# Programming Project 08

This assignment is worth 50 points (5.0% of the course grade) and must be **completed and turned in before 11:59 on Monday, November 13 2017.**

### Assignment Overview

- Dictionaries
- Lists and Tuples

### Assignment Background

Hurricane season is back and it came with a vengeance. Over five hurricanes have passed so far and two of them have done massive damage to the Caribbean, including Puerto Rico. In order to prepare countermeasures against the destruction these atmospheric phenomena leave on their way, it is imperative to gather information about their wind speeds and trajectory for the creation of better predictive models. The National Hurricane Center is responsible to record these disasters and create these predictive models (http://www.nhc.noaa.gov/).

For this project, you are tasked to create a program that stores a record of all the hurricanes that occurred within a range of years into a dictionary of dictionaries. Using this dictionary, it is required to extract all the hurricanes that occurred in a year and print the peak wind speed of each hurricane with their coordinates and dates, plot the trajectory of each hurricane, and plot a line chart with the peak wind speeds and show the category each hurricane reached.

### Project Specifications

1. You must implement the following functions:

   a) **`open_file()`** prompts the user to enter a filename containing the hurricane data. The program will try to open a file. An error message should be shown if the file cannot be opened. This function will loop until it receives proper input and successfully opens the file. It returns a file pointer.

   b) **`update_dictionary(dictionary, year, hurricane_name, data)`** receives the dictionary, the year, the name of the hurricane, and the tuple (**`data`**) with the coordinates, date, wind speed, and pressure. The updated dictionary is returned.
   In this project we use a dictionary with year as the key and whose value is another dictionary. The nested dictionary will have the name of the hurricane as its key and a list of tuples as the value. For example

   ```
   Dict = {'2017':{'MARIA': hurricane_data1, 'IRMA': hurricane_data2} }
   ```

where `hurricane_data1` and `hurricane_data2` are lists of tuples.

The value of expression `Dict['2017']['MARIA']` is the list `hurricane_data1`

If the `dictionary[year]` is not defined, assign an empty dictionary to this entry and then fill that empty dictionary using `hurricane_name` as the key and that hurricane's `data` as its value. *Remember to put that data in a list* (so you can append more data for that hurricane when you read it). If the `dictionary[year]` is defined but the `dictionary[year][hurricane_name]` is *not* defined (that is, this is a new hurricane name for that year), add this new hurricane to the year (similar to the previous when we put the first hurricane in for the year) using `hurricane_name` as the key and that hurricane's `data` as its value (in a list, as before). Otherwise (that is, both the year and the hurricane are already in the dictionary) append the data tuple to the existing list for that year and hurricane.

c) **`create_dictionary(fp)`** takes one parameter `fp`, the file pointer, reads the file, and creates the dictionary containing the hurricane records. All the work of updating the dictionary is done in the **`update_dictionary`** function. Each line in the file contains the following:

```
year = line[0]
hurricane_name = line[1]
lat = float(line[3])
lon = float(line[4])
date = line[5]
wind = float(line[6]) if the value is a number, 0 otherwise
pressure = float(line[7]) if the value is a number, 0 otherwise
```

Create a data tuple: `(lat, lon, date, wind, pressure);` then call the **`update_dictionary`** function to add the tuple to the dictionary.

d) **`display_table(dictionary, year)`** This function receives a dictionary and a year value and for every hurricane in that year it displays the name of the hurricane, the coordinate, date, and value where the hurricane reached the peak wind speed. If two data points have the same peak wind speed, print the one with the larger `lat` value. (Hint: sort the data for a storm first on `wind` speed and then on `lat`, largest first; itemgetter is your friend.)

e) **`get_years(dictionary)`** Returns the oldest year and most recent year (min and max year) in the dictionary. Return a tuple (`min_year, max_year`). **Hint:** sort the keys! Use this function to find the range of years and print it.

f) **`prepare_plot(dictionary, year)`** Call this function to prepare for plotting hurricanes for the specified year. This function should create the following lists. Each list should be ordered by hurricane name, e.g. `max_speed` is a list of peak speeds, but should be ordered by hurricane name (see the plot): (1) `names` : a sorted list of all the names of the hurricanes in that year—sorted alphabetically, (2) `max_speed` : a list of maximum speeds of all the hurricanes. (3) `coordinates`: a list of coordinate paths (list of lists) for the trajectory of the hurricanes. Each hurricane path is a list of tuples that hold a `(latitude, longitude)`. Finally return the three lists in a tuple: `(names,coordinates,max_speed)`.

g) **`main()`** The main function use the functions mentioned above.
You should call the `prepare_plot` function inside the main function. It should prompt the user for whether to plot. We provide `plot_map(year, size, names, coordinates)`, and `plot_wind_chart(year,size,names,max_speed)` functions. Call them if the user decides to plot. You need the integer `size` which contains the number of hurricanes in that year. (Hint: use `len()` to get size).

2. Hints and Suggestions

a) Dictionary values can be any object such as floats and lists, but can also be another dictionary. In this project we use a dictionary with year as the key and whose value is another dictionary. The nested dictionary will have the name of the hurricane as its key and a list of tuples as the value. For example

```
D = {'2017':{'MARIA': hurricane_data1, 'IRMA': hurricane_data2} }
```

where `hurricane_data1` and `hurricane_data2` are lists of tuples.

The value of expression `D['2017']['MARIA']` is `hurricane_data1`

b) Dictionaries are unordered, so how do we sort keys (or values) of a dictionary? One way is to create a list of keys and sort that list. To get the list of keys on a dictionary, you can use the keys() method.

**Deliverables**

The deliverable for this assignment is the following file:

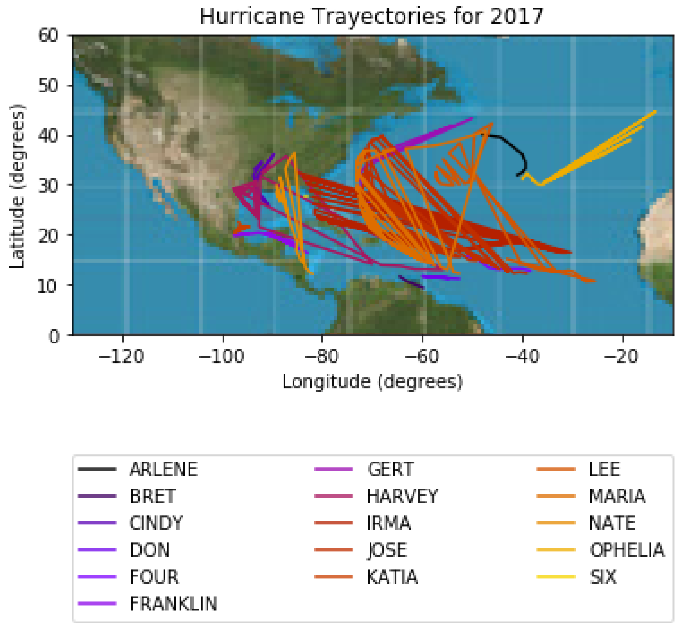
`proj08.py` – the source code for your Python program

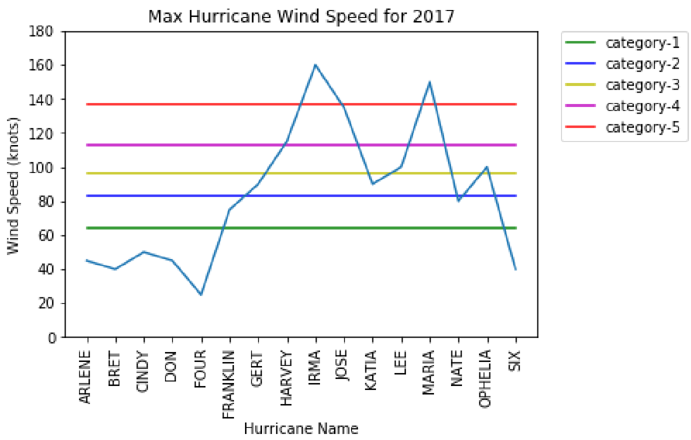
Be sure to use the specified file name and to submit it for grading via the **Mimir system** before the project deadline.

## Sample Output:

### Test Case 1:

```
Input a file name: storm_track1.txt
Hurricane Record Software
Records from 2007 to 2017

Enter the year to show hurricane data or 'quit': 2017
              Peak Wind Speed for the Hurricanes in 2017
Name                  Coordinates  Wind Speed (knots)          Date
ARLENE         ( 40.00,-48.00)                45.00      04/21/06Z
BRET           ( 11.60,-64.40)                40.00      06/20/12Z
CINDY          ( 27.30,-91.90)                50.00      06/21/06Z
DON            ( 11.50,-56.20)                45.00      07/18/06Z
FOUR           ( 15.60,-50.90)                25.00      07/07/12Z
FRANKLIN       ( 20.20,-96.10)                75.00      08/10/00Z
GERT           ( 40.10,-58.40)                90.00      08/17/00Z
HARVEY         ( 28.00,-97.00)               115.00      08/26/00Z
IRMA           ( 19.40,-66.80)               160.00      09/07/00Z
JOSE           ( 16.90,-59.30)               135.00      09/09/11Z
KATIA          ( 21.00,-96.50)                90.00      09/08/18Z
LEE            ( 31.20,-57.10)               100.00      09/27/18Z
MARIA          ( 17.30,-64.70)               150.00      09/20/00Z
NATE           ( 28.40,-89.10)                80.00      10/07/18Z
OPHELIA        ( 37.30,-21.50)               100.00      10/15/00Z
SIX            ( 27.70,-83.20)                40.00      07/31/06Z


Do you want to plot? Yes
```



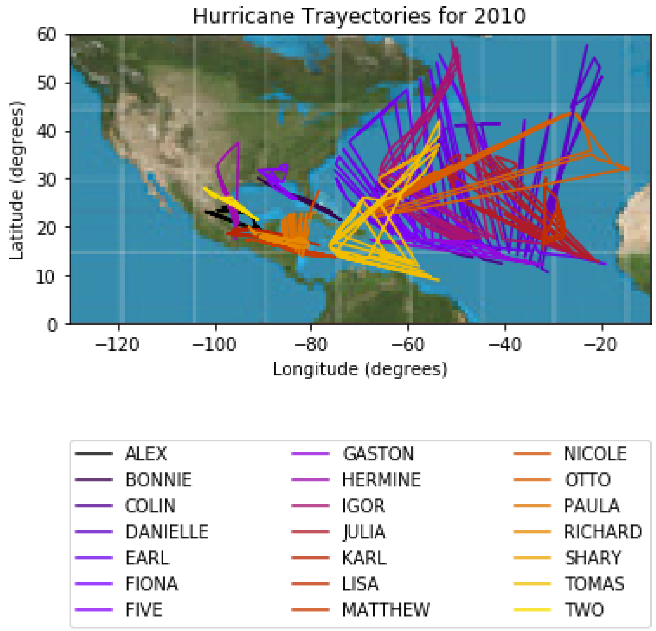


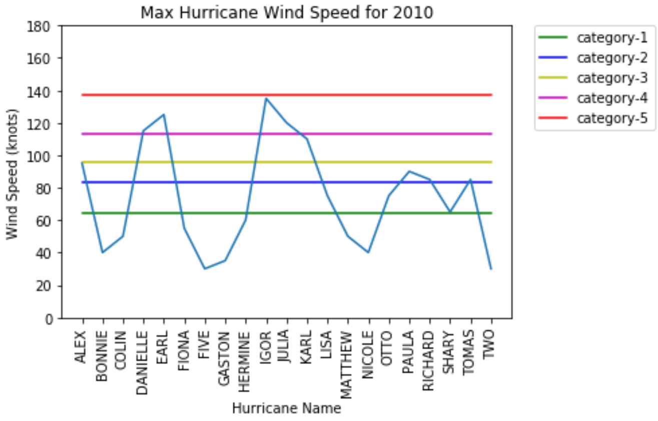
```
Enter the year to show hurricane data or 'quit': quit
```

## Test Case 2:

```
Input a file name: xxxx
Unable to open file. Please try again.

Input a file name: storm_track1.txt
Hurricane Record Software
Records from 2007 to 2017

Enter the year to show hurricane data or 'quit': abc
Error with the year key! Try another year

Enter the year to show hurricane data or 'quit': 2000
Error with the year key! Try another year

Enter the year to show hurricane data or 'quit': 2010
              Peak Wind Speed for the Hurricanes in 2010
Name               Coordinates  Wind Speed (knots)           Date
ALEX           ( 24.20,-97.70)               95.00      07/01/02Z
BONNIE         ( 23.80,-77.80)               40.00      07/23/06Z
COLIN          ( 25.60,-66.60)               50.00      08/06/00Z
DANIELLE       ( 27.10,-60.10)              115.00      08/27/18Z
EARL           ( 28.60,-74.30)              125.00      09/02/06Z
FIONA          ( 19.50,-62.50)               55.00      09/01/18Z
FIVE           ( 26.50,-85.00)               30.00      08/11/06Z
GASTON         ( 12.90,-36.10)               35.00      09/01/18Z
HERMINE        ( 25.30,-97.40)               60.00      09/07/02Z
IGOR           ( 18.90,-53.50)              135.00      09/15/00Z
JULIA          ( 17.70,-32.20)              120.00      09/15/12Z
KARL           ( 19.40,-96.00)              110.00      09/17/15Z
LISA           ( 20.40,-27.80)               75.00      09/25/00Z
MATTHEW        ( 15.20,-84.60)               50.00      09/25/00Z
NICOLE         ( 27.40,-78.50)               40.00      09/30/12Z
OTTO           ( 28.50,-59.70)               75.00      10/09/06Z
PAULA          ( 19.60,-86.00)               90.00      10/13/00Z
RICHARD        ( 17.20,-88.30)               85.00      10/25/00Z
SHARY          ( 35.10,-57.20)               65.00      10/30/12Z
```

```
TOMAS           ( 13.80,-62.40)             85.00      10/31/06Z
TWO             ( 26.10,-97.10)             30.00      07/08/14Z


Do you want to plot? yEs
```





```
Enter the year to show hurricane data or 'quit': QuIt
```

**Grading Rubrics**

Computer Project #08 Scoring Summary

General Requirements:

__0__ (5 pts) Coding Standard 1-9

(descriptive comments, function headers, etc...)

Implementation:

__0__ (5 pts) open_file function

-1 Did not use try/except

-2 Did not while loop

__0__ (5 pts) update_dictionary function

__0__ (5 pts) create_dictionary function

__0__ (5 pts) display_table function

__0__ (5 pts) prepare_plot function

__0__ (5 pts) Pass Test1

__0__ (5 pts) Pass Test2

__0__ (5 pts) Pass Test3: Blind Test

__0__ (5 pts) Plots both plots

TA Comments