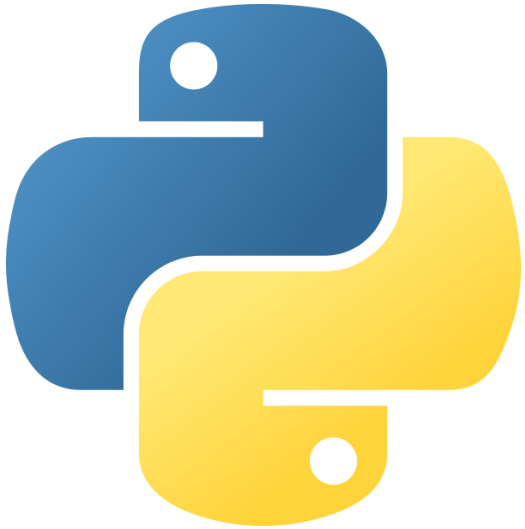
MSAS Tutorial Sequence -Module Three-

WRITTEN BY GARRETT FOLBE

LET'S GET READY TO WORK

Goals of Today

1. Finish up the basics of Python
    1. Booleans
    2. If/Else
    3. Lists
    4. Loops
    5. Dictionaries
2. Understand Pandas
3. Getting some I/O with dataframes
    1. Reading from Excel
    2. Webscraping
    3. Basic dataframe operations



More Python

Booleans

- Booleans represent a “True” or “False” variable (can only hold these two values)
- Often used for comparison purposes
- Declared just like any other variable
  - is_starter = True
  - temp = False
- Can also be used in inequalities and expressions
  - More on this in a bit

Operators

- The only three operators you should need to know for python are the following:
  - “and”
  - “or”
  - “not”
  - All three operators are used in their plaintext form (no need for “&&” or “||” or “!”)
- Truth tables:

A	Operand	B	Result
True	and	True	True
True	and	False	False
False	and	False	False
True	or	True	True
True	or	False	True
False	or	False	False

Conditions

- Recap: Python supports the usual logical conditions from mathematics:
  - Equals: a == b
  - Not Equals: a != b
  - Less than: a < b
  - Less than or equal to: a <= b
  - Greater than: a > b
  - Greater than or equal to: a >= b
- “If” statements allow us to check “if” a condition is true or false
  - If the statement evaluates to True, we will go into to that “if” block and run what is inside it

In [1]:
```
if 2 < 3:
    print("hello")
```

```
hello
```

In [2]:
```
brady_touchdowns = 25
rivers_touchdowns = 20

if brady_touchdowns > rivers_touchdowns:
    print("Brady is better")
```

```
Brady is better
```

In [4]:
```
home = True
sun = True

if home and sun:
    print("We should win!")
```

```
We should win!
```

In [5]:
```
home = False
sun = True

if home or sun:
    print("We have a chance")
```

```
We have a chance
```

In [6]:
```
road = False

if not road:
    print("We are playing at home")
```

```
We are playing at home
```

Else statements

- Must be directly paired with an “if” statement
- The “else” keyword catches anything that isn’t caught by the if statement
- If a condition is not hit, the else statement will run. Otherwise it will not.
  - Yes, an if/else clause is literally an if/else clause

```
In [1]: lebron = 27.4
        harden = 36.1

Harden averaged more ppg than lebron
```

```
In [2]: # Don't do this

        if lebron > harden:
            print("Lebron averaged more ppg than harden")
        if harden > lebron:
            print("Harden averaged more ppg than lebron")

Harden averaged more ppg than lebron
```

```
In [3]: # Do this

        if lebron > harden:
            print("Lebron averaged more ppg than harden")
        else:
            print("Harden averaged more ppg than lebron")

Harden averaged more ppg than lebron
```

In [4]:
```
goals_scored = 3

if goals_scored == 0:
    print("shutout")
elif goals_scored == 1:
    print("scored")
elif goals_scored == 3:
    print("Hat Trick!")
else:
    print("multiple scored")
```

```
Hat Trick!
```

In [5]:
```
goals_scored = 2

if goals_scored == 0:
    print("shutout")
elif goals_scored == 1:
    print("scored")
elif goals_scored == 3:
    print("Hat Trick!")
else:
    print("multiple scored")
```

```
multiple scored
```

If/Elif/Else

- "Elif" clauses allow for multiple if statements to be checked (short for "else if")
- First, the "if" statement is checked
- Next, each "elif" clause will be checked until one is hit
- Finally, if none of the "elif" clauses are hit, the "else" clause is run

INDENTATION MATTERS

```
In [1]: a = 10
        b = 5

        if a > b:
        print("here")
```

```
  File "<ipython-input-1-c0905ae9b858>", line 5
    print("here")
        ^
IndentationError: expected an indented block
```

Lists

- Lists are a collection of items that is ordered and can be changed
- Lists are indicated by square brackets: []
- We can declare a list in three different ways:
  - An empty list → my_list = []
  - Fill it with elements → my_list_2 = [“Ravens”, “Saints”, “Patriots”]
    - This is a list of strings, but we can have a list of any datatype
    - You can mix and match your datatypes within the list, but this is considered bad practice
  - Set it equal to another list → my_list_3 = my_list_2
- You can get the number of elements in the list by calling the “len” function
  - my_list = [1, 2, 3, 4]
  - print(len(my_list)) → 4
- Clear the list by calling the “clear function”
  - my_list.clear()
  - print(my_list) → ???

Accessing elements of a list

- You can access list items by referring to the index number
- Lists in Python are “0-index based”
- Example:
  - stats = [“pts”, “reb”, “ast”]
  - print(stats[0]) → “pts”
  - print(stats[1]) → “reb”
  - Print(stats[2]) → “ast”
  - Print(stats[3]) → Error! Why?
  - Print(stats[-1]) → ???
- You can access a range of indexes by specifying where to start and where to end (called slicing)
  - Use the following format: list[start:end]
  - qbs = [“Brady”, “Rivers”, “Jackson”, “Stafford”, “Cousins”]
  - slice = qbs[2:4]
  - print(slice) → [“Jackson”, “Stafford”, “Cousins”]

Updating a list element

- To update a list element, simply index into the list and reassign its value

```
In [9]: points = [10, 7, 13, 21, 15]
        print(points)
        print(points[3])
        points[3] = 19
        print(points)
        print(points[3])
```

```
[10, 7, 13, 21, 15]
21
[10, 7, 13, 19, 15]
19
```

Adding to a list

```
In [1]: ppg = [27.4, 31.5, 21.5, 18.9, 29.7]

In [2]: # append to the end of a list
        ppg.append(15.7)
        ppg

Out[2]: [27.4, 31.5, 21.5, 18.9, 29.7, 15.7]

In [3]: # add another list
        more_ppg = [11.5, 20.1, 16.7]
        ppg += more_ppg
        ppg

Out[3]: [27.4, 31.5, 21.5, 18.9, 29.7, 15.7, 11.5, 20.1, 16.7]

In [4]: # insert at a specific position
        ppg.insert(3, 10.1)
        ppg

Out[4]: [27.4, 31.5, 21.5, 10.1, 18.9, 29.7, 15.7, 11.5, 20.1, 16.7]
```

Range-based for loops (one way to loop)

- A “for” loop is used for iterating over a sequence
  - For our purposes, this will usually be a list
- We will only cover range based loops in this module
  - This is a brief sneak peak… for more information
  - Other loops aren’t used traditionally in data science unless you are exploring a niche
  - Don’t need to index into array
- Use cases:
  - When you want to view every element of a list in sequential order
  - Save time from indexing into specific elements
- Syntax:

```
for element in list:
    do something
```

Basic loop examples

In [6]:
```
simple_list = [0, 3, 2, 5]
for number in simple_list:
    print(number)
```

```
0
3
2
5
```

In [5]:
```
AFC_West = ["Broncos", "Chargers", "Chiefs", "Raiders"]

for team in AFC_West:
    print(team)
```

```
Broncos
Chargers
Chiefs
Raiders
```

Basic loop applications

In [7]:
```
rebounds = [1, 4, 3, 2, 6, 1, 3]
sum = 0

for game in rebounds:
    sum = sum + game

print(sum / len(rebounds))
# What does this value represent?
```

```
2.857142857142857
```

In [18]:
```
rebounds = [1, 4, 3, 2, 6, 1, 3]
good_games = []
bad_games = []

for game in rebounds:
    if game <= 3:
        bad_games.append(game)
    else:
        good_games.append(game)

print(bad_games)
print(good_games)
```

```
[1, 3, 2, 1, 3]
[4, 6]
```

Dictionaries

- Arguably one of the most important data structures in all of computer science
- A dictionary is a collection of items which is unordered and indexed.
- In Python, dictionaries are written with curly brackets and have keys and values
  - Keys are how you access values within the data structure
    - In a list, you index into the elements by numerical index
    - In a dictionary, you index into values with a key!
  - Every key is unique, but keys can have the same value
- Why are dictionaries useful?

Example Dictionaries

```
players = {
    "LeBron James": "PF",
    "Anthony Davis": "C",
    "Steph Curry" : "PG",
    "Luka Doncic" : "SF",
    "Trae Young" : "PG",
    "Pau Gasol" : "C"
}
```

```
team_names = {
    "DET" : "Lions",
    "GB" : "Packers",
    "CHI" : "Bears",
    "MIN" : "Vikings"
}
```

```
In [1]: players = {
            "LeBron James": "PF",
            "Anthony Davis": "C",
            "Steph Curry" : "PG",
            "Luka Doncic" : "SF",
            "Trae Young" : "PG",
            "Pau Gasol" : "C"
        }

In [2]: players["LeBron James"]

Out[2]: 'PF'

In [3]: players["LeBron James"] = "C"
        players

Out[3]: {'LeBron James': 'C',
         'Anthony Davis': 'C',
         'Steph Curry': 'PG',
         'Luka Doncic': 'SF',
         'Trae Young': 'PG',
         'Pau Gasol': 'C'}

In [4]: players["Kevin Love"]

---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
<ipython-input-4-b16d7fa527bf> in <module>
----> 1 players["Kevin Love"]

KeyError: 'Kevin Love'
```

Accessing elements in a dictionary

```
In [14]: mlb_teams = {
             "NYY" : "Yankees",
             "BAL" : "Orioles",
             "BOS" : "Red Sox",
             "TB" : "Rays"
         }

In [15]: if "TB" in mlb_teams:
             print("The value of TB is: " + mlb_teams["TB"])

         The value of TB is: Rays

In [16]: if "TOR" not in mlb_teams:
             print("Forgot that one")
             mlb_teams["TOR"] = "Blue Jays"
             print(mlb_teams)

         Forgot that one
         {'NYY': 'Yankees', 'BAL': 'Orioles', 'BOS': 'Red Sox', 'TB': 'Rays', 'TOR': 'Blue Jays'}
```

Checking if an element is in a dictionary (try it on lists too!)

Questions about anything we talked about?

IF NOT, TAKE A COUPLE MINUTES TO WORK WITH THESE CONCEPTS

Pandas

Welcome to REAL Data Science

Libraries in Python

- A python library is a collection of functions that allows you to perform specific actions with your code
- More often than not, a library is designed for a specific feature. There are libraries to…
  - Move and modify files on your computer
  - Create graphical interfaces for your code
  - Webscrape (more on that in the next module)
  - Perform data science operations ☺
  - And much more!
- Libraries can be imported with the following syntax:
  - import library (imports entire library)
  - import library as lib (imports entire library as an alias, usually used to not clutter up code)
  - from library, import function a, b (imports functions a and b from the library, saves memory)
- To access functions of your imported library, you will need to use the dot operator
  - We will see this throughout the module sequence

What is Pandas?

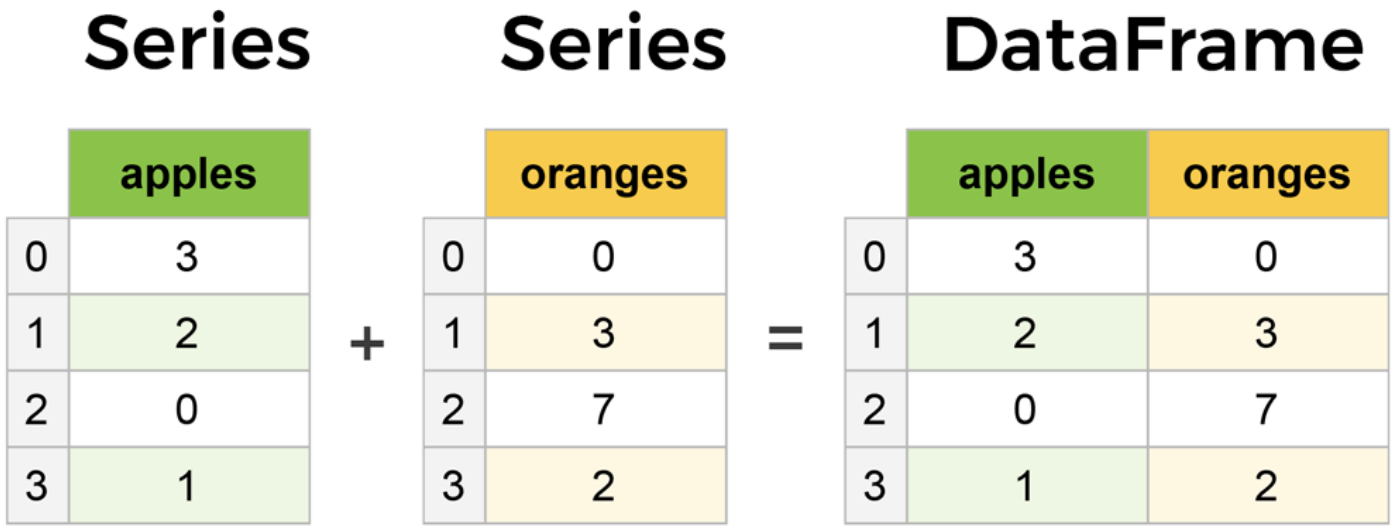
- From their documentation:

“pandas is an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language.”

- Very powerful data science library
- The basis of the rest of this module, as well as the next three!
- Import pandas at the top of your jupyter notebok
  - import pandas as pd

Series vs DataFrames

- The primary two components of pandas are Series and DataFrames
- Series is a column in your table, and a DataFrame is a multidimensional table comprised of a collection of Series



Reading in Files

import url lib.request
urllib.request.urlretrieve('https://github.com/gfolbe318/MSAS_tutorials/raw/master/3_Module/nfl_stats.xlsx', 'nfl_stats.xlsx')

In [1]:
```
import pandas as pd
```

In [5]:
```
# Change the filename if you aren't in the same directory

file_name = "nfl_stats.xlsx"

# Read in the file from excel
df = pd.read_excel(file_name)
```

Printing a DataFrame

In [6]:
```
# This makes things ugly
print(df)
```

```
      Rk              Player   Tm  Age    Pos   G  GS  Cmp  Att   Cmp%   Yds  \
0      1  Ben Roethlisberger  PIT   36     QB  16  16  452  675   67.0  5129
1      2        Andrew Luck*  IND   29     QB  16  16  430  639   67.3  4593
2      3           Matt Ryan  ATL   33     QB  16  16  422  608   69.4  4924
3      4         Kirk Cousins  MIN   30     QB  16  16  425  606   70.1  4298
4      5      Aaron Rodgers*  GNB   35     QB  16  16  372  597   62.3  4442
5      6         Case Keenum  DEN   30     QB  16  16  365  586   62.3  3890
6      7   Patrick Mahomes*+  KAN   23     QB  16  16  383  580   66.0  5097
7      8         Eli Manning  NYG   37     QB  16  16  380  576   66.0  4299
8      9          Tom Brady*  NWE   41     QB  16  16  375  570   65.8  4355
9     10         Jared Goff*  LAR   24     QB  16  16  364  561   64.9  4688
10    11    Matthew Stafford  DET   30     QB  16  16  367  555   66.1  3777
11    12          Derek Carr  OAK   27     QB  16  16  381  553   68.9  4049
12    13       Dak Prescott*  DAL   25     QB  16  16  356  526   67.7  3885
13    14       Philip Rivers*  LAC   37     QB  16  16  347  508   68.3  4308
14    15      Deshaun Watson*  HOU   23     QB  16  16  345  505   68.3  4165
15    16          Drew Brees*  NOR   39     QB  15  15  364  489   74.4  3992
16    17      Baker Mayfield  CLE   23     QB  14  13  310  486   63.8  3725
17    18          Cam Newton  CAR   29     QB  14  14  320  471   67.9  3395
18    19  Mitchell Trubisky*  CHI   24     QB  14  14  289  434   66.6  3223
```

Displaying a DataFrame

In [7]:
```
# This makes things pretty
df
```

Out[7]:

	Rk	Player	Tm	Age	Pos	G	GS	Cmp	Att	Cmp%	Yds	TD	Int	Y/A	Y/C	Y/G	Rate	QBR	Sk
0	1	Ben Roethlisberger	PIT	36	QB	16	16	452	675	67.0	5129	34	16	7.6	11.3	320.6	96.5	71.0	24
1	2	Andrew Luck*	IND	29	QB	16	16	430	639	67.3	4593	39	15	7.2	10.7	287.1	98.7	69.4	18
2	3	Matt Ryan	ATL	33	QB	16	16	422	608	69.4	4924	35	7	8.1	11.7	307.8	108.1	68.5	42
3	4	Kirk Cousins	MIN	30	QB	16	16	425	606	70.1	4298	30	10	7.1	10.1	268.6	99.7	58.2	40
4	5	Aaron Rodgers*	GNB	35	QB	16	16	372	597	62.3	4442	25	2	7.4	11.9	277.6	97.6	54.4	49
5	6	Case Keenum	DEN	30	QB	16	16	365	586	62.3	3890	18	15	6.6	10.7	243.1	81.2	45.5	34
6	7	Patrick Mahomes*+	KAN	23	QB	16	16	383	580	66.0	5097	50	12	8.8	13.3	318.6	113.8	80.4	26
7	8	Eli Manning	NYG	37	QB	16	16	380	576	66.0	4299	21	11	7.5	11.3	268.7	92.4	48.7	47
8	9	Tom Brady*	NWE	41	QB	16	16	375	570	65.8	4355	29	11	7.6	11.6	272.2	97.7	66.6	21
9	10	Jared Goff*	LAR	24	QB	16	16	364	561	64.9	4688	32	12	8.4	12.9	293.0	101.1	63.1	33
10	11	Matthew Stafford	DET	30	QB	16	16	367	555	66.1	3777	21	11	6.8	10.3	236.1	89.9	48.4	40
11	12	Derek Carr	OAK	27	QB	16	16	381	553	68.9	4049	19	10	7.3	10.6	253.1	93.9	46.9	51

Displaying the head of a DataFrame

In [8]:
```
# Print out the head(start) of your DataFrame
df.head()
```

Out[8]:

	Rk	Player	Tm	Age	Pos	G	GS	Cmp	Att	Cmp%	Yds	TD	Int	Y/A	Y/C	Y/G	Rate	QBR	Sk
0	1	Ben Roethlisberger	PIT	36	QB	16	16	452	675	67.0	5129	34	16	7.6	11.3	320.6	96.5	71.0	24
1	2	Andrew Luck*	IND	29	QB	16	16	430	639	67.3	4593	39	15	7.2	10.7	287.1	98.7	69.4	18
2	3	Matt Ryan	ATL	33	QB	16	16	422	608	69.4	4924	35	7	8.1	11.7	307.8	108.1	68.5	42
3	4	Kirk Cousins	MIN	30	QB	16	16	425	606	70.1	4298	30	10	7.1	10.1	268.6	99.7	58.2	40
4	5	Aaron Rodgers*	GNB	35	QB	16	16	372	597	62.3	4442	25	2	7.4	11.9	277.6	97.6	54.4	49

Display a Specific Number of Rows

In [10]:
```
# Print out n number of rows
num_rows = 10
df.head(num_rows)
```

Out[10]:

	Rk	Player	Tm	Age	Pos	G	GS	Cmp	Att	Cmp%	Yds	TD	Int	Y/A	Y/C	Y/G	Rate	QBR	Sk
0	1	Ben Roethlisberger	PIT	36	QB	16	16	452	675	67.0	5129	34	16	7.6	11.3	320.6	96.5	71.0	24
1	2	Andrew Luck*	IND	29	QB	16	16	430	639	67.3	4593	39	15	7.2	10.7	287.1	98.7	69.4	18
2	3	Matt Ryan	ATL	33	QB	16	16	422	608	69.4	4924	35	7	8.1	11.7	307.8	108.1	68.5	42
3	4	Kirk Cousins	MIN	30	QB	16	16	425	606	70.1	4298	30	10	7.1	10.1	268.6	99.7	58.2	40
4	5	Aaron Rodgers*	GNB	35	QB	16	16	372	597	62.3	4442	25	2	7.4	11.9	277.6	97.6	54.4	49
5	6	Case Keenum	DEN	30	QB	16	16	365	586	62.3	3890	18	15	6.6	10.7	243.1	81.2	45.5	34
6	7	Patrick Mahomes*+	KAN	23	QB	16	16	383	580	66.0	5097	50	12	8.8	13.3	318.6	113.8	80.4	26
7	8	Eli Manning	NYG	37	QB	16	16	380	576	66.0	4299	21	11	7.5	11.3	268.7	92.4	48.7	47
8	9	Tom Brady*	NWE	41	QB	16	16	375	570	65.8	4355	29	11	7.6	11.6	272.2	97.7	66.6	21
9	10	Jared Goff*	LAR	24	QB	16	16	364	561	64.9	4688	32	12	8.4	12.9	293.0	101.1	63.1	33

```
In [11]: # Get dimensions of dataframe in the format of (rows, columns)
         df.shape

Out[11]: (106, 19)

In [12]: # Get the names of of the columns
         df.columns

Out[12]: Index(['Rk', 'Player', 'Tm', 'Age', 'Pos', 'G', 'GS', 'Cmp', 'Att', 'Cmp%',
                'Yds', 'TD', 'Int', 'Y/A', 'Y/C', 'Y/G', 'Rate', 'QBR', 'Sk'],
               dtype='object')

In [13]: # Get the tyeps of each column
         df.dtypes

Out[13]: Rk          int64
         Player     object
         Tm         object
         Age         int64
         Pos        object
         G           int64
         GS          int64
         Cmp         int64
         Att         int64
         Cmp%      float64
         Yds         int64
         TD          int64
         Int         int64
         Y/A       float64
         Y/C       float64
         Y/G       float64
         Rate      float64
         QBR       float64
         Sk          int64
         dtype: object
```

Get Information about the DataFrame

Extract Certain Columns

In [15]:
```
# Pick out specifc columns that your want
new_df = df[["Player"]]
new_df.head()
```

Out[15]:

	Player
0	Ben Roethlisberger
1	Andrew Luck*
2	Matt Ryan
3	Kirk Cousins
4	Aaron Rodgers*

In [17]:
```
# Get more than one column
new_df = df[["Player", "Tm", "TD", "Yds"]]
new_df.head()
```

Out[17]:

	Player	Tm	TD	Yds
0	Ben Roethlisberger	PIT	34	5129
1	Andrew Luck*	IND	39	4593
2	Matt Ryan	ATL	35	4924
3	Kirk Cousins	MIN	30	4298
4	Aaron Rodgers*	GNB	25	4442

Write to Excel

In [36]:
```
# Write back to an excel sheet
# Be careful, you can only write to a sheet once
new_df.to_excel("important.xlsx")
```

Any Questions?