k(3)*100,1)), '%'), strcat('Superior:', num2str(round(k(4)*100,1)), '%'), strcat('Huron:'  
, num2str(round(k(5)*100,1)), '%') }  
pie(k,lakes)
```

Number 8

```
[~,~,lmichigan]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\Michigan.xlsx'));  
lmichigan=lmichigan';  
michagany=1:366;  
for r=1:366  
    d=strsplit(char(lmichigan(r)));  
    michigany(r)=str2double(d(3));  
end  
sumavg(1)=mean(michigany(1:366));
```

```
[~,~,lontario]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\ontario.xlsx'));  
lontario=lontario';  
ontarioy=1:366;  
for r=1:366
```

```

    d=strsplit(char(lontario(r)));
    ontarioy(r)=str2double(d(3));
end
sumavg(2)=mean(ontarioy(1:366));

```

```

[~,~,lsuperior]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\superior.xlsx'));
lsuperior=lsuperior';
superiory=1:366;
for r=1:366
    d=strsplit(char(lsuperior(r)));
    superiory(r)=str2double(d(3));
end
sumavg(3)=mean(superiory(1:366));

```

```

[~,~,lhuron]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\huron.xlsx'));
lhuron=lhuron';
hurony=1:366;
for r=1:366
    d=strsplit(char(lhuron(r)));
    hurony(r)=str2double(d(3));
end
sumavg(4)=mean(hurony(1:366));

```

```

[~,~,lerie]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\erie.xlsx'));
lerie=lerie';
eriey=1:366;
for r=1:366
    d=strsplit(char(lerie(r)));
    eriey(r)=str2double(d(3));
end
sumavg(5)=mean(eriey(1:366));

```

%equations for number 1

```

x=1:366;
[P] = polyfit(x,michigany,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
michigan_yearly_average_equation = eqn(1:end-3)
[P] = polyfit(x,ontarioy,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
ontario_yearly_average_equation = eqn(1:end-3)
[P] = polyfit(x,superiory,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];

```

```

superior_yearly_average_equation = eqn(1:end-3)
[P] = polyfit(x,hurony,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
huron_yearly_average_equation = eqn(1:end-3)
[P] = polyfit(x,eriey,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
erie_yearly_average_equation = eqn(1:end-3)

```

%equations for number 8

```

x=172:265;
[P] = polyfit(x,michigany(172:265),2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
michigan_summer_average_equation = eqn(1:end-3)
[P] = polyfit(x,ontarioy(172:265),2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
ontario_summer_average_equation = eqn(1:end-3)
[P] = polyfit(x,superiory(172:265),2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
superior_summer_average_equation = eqn(1:end-3)
[P] = polyfit(x,hurony(172:265),2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
huron_summer_average_equation = eqn(1:end-3)
[P] = polyfit(x,eriey(172:265),2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
erie_yearly_average_equation = eqn(1:end-3)

```

%equations for number 6

```

[~,~,lmichigan]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\Michigan.xlsx'));
lmichigan=lmichigan';
michagany=1:366;
for r=1:366
    d=strsplit(char(lmichigan(r)));
    michigany(r)=str2double(d(3));
end
wdmichigany=[michigany(355:end),michigany(1:79)];
sumavg(1)=mean(wdmichigany);

```

```

[~,~,lontario]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\ontario.xlsx'));
lontario=lontario';
ontarioy=1:366;
for r=1:366
    d=strsplit(char(lontario(r)));
    ontarioy(r)=str2double(d(3));
end
wdontarioy=[ontarioy(355:end),ontarioy(1:79)];

```

```
sumavg(2)=mean(wdontarioy);
```

```
[~,~,lsuperior]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\superior.xlsx'));  
lsuperior=lsuperior';  
superiory=1:366;  
for r=1:366  
    d=strsplit(char(lsuperior(r)));  
    superiory(r)=str2double(d(3));  
end  
wdsuperiory=[superiory(355:end),superiory(1:79)];  
sumavg(3)=mean(wdsuperiory);
```

```
[~,~,lhuron]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\huron.xlsx'));  
lhuron=lhuron';  
hurony=1:366;  
for r=1:366  
    d=strsplit(char(lhuron(r)));  
    hurony(r)=str2double(d(3));  
end  
wdhurony=[hurony(355:end),hurony(1:79)];  
sumavg(4)=mean(wdhurony);
```

```
[~,~,lerie]=xlsread(fullfile('C:\Users\Paul\Documents\MATLAB\erie.xlsx'));  
lerie=lerie';  
eriey=1:366;  
for r=1:366  
    d=strsplit(char(lerie(r)));  
    eriey(r)=str2double(d(3));  
end  
wderiey=[eriey(355:end),eriey(1:79)];  
sumavg(5)=mean(wderiey);
```

```
x=[355:1:366,1:1:79];  
dayssize = size(x);  
x = 1:1:dayssize(2);
```

```
[P] = polyfit(x,wdmichigany,2);
```

```

eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
michigan_winter_average_equation = eqn(1:end-3)
[P] = polyfit(x,wdontarioy,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
ontario_winter_average_equation = eqn(1:end-3)
[P] = polyfit(x,wdsuperiory,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
superior_winter_average_equation = eqn(1:end-3)
[P] = polyfit(x,wdhurony,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
huron_winter_average_equation = eqn(1:end-3)
[P] = polyfit(x,wderiey,2);
eqn = ['y = ' sprintf('%3.7fx^%1.0f + ',[P ;length(P)-1:-1:0])];
erie_winter_average_equation = eqn(1:end-3)

```