Lab 10 - More Dictionaries

Background

As we discovered last week, dictionaries are one of the most versatile data types because of how much information they can hold. They become even more versatile when you put a dictionary in a dictionary. This can get complicated when you have dictionaries in dictionaries in dictionaries, or dictionary-ception. One simple way to think about this, I'll ask about this when talk to the class, is like a letter, in a word, in a sentence, in a paragraph, in a chapter in a book, and so on. Today we will be using nested dictionaries to simulate radiosonde observations and analyzing a vertical profile of the atmosphere.

Content Learning Objectives

- Practice working with dictionaries
- Work with dictionaries in dictionaries

Start by creating all of these dictionaries in a new python file. If you're using Wing, copy and paste them in a new file. If you're using Jupyter, just run the cell.

In [1]:
```
grand_forks = {
    'sfc': {'wx': 'Snow' , 'temp':  -4, 'dew':  -4, 'w_dir':  'S', 'w_
    '900': {'wx': 'Snow' , 'temp': -14, 'dew': -14, 'w_dir':  'S', 'w_
    '800': {'wx': 'Snow' , 'temp': -23, 'dew': -23, 'w_dir': 'SE', 'w_
    '700': {'wx': 'N/A'  , 'temp': -29, 'dew': -29, 'w_dir': 'SE', 'w_
    '600': {'wx': 'N/A'  , 'temp': -44, 'dew': -48, 'w_dir':  'E', 'w_
    '500': {'wx': 'N/A'  , 'temp': -52, 'dew': -62, 'w_dir':  'E', 'w_
    '400': {'wx': 'N/A'  , 'temp': -54, 'dew': -72, 'w_dir':  'E', 'w_
    '300': {'wx': 'N/A'  , 'temp': -53, 'dew': -79, 'w_dir': 'NE', 'w_
    '200': {'wx': 'N/A'  , 'temp': -55, 'dew': -82, 'w_dir': 'NE', 'w_

fargo = {
    'sfc': {'wx': 'Sleet', 'temp':   2, 'dew':  -4, 'w_dir':  'S', 'w_
    '900': {'wx': 'Snow' , 'temp':  -4, 'dew':  -4, 'w_dir':  'S', 'w_
    '800': {'wx': 'Snow' , 'temp': -12, 'dew': -12, 'w_dir':  'S', 'w_
    '700': {'wx': 'N/A'  , 'temp': -24, 'dew': -24, 'w_dir': 'SE', 'w_
    '600': {'wx': 'N/A'  , 'temp': -32, 'dew': -38, 'w_dir': 'SE', 'w_
    '500': {'wx': 'N/A'  , 'temp': -52, 'dew': -62, 'w_dir':  'E', 'w_
```

```
    '400': {'wx': 'N/A'  , 'temp': -54, 'dew': -72, 'w_dir':  'E', 'w_
    '300': {'wx': 'N/A'  , 'temp': -53, 'dew': -79, 'w_dir': 'NE', 'w_
    '200': {'wx': 'N/A'  , 'temp': -55, 'dew': -82, 'w_dir': 'NE', 'w_

sioux_falls = {
    'sfc': {'wx': 'Snow', 'temp':  5 , 'dew':   5, 'w_dir': 'S' , 'w_s
    '900': {'wx': 'Snow', 'temp': -1 , 'dew':  -1, 'w_dir': 'S' , 'w_s
    '800': {'wx': 'Snow', 'temp': -9 , 'dew':  -9, 'w_dir': 'SE', 'w_s
    '700': {'wx': 'N/A' , 'temp': -21, 'dew': -24, 'w_dir': 'SE', 'w_s
    '600': {'wx': 'N/A' , 'temp': -28, 'dew': -38, 'w_dir': 'E' , 'w_s
    '500': {'wx': 'N/A' , 'temp': -48, 'dew': -62, 'w_dir': 'E' , 'w_s
    '400': {'wx': 'N/A' , 'temp': -54, 'dew': -72, 'w_dir': 'E' , 'w_s
    '300': {'wx': 'N/A' , 'temp': -52, 'dew': -79, 'w_dir': 'NE', 'w_s
    '200': {'wx': 'N/A' , 'temp': -57, 'dew': -82, 'w_dir': 'NE', 'w_s

minot = {
    'sfc': {'wx': 'Rain', 'temp': 6  , 'dew': 3  , 'w_dir': 'SW', 'w_s
    '900': {'wx': 'Rain', 'temp': 3  , 'dew': 1  , 'w_dir': 'SW', 'w_s
    '800': {'wx': 'Rain', 'temp': -2 , 'dew': -3 , 'w_dir': 'S' , 'w_s
    '700': {'wx': 'N/A' , 'temp': -12, 'dew': -15, 'w_dir': 'S' , 'w_s
    '600': {'wx': 'N/A' , 'temp': -25, 'dew': -30, 'w_dir': 'SE', 'w_s
    '500': {'wx': 'N/A' , 'temp': -40, 'dew': -50, 'w_dir': 'E' , 'w_s
    '400': {'wx': 'N/A' , 'temp': -48, 'dew': -60, 'w_dir': 'E' , 'w_s
    '300': {'wx': 'N/A' , 'temp': -47, 'dew': -68, 'w_dir': 'NE', 'w_s
    '200': {'wx': 'N/A' , 'temp': -53, 'dew': -78, 'w_dir': 'NE', 'w_s

bismarck = {
    'sfc': {'wx': 'Rain', 'temp': 7, 'dew': 4, 'w_dir': 'SW', 'w_spd':
    '900': {'wx': 'Rain', 'temp': 4, 'dew': 2, 'w_dir': 'SW', 'w_spd':
    '800': {'wx': 'Rain', 'temp': -1, 'dew': -3, 'w_dir': 'S', 'w_spd'
    '700': {'wx': 'N/A', 'temp': -11, 'dew': -15, 'w_dir': 'S', 'w_spd
    '600': {'wx': 'N/A', 'temp': -24, 'dew': -30, 'w_dir': 'SE', 'w_sp
    '500': {'wx': 'N/A', 'temp': -41, 'dew': -52, 'w_dir': 'E', 'w_spd
    '400': {'wx': 'N/A', 'temp': -49, 'dew': -60, 'w_dir': 'E', 'w_spd
    '300': {'wx': 'N/A', 'temp': -47, 'dew': -68, 'w_dir': 'NE', 'w_sp
    '200': {'wx': 'N/A', 'temp': -53, 'dew': -78, 'w_dir': 'NE', 'w_sp
}

rapid_city = {
    'sfc': {'wx': 'Rain', 'temp': 10, 'dew': 6, 'w_dir': 'SW', 'w_spd'
    '900': {'wx': 'Rain', 'temp': 7, 'dew': 4, 'w_dir': 'SW', 'w_spd':
    '800': {'wx': 'Rain', 'temp': 2, 'dew': 0, 'w_dir': 'S', 'w_spd':
    '700': {'wx': 'N/A', 'temp': -8, 'dew': -12, 'w_dir': 'S', 'w_spd'
    '600': {'wx': 'N/A', 'temp': -22, 'dew': -28, 'w_dir': 'SE', 'w_sp
    '500': {'wx': 'N/A', 'temp': -36, 'dew': -48, 'w_dir': 'E', 'w_spd
    '400': {'wx': 'N/A', 'temp': -46, 'dew': -58, 'w_dir': 'E', 'w_spd
    '300': {'wx': 'N/A', 'temp': -45, 'dew': -67, 'w_dir': 'NE', 'w_sp
    '200': {'wx': 'N/A', 'temp': -51, 'dew': -77, 'w_dir': 'NE', 'w_sp
}

international_falls = {
    'sfc': {'wx': 'Snow', 'temp': -12, 'dew': -14, 'w_dir': 'NE', 'w_s
```

```
    '900': {'wx': 'Snow', 'temp': -13, 'dew': -14, 'w_dir': 'E', 'w_sp
    '800': {'wx': 'Snow', 'temp': -20, 'dew': -20, 'w_dir': 'SE', 'w_s
    '700': {'wx': 'N/A', 'temp': -30, 'dew': -31, 'w_dir': 'SE', 'w_sp
    '600': {'wx': 'N/A', 'temp': -38, 'dew': -44, 'w_dir': 'E', 'w_spd
    '500': {'wx': 'N/A', 'temp': -51, 'dew': -62, 'w_dir': 'E', 'w_spd
    '400': {'wx': 'N/A', 'temp': -56, 'dew': -72, 'w_dir': 'E', 'w_spd
    '300': {'wx': 'N/A', 'temp': -54, 'dew': -79, 'w_dir': 'NE', 'w_sp
    '200': {'wx': 'N/A', 'temp': -58, 'dew': -82, 'w_dir': 'NE', 'w_sp
}

duluth = {
    'sfc': {'wx': 'Freezing Rain', 'temp': -6, 'dew': -8, 'w_dir': 'E'
    '900': {'wx': 'Freezing Rain', 'temp': -8, 'dew': -8, 'w_dir': 'E'
    '800': {'wx': 'Freezing Rain', 'temp': -16, 'dew': -16, 'w_dir': '
    '700': {'wx': 'N/A', 'temp': -25, 'dew': -26, 'w_dir': 'SE', 'w_sp
    '600': {'wx': 'N/A', 'temp': -34, 'dew': -40, 'w_dir': 'E', 'w_spd
    '500': {'wx': 'N/A', 'temp': -50, 'dew': -60, 'w_dir': 'E', 'w_spd
    '400': {'wx': 'N/A', 'temp': -54, 'dew': -70, 'w_dir': 'E', 'w_spd
    '300': {'wx': 'N/A', 'temp': -52, 'dew': -78, 'w_dir': 'NE', 'w_sp
    '200': {'wx': 'N/A', 'temp': -56, 'dew': -82, 'w_dir': 'NE', 'w_sp
}

rochester = {
    'sfc': {'wx': 'Snow', 'temp': -2, 'dew': -3, 'w_dir': 'E', 'w_spd'
    '900': {'wx': 'Snow', 'temp': -4, 'dew': -4, 'w_dir': 'E', 'w_spd'
    '800': {'wx': 'Snow', 'temp': -11, 'dew': -11, 'w_dir': 'SE', 'w_s
    '700': {'wx': 'N/A', 'temp': -21, 'dew': -23, 'w_dir': 'SE', 'w_sp
    '600': {'wx': 'N/A', 'temp': -30, 'dew': -36, 'w_dir': 'E', 'w_spd
    '500': {'wx': 'N/A', 'temp': -48, 'dew': -60, 'w_dir': 'E', 'w_spd
    '400': {'wx': 'N/A', 'temp': -53, 'dew': -70, 'w_dir': 'E', 'w_spd
    '300': {'wx': 'N/A', 'temp': -51, 'dew': -78, 'w_dir': 'NE', 'w_sp
    '200': {'wx': 'N/A', 'temp': -55, 'dew': -82, 'w_dir': 'NE', 'w_sp
}



stations = {
    "KGFK": {"name": "Grand Forks", "lat": 47.9493, "lon": -97.1764, '
    "KFAR": {"name": "Fargo", "lat": 46.9230, "lon": -96.8158, 'obs':
    "KFSD": {"name": "Sioux Falls", "lat": 43.5854, "lon": -96.7419, '
    "KBIS": {"name": "Bismarck", "lat": 46.7727, "lon": -100.7460, 'ob
    "KMOT": {"name": "Minot", "lat": 48.2594, "lon": -101.2803, 'obs':
    "KRAP": {"name": "Rapid City", "lat": 44.0453, "lon": -103.0574, '
    "KINL": {"name": "International Falls", "lat": 48.5662, "lon": -93
    "KDLH": {"name": "Duluth", "lat": 46.8421, "lon": -92.1936, 'obs':
    "KRST": {"name": "Rochester", "lat": 43.9083, "lon": -92.4979, 'ob
}
```

Part 1

We'll start by looking at just one dictionary and identifying some features associated with it.

1. Complete this function to find the maximum wind speed of an individual radiosonde from the ***stations*** dictionary. The function takes a station ID from the stations dictionary as an argument and returns the fastes wind speed and the pressure level it occured at. Once you have finished the function, what is the maximum wind speed reported for Grand Forks? How about Minot?

In [ ]:
```
def max_wind(???):
    #create a variable for your observations
    #use a for loop to find the max
    # We've found the max before, use those same concepts
    #If you get stuck, try independent debuggiung by printing a variab

    return fastest_wind, press

print(max_wind(???)) #function call
```

2. Now that we know how to get data from one of these stations, let's find the average lapse rate of a station. Finish the lapse_rate function below. It will take the same argument as max_wind and will return the average lapse rate found by the radiosonde in degrees C per km. Once you have finsihed the function, what is the average lapse rate for sioux falls? How about rochester?

In [ ]:
```
def lapse_rate(???):
    # start the same way as max_wind
    # use a for loop
    # try independent debugging if you get stuck

    return lapse


print(lapse_rate(???)) #function call
```

3. Let's figure out how the temperature at a station compares to another. Finish the temp_diff function below. This function with take two stations as arguments then return a dictionary with the temperature difference between the two stations at each pressure level. Finish the function below then find the temperature difference between duluth and international falls at 700 mb. How about rapid city and bismarck at 400 mb?

In [4]:
```
def temp_diff(station1, station2):
    #make a dictionary
    #use a for loop for to fill the dictionary
```

```
    return diff


??? #function call
```

4. Now let's figure out which station has the most stable air. We can do this by looking at the lapse rate of each station. We know that the lapse rate is greater than 9.8 C per km the air is unstable and if it is less than 9.8 C per km the air is stable. Finish the function below to calcualte the lapse rate of each station, then return the most stable and most unstable stations and thier lapse rates. The function stability will take the stations dictionary as an argument. Which station is most stable and which station is least stable? What are their lapse rates?

In [5]:
```
def stability(stations):
    #make dictioanry
    # use forloop to fill dictionary
    #set place holder values
    #use for loop to find max and min

    return (???, ???), (???, ???)


??? #fucntion call
```

```
  Cell In[5], line 7
    return (???, ???), (???, ???)
           ^
SyntaxError: invalid syntax
```

5. Let's figure out the average relative humdidity of a station. For this we will use multiple functions and call them in another function like the last example. We will use the equations below to find relative humdity. The three functions we'll use are vapor_pressure, rh, and average_rh. vapor_pressure will solve the first two equations, rh will solve the third equation for a single pressure level and average_rh will solve the average relative humidity for the entire observation. What is the average realtive humidity of international falls? How about rapid city?

In [6]:
```
def vapor_pressure(temp):

    # add equation to solve
```

```
    return vap_press

def rh (temp, dew):

    #fucntion call
    #function call
    #calculate RH

    return rel_hum



def average_rh(station):

    #make list of rh values
    #use for loop to find temp and dew point
    #fucntion call
    #add rh to list of values
    #find average rh


    return avg_rh

#function call
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[6], line 28
     17 def average_rh(station):
     18
     19     #make list of rh values
   (...)     22     #add rh to list of values
     23     #find average rh
     26     return avg_rh
---> 28 average_rh(stations[      ])

Cell In[6], line 26, in average_rh(station)
     17 def average_rh(station):
     18
     19     #make list of rh values
   (...)     22     #add rh to list of values
     23     #find average rh
---> 26     return avg_rh

NameError: name 'avg_rh' is not defined
```

In [ ]:

In [ ]: