Introduction to Pandas & Jupyter

Data Boot Camp

Lesson 4.1

Class Objectives

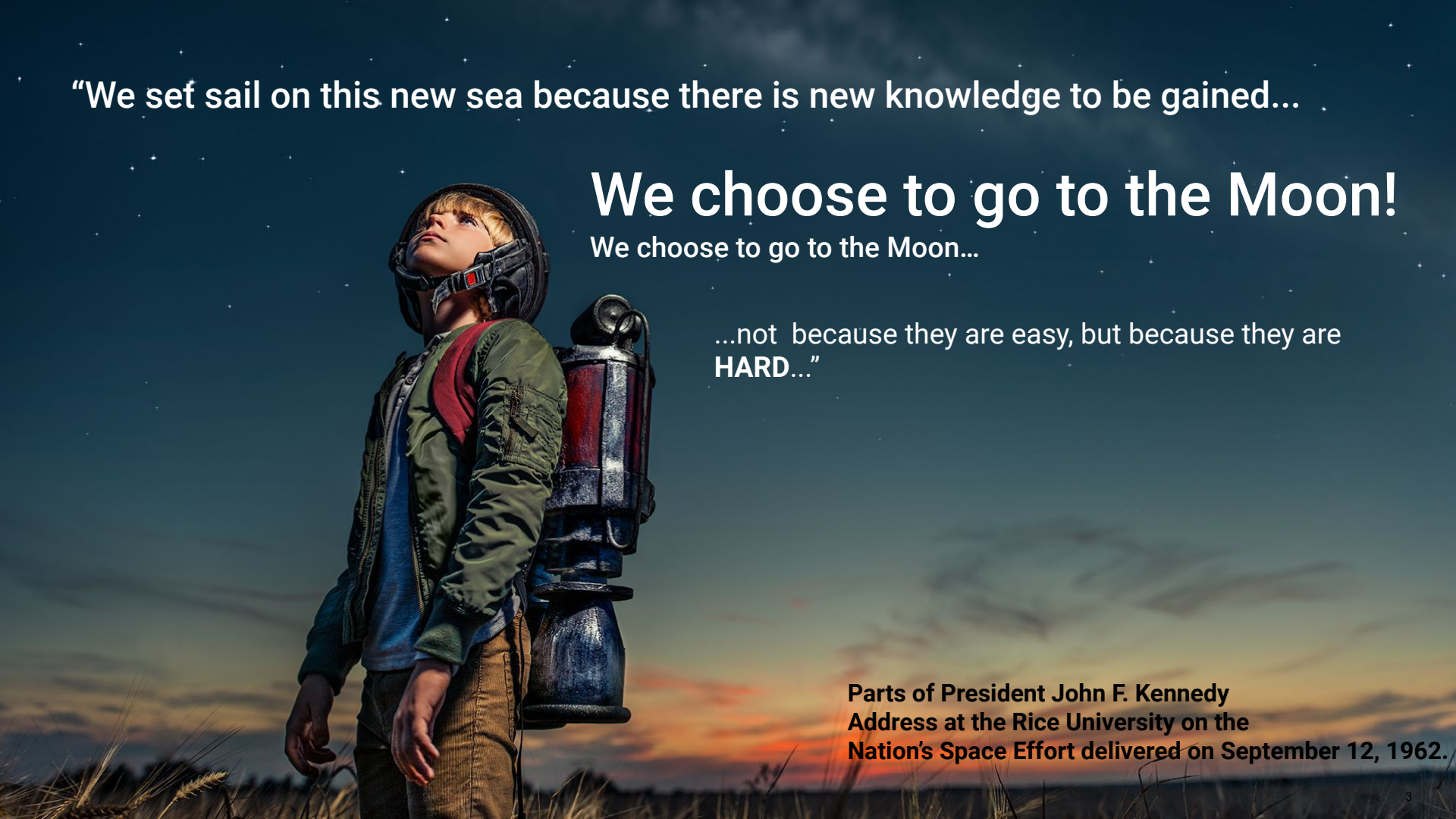
By the end of today's class you will be able to:

Serve Jupyter Notebook files from local directories and connect their development environment.

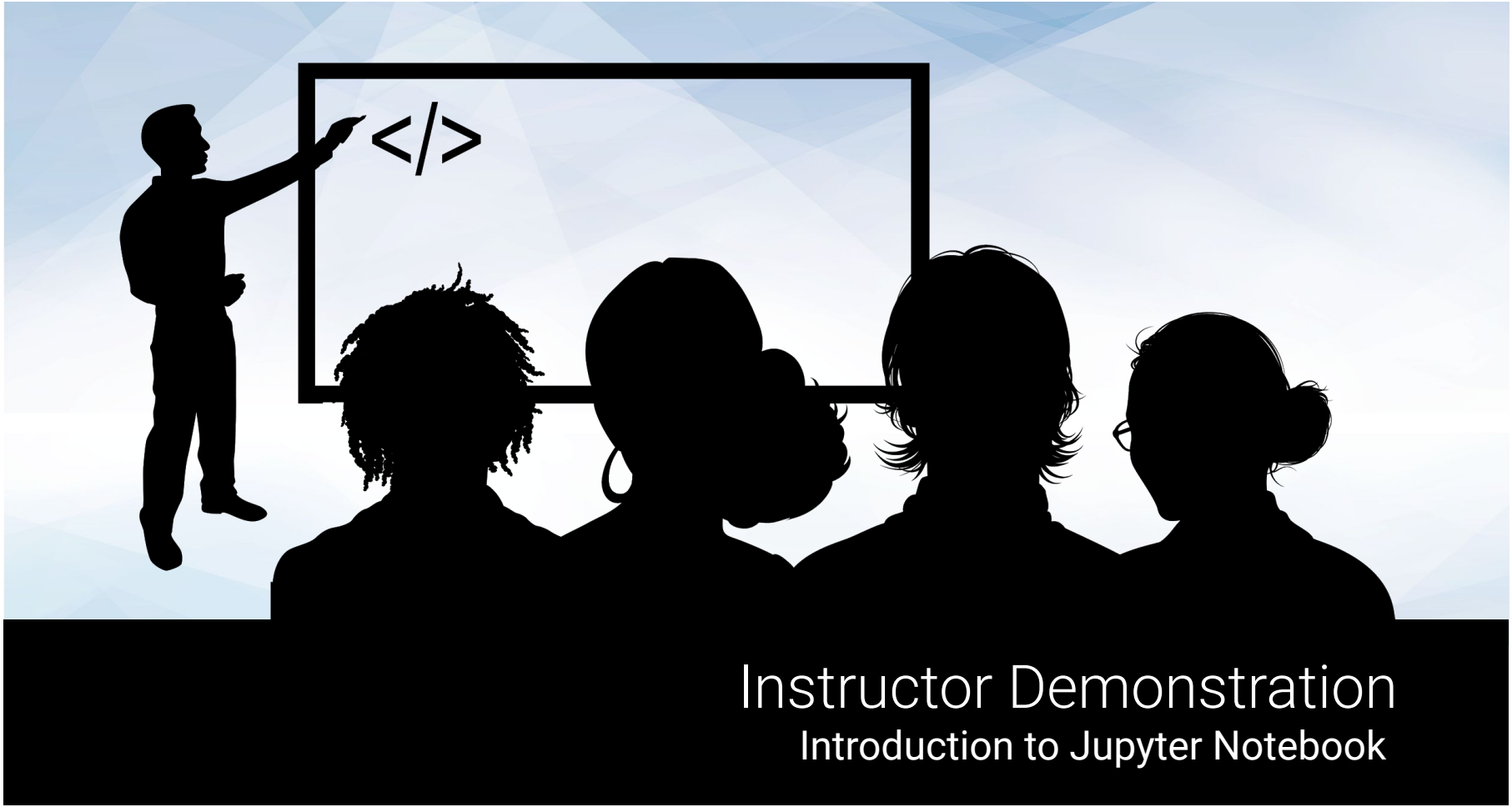
Create Pandas DataFrames from scratch.

Understand how to run functions on Pandas DataFrame.

Read/write DataFrames from/to CSV files using Pandas.


“We set sail on this new sea because there is new knowledge to be gained...
We choose to go to the Moon!
We choose to go to the Moon…
...not because they are easy, but because they are HARD...”
Parts of President John F. Kennedy Address at the Rice University on the Nation’s Space Effort delivered on September 12, 1962.

A little something to assist you throughout your journey..



Instructor Demonstration

Introduction to Jupyter Notebook

Introduction to Jupyter Notebook

- Jupyter Notebook is an open-source application that allows its users to create documents that contain live code, equations, visualizations, and explanatory text.
- In other words, Jupyter Notebook combines a text editor, the console, and a markdown file into one application.

Introduction to Jupyter Notebook

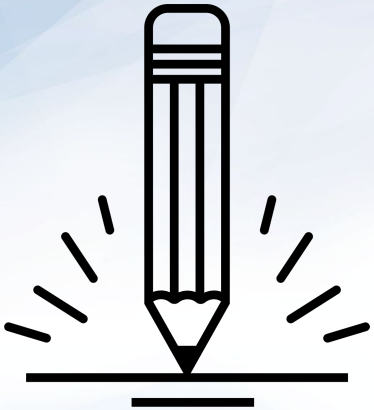
- Create a Python file with Jupyter Notebook. **Set the kernel as 'PythonData'**
    - Setting the kernel for Jupyter projects is important because these kernels let the program know which libraries will be available for use. Only those libraries loaded into the development environment selected can be used in a Jupyter Notebook project.
    - If the development environment does not show up within Jupyter Notebook, install the `nb_conda_kernels` package as directed by the instructor.

Before diving into Pandas, let's take few notes on Jupyter Notebook

Introduction to Jupyter Notebook

- Comprehend the structure of the file in Jupyter Notebook and navigating thru it.

  - Each cell contains Python code which can be run independently by placing the cursor inside a cell and pressing `Shift + Enter`.
  - Jupyter notebook allow users to both to experiment with code directly and save it for late.
  - The running order of the cells won't dictate the stored value of the code. What dictates in Jupyter Notebook is which cell ran lastly.



Activity: Netflix Remix

In this activity, you will create a Jupyter Notebook that performs the same functions as the Netflix activity from last week.

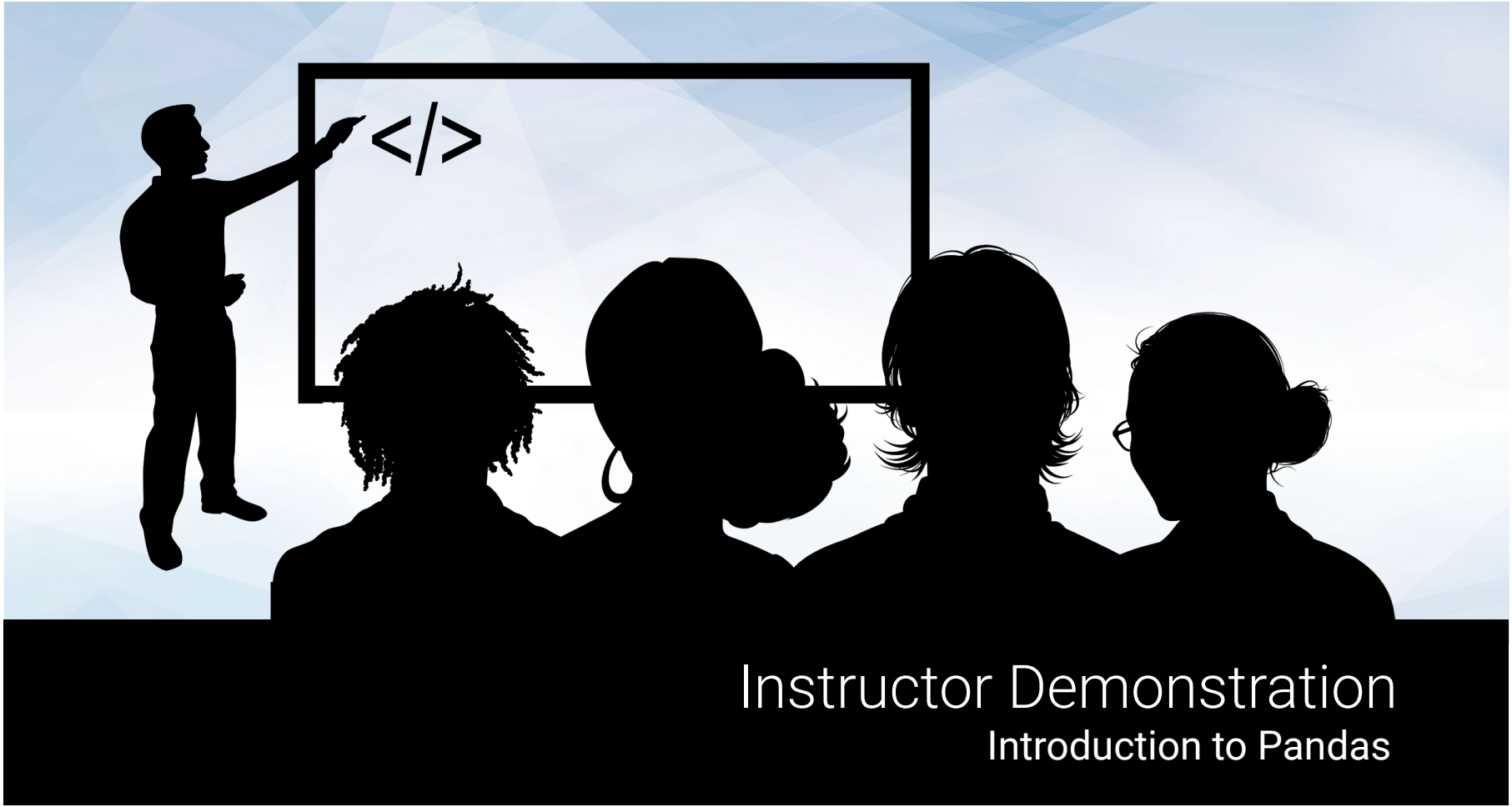
Suggested Time:
15 Minutes

Activity: Netflix Remix

Instructions:

- Using `Netflix.py` as a jumping off point, convert the application so that it runs properly within a Jupyter Notebook.
- Make sure to have the application print out the user's input, the path to `Netflix_Ratings.csv`, and the final rating/review for the film in different cells.
- **Bonus**:
  - Go through any of the activities from last week and attempt to convert them to run within a Jupyter Notebook. While doing this, try to split up the code into cells and print out the outputs.
- **Hints**:
  - If your development environment does not appear as a potential kernel within Jupyter Notebook, close out of Jupyter Notebook and run `conda install -c anaconda nb_conda_kernels` within the terminal. Upon reloading Jupyter Notebook, all possible kernels should now appear.

Time’s Up! Let’s Review.

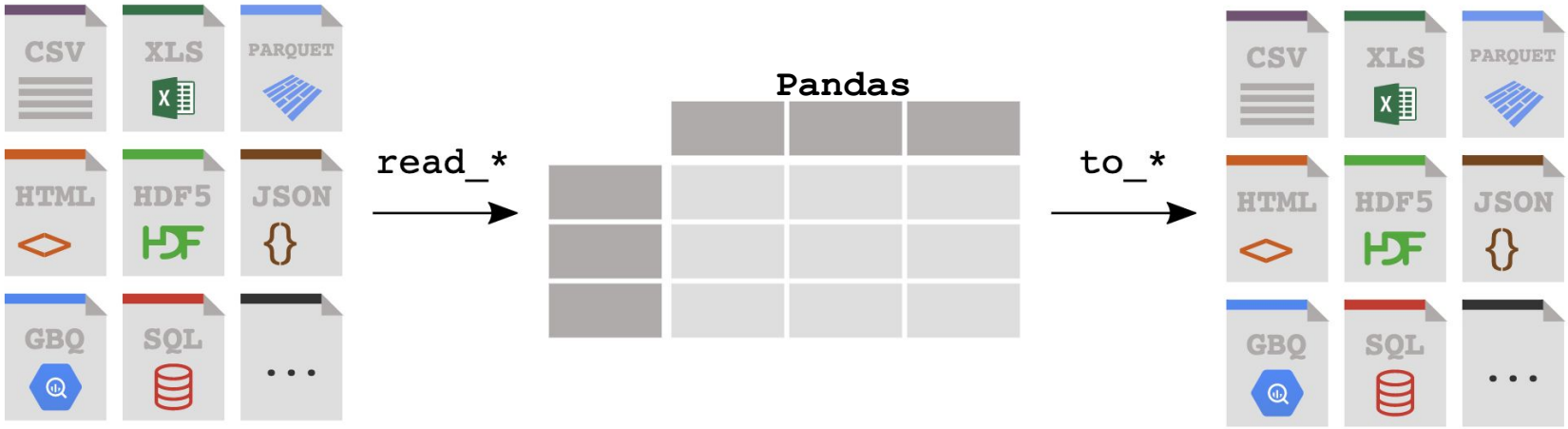


Instructor Demonstration

Introduction to Pandas

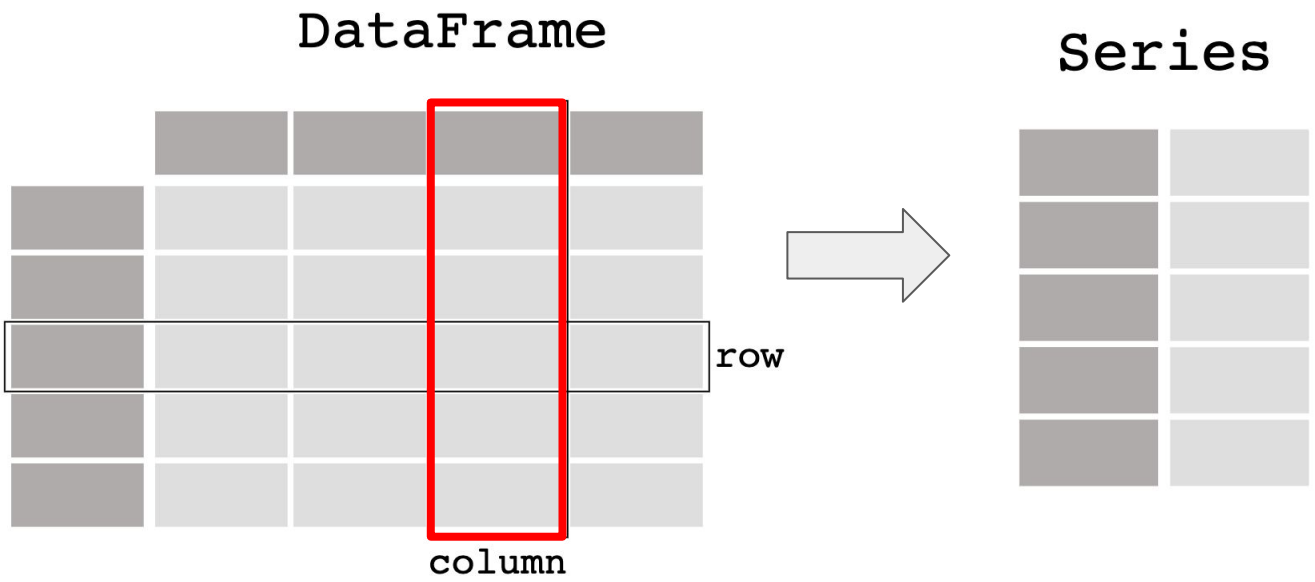
Introduction to Pandas

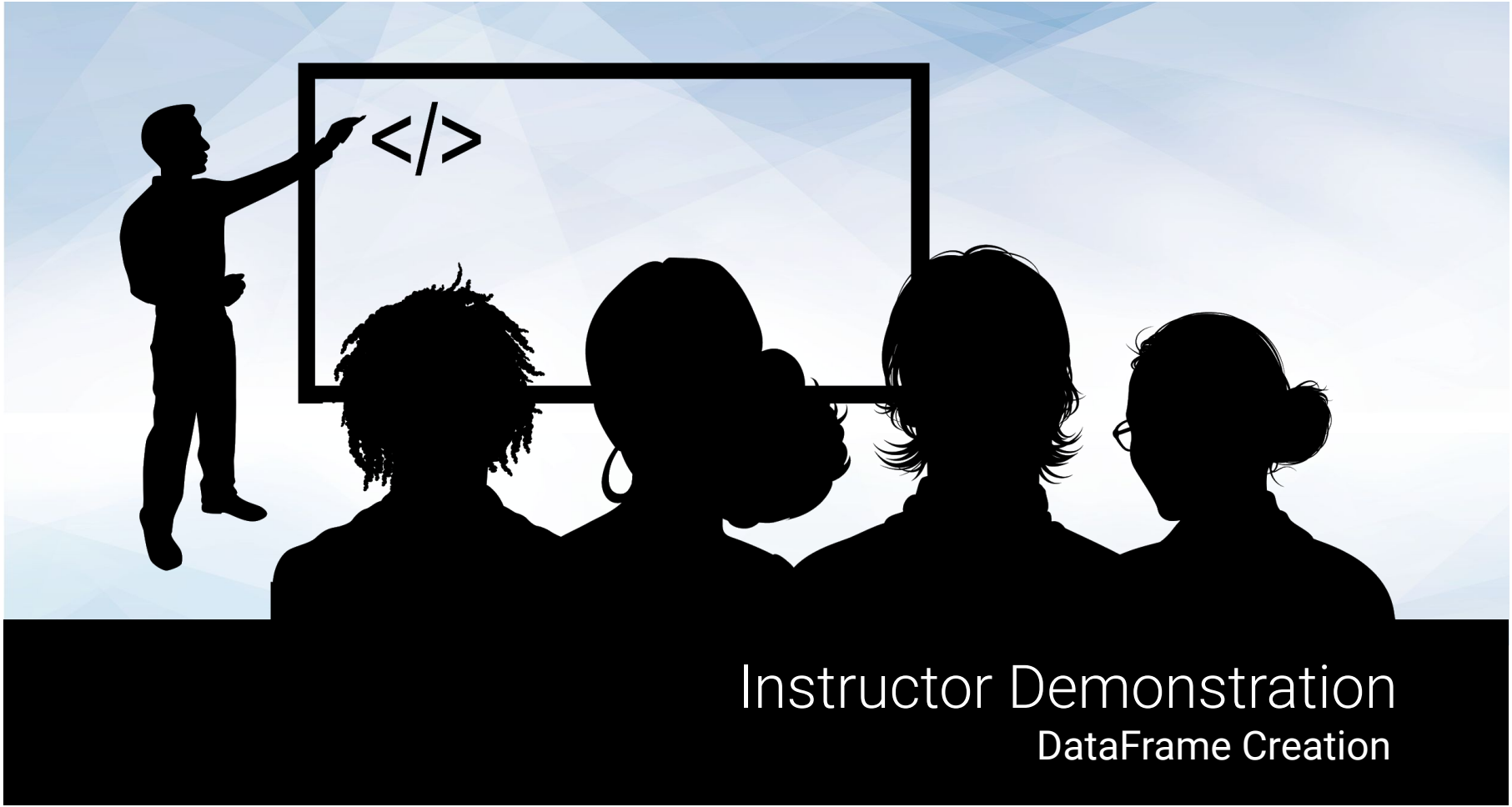
- Thankfully there exists a library that, despite its cute and cuddly name, is extraordinarily powerful when it comes to visualizing, analyzing, and altering large datasets. This library is **Pandas**.



Introduction to Pandas

- While Python alone is stuck using lists, tuples, and dictionaries, Pandas lets Python programmers work with "Series" and "DataFrames"
- Each Column in a DataFrame is a Series.





Instructor Demonstration

DataFrame Creation

DataFrame Creation

A few thing to note when creating a DataFrame

- First, import Pandas library running `import pandas as pd`.This method of import allows Pandas functions/methods to be called using the variable `pd`.

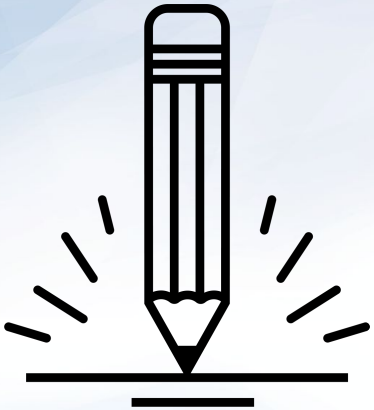
- To create a Series, simply run `pd.Series()` function and place a list within the parentheses. Note that the index for the values within the Series will be the numeric index of the initial list.

DataFrame Creation

A few thing to note when creating a DataFrame

- One of many different ways to create DataFrames from scratch is to use the `pd.DataFrame()` function and provide it with a list of dictionaries. Each dictionary will represent a new row where the keys become column headers and the values will be placed inside the table.

- Another way to use `pd.DataFrame()` function is to provide a dictionary of lists. The keys of the dictionary will be the column headers and the listed values will be placed into their respective rows.



Activity: Data-Frame Shop

In this activity, you will create DataFrames from scratch using the two methods discussed earlier.

Suggested Time:
15 Minutes

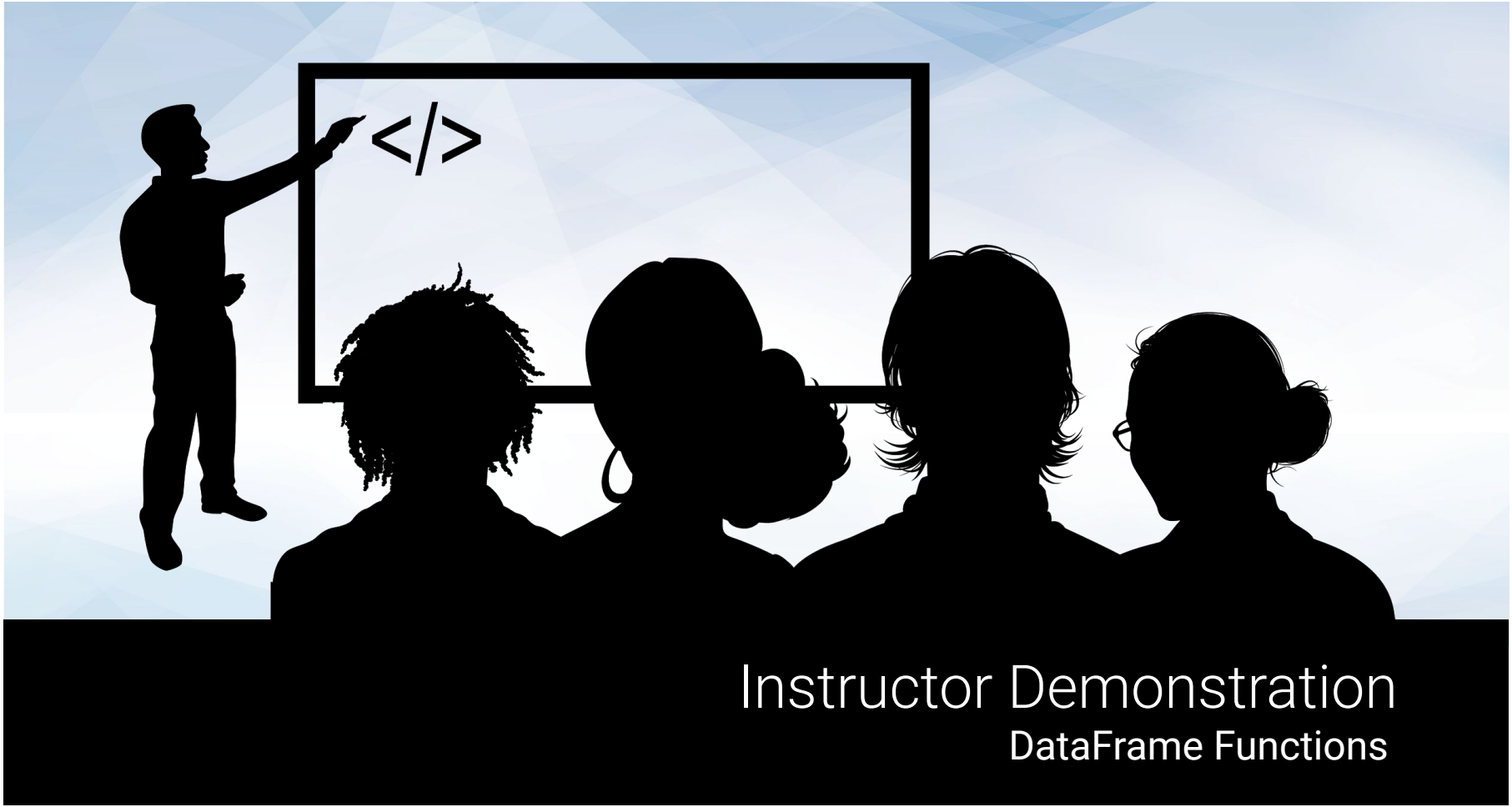
Activity: DataFrame Shop

- Create a DataFrame for a frame shop that contains three columns - "Frame", "Price", and "Sales" - and has five rows of data stored within it.

- Using an alternate method from that used before, create a DataFrame for an art gallery that contains three columns - "Painting", "Price", and "Popularity" - and has four rows of data stored within it.

- **Bonus**:
  - Once both of the DataFrames have been created, discuss with those around you which method you prefer to use and why.

Time’s Up! Let’s Review.



Instructor Demonstration

DataFrame Functions

DataFrame Functions

- The `head()` method is helpful insomuch as it allows the programmer to look at a minified version of a much larger table, thus allowing them to make informed changes without having to search through the entire dataset.

In [3]:
```
# Use Pandas to read data
data_file_df = pd.read_csv(data_file)
data_file_df.head()
```

Out[3]:

	id	First Name	Last Name	Gender	Amount
0	1	Todd	Lopez	M	8067.7
1	2	Joshua	White	M	7330.1
2	3	Mary	Lewis	F	16335.0
3	4	Emily	Burns	F	12460.8
4	5	Christina	Romero	F	15271.9

DataFrame Functions

Built in Function: `describe()`

- The `describe()` method will print out a DataFrame containing some analytic information on the table and its columns. It is also helpful in showing what other data functions can be performed on a DataFrame or Series.

```
In [4]: # Display a statistical overview of the DataFrame
        data_file_df.describe()
```

Out[4]:

	id	Amount
count	1000.000000	1000.000000
mean	500.500000	10051.323600
std	288.819436	5831.230806
min	1.000000	3.400000
25%	250.750000	4854.875000
50%	500.500000	10318.050000
75%	750.250000	15117.425000
max	1000.000000	19987.400000

DataFrame Functions

Working with a single column

- Most data functions can also be performed on a Series by referencing a single column within the whole DataFrame.
- This is done in a similar way to referencing a key within dictionary by taking the DataFrame and following it up with brackets with the desired column's header contained within like a key.

In [5]:
```
# Reference a single column within a DataFrame
data_file_df["Amount"].head()
```

Out[5]:
```
0     8067.7
1     7330.1
2    16335.0
3    12460.8
4    15271.9
Name: Amount, dtype: float64
```

DataFrame Functions

Working with multiple columns

- Multiple columns can be referenced as well by placing all of the column headers desired within a pair of double brackets. If two sets of brackets are not used then Pandas will return an error.

In [6]:
```
# Reference multiple columns within a DataFrame
data_file_df[["Amount", "Gender"]].head()
```

Out[6]:

	Amount	Gender
0	8067.7	M
1	7330.1	M
2	16335.0	F
3	12460.8	F
4	15271.9	F

DataFrame Functions

Couple of Aggregating Functions

- `.mean()` method simply computes the mean.
- `.sum()` method add the values.

```
In [7]: # The mean method averages the series
        average = data_file_df["Amount"].mean()
        average

Out[7]: 10051.323600000002
```

```
In [8]: # The sum method adds every entry in the series
        total = data_file_df["Amount"].sum()
        total

Out[8]: 10051323.600000001
```

DataFrame Functions

Built in Function: unique()

- There are situations in which it is helpful to list out all of the unique values stored within a column. This is precisely what the `unique()` function does by looking into a Series and returning all of the different values within.

```
In [9]: # The unique method shows every element of the series that appears only once
        unique = data_file_df["Last Name"].unique()
        unique

Out[9]: array(['Lopez', 'White', 'Lewis', 'Burns', 'Romero', 'Andrews', 'Baker',
               'Diaz', 'Burke', 'Richards', 'Hansen', 'Tucker', 'Wheeler',
               'Turner', 'Reynolds', 'Carpenter', 'Scott', 'Ryan', 'Marshall',
               'Fernandez', 'Olson', 'Riley', 'Woods', 'Wells', 'Gutierrez',
               'Harvey', 'Ruiz', 'Lee', 'Welch', 'Cooper', 'Nichols', 'Murray',
               'Gomez', 'Green', 'Jacobs', 'Griffin', 'Perry', 'Dunn', 'Gardner',
               'Gray', 'Walker', 'Harris', 'Lawrence', 'Black', 'Simpson', 'Sims',
               'Weaver', 'Carr', 'Owens', 'Stephens', 'Butler', 'Matthews', 'Cox',
               'Brooks', 'Austin', 'Moore', 'Hunter', 'Cunningham', 'Lane',
               'Montgomery', 'Vasquez', 'Freeman', 'Hernandez', 'Alexander',
               'Pierce', 'Mcdonald', 'Kelly', 'Foster', 'Bell', 'Johnson',
               'Bowman', 'Porter', 'Wood', 'Reid', 'Willis', 'Bishop',
               'Washington', 'Gonzales', 'Davis', 'Martinez', 'Martin', 'Long',
               'Howell', 'Hawkins', 'Knight', 'Price', 'Day', 'Bailey', 'Flores',
               'Young', 'Evans', 'Cruz', 'Chavez', 'Barnes', 'Coleman', 'Burton',
               'Clark', 'Carter', 'Franklin', 'Ellis', 'Miller', 'Allen', 'Mason',
               'Patterson', 'Stevens', 'Kim', 'Kelley', 'Robinson', 'Hughes',
               'Morgan', 'Dean', 'Stewart', 'Murphy', 'Fox', 'Simmons',
               'Thompson', 'Fuller', 'Peterson', 'Hanson', 'Wright', 'Reed',
               'Graham', 'Parker', 'Boyd', 'Taylor', 'Greene', 'George', 'Mills',
               'Duncan', 'Hill', 'Jordan', 'Stanley', 'Hall', 'James', 'Stone',
               'Warren', 'Fowler', 'Williamson', 'Lynch', 'Harper', 'Little',
               'Nguyen', 'Morrison', 'Ramirez', 'Howard', 'Watkins', 'Robertson',
               'Powell', 'Sanchez', 'Sanders', 'Grant', 'Ross', 'Mitchell',
               'Henderson', 'Rose', 'Perez', 'Berry', 'Watson', 'Gordon',
               'Morales', 'Arnold', 'Morris', 'Crawford', 'Smith', 'Medina',
               'Alvarez', 'Collins', 'Rodriguez', 'Mccoy', 'Bennett',
               'Richardson', 'Chapman', 'Johnston', 'Gilbert', 'Ford', 'Russell',
               'Nelson', 'Castillo', 'Cole', 'Rice', 'Payne', 'Frazier', 'Webb',
               'Armstrong', 'Wilson', 'Garza', 'Garrett', 'Spencer', 'Peters',
               'Sullivan', 'Brown', 'Williams', 'Gonzalez', 'Palmer', 'Fields',
               'Snyder', 'Jackson', 'Edwards', 'Anderson', 'Cook', 'Ramos',
               'Harrison', 'Lawson', 'Banks', 'Wallace', 'Ortiz', 'Gibson',
               'Reyes', 'Shaw', 'Ward', 'Perkins', 'Bradley', 'Rivera', 'Jenkins',
               'Hart', 'Phillips', 'Garcia', 'Fisher', 'King', 'Larson', 'Hunt',
               'Jones', 'Hudson', 'Myers', 'Hayes', 'Dixon', 'Schmidt', 'Moreno',
               'Rogers', 'Thomas', 'Meyer', 'Daniels', 'Bryant', 'Henry',
               'Campbell', 'Ferguson', 'Oliver', 'Ray', 'Carroll', 'Wagner',
               'Kennedy', 'Holmes'], dtype=object)
```

DataFrame Functions

Built in Function: `value_counts()`

- Another method that holds similar functionality is that of `value_counts()` which not only returns a list of all unique values within a series but also counts how many times a value appears.

In [10]:
```
# The value_counts method counts unique values in a column
count = data_file_df["Gender"].value_counts()
count
```

Out[10]:
```
M    515
F    485
Name: Gender, dtype: int64
```

DataFrame Functions

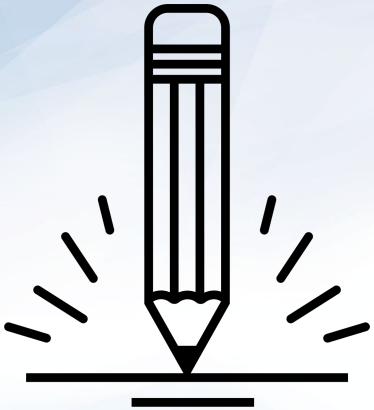
- Calculations can also be performed on columns and then added back into a DataFrame as a new column by referencing the DataFrame, placing the desired column header within brackets, and then setting it equal to a Series.

In [11]:
```
# Calculations can also be performed on Series and added into DataFrames as new columns
thousands_of_dollars = data_file_df["Amount"]/1000
data_file_df["Thousands of Dollars"] = thousands_of_dollars

data_file_df.head()
```

Out[11]:

	id	First Name	Last Name	Gender	Amount	Thousands of Dollars
0	1	Todd	Lopez	M	8067.7	8.0677
1	2	Joshua	White	M	7330.1	7.3301
2	3	Mary	Lewis	F	16335.0	16.3350
3	4	Emily	Burns	F	12460.8	12.4608
4	5	Christina	Romero	F	15271.9	15.2719



Activity: Training Grounds

In this activity, you will now take a large DataFrame consisting of 200 rows, analyze it using some data functions, and then add a new column into it.

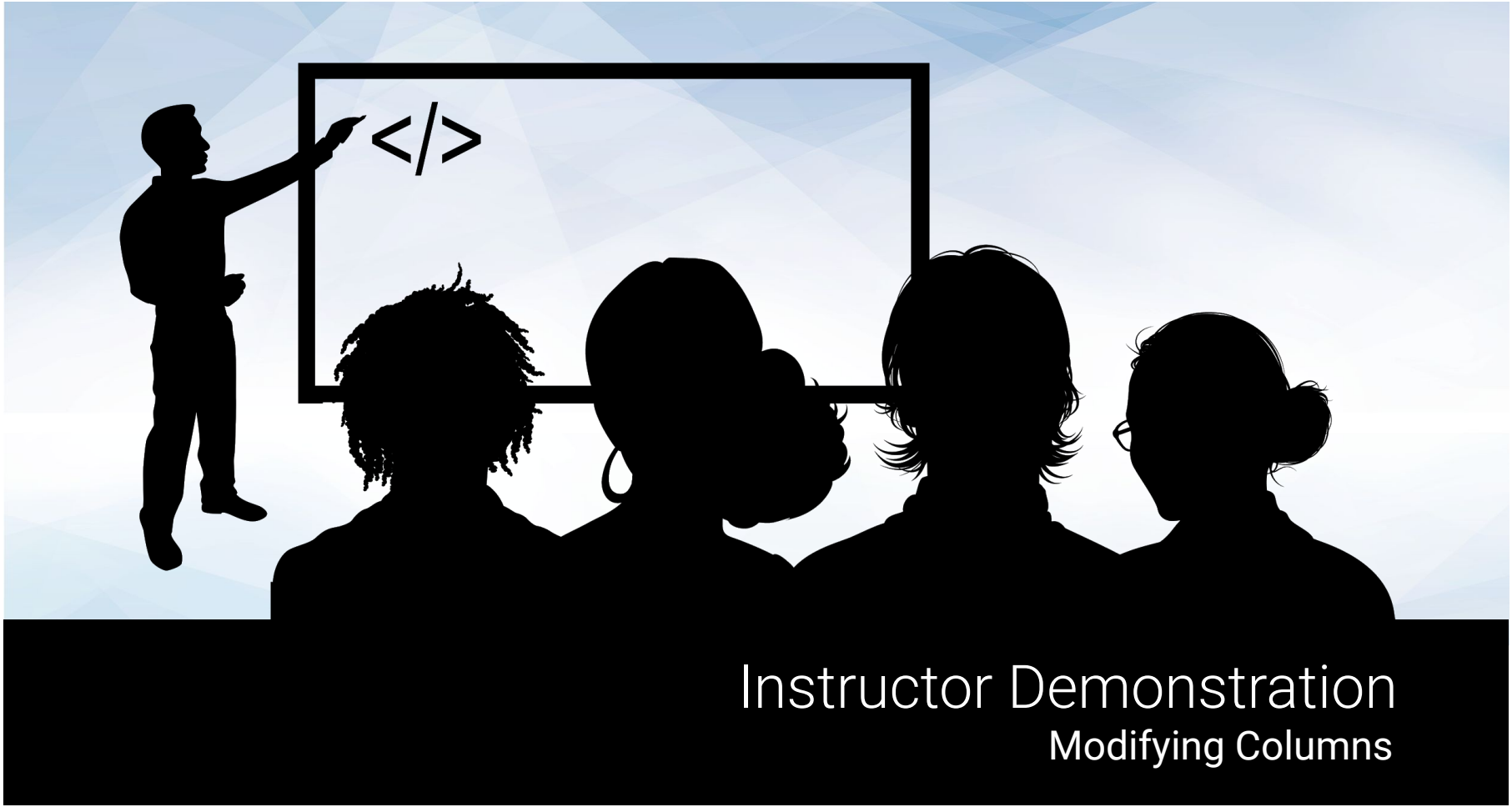
Suggested Time:
15 Minutes

Activity: Training Grounds

Instructions:

- Using the DataFrame provided, perform all of the following actions...
- Provide a simple, analytical overview of the dataset's numeric columns.
- Collect all of the names of the trainers within the dataset.
- Figure out how many students each trainer has.
- Find the average weight of the students at the gym.
- Find the combined weight of all of the students at the gym.
- Convert the "Membership (Days)" column into weeks and then add this new series into the DataFrame.

Time’s Up! Let’s Review.



Instructor Demonstration

Modifying Columns

Modifying Columns

- There it is a very easy way to modify the names/placement of columns using the `rename()` function and the use of double brackets.

- Use the `df.columns` method and it will call and an object containing the column headers will be printed to the screen.

```
In [3]: # Collecting a list of all columns within the DataFrame
        training_df.columns
```

```
Out[3]: Index(['Membership(Days)', 'Name', 'Trainer', 'Weight'], dtype='object')
```

Modifying Columns

- To reorder the columns, create a reference to the DataFrame followed by two brackets with the column headers placed in the order desired.

- It is also possible to remove columns in this way by simply not creating a reference to them. This will, in essence, drop them from the newly made DataFrame.

In [4]:
```
# Reorganizing the columns using double brackets
organized_df = training_df[["Name","Trainer","Weight","Membership(Days)"]]
organized_df.head()
```

Out[4]:

	Name	Trainer	Weight	Membership(Days)
0	Gino Walker	Bettyann Savory	128	52
1	Hiedi Wasser	Mariah Barberio	180	70
2	Kerrie Wetzel	Gordon Perrine	193	148
3	Elizabeth Sackett	Pa Dargan	177	124
4	Jack Mitten	Blanch Victoria	237	186

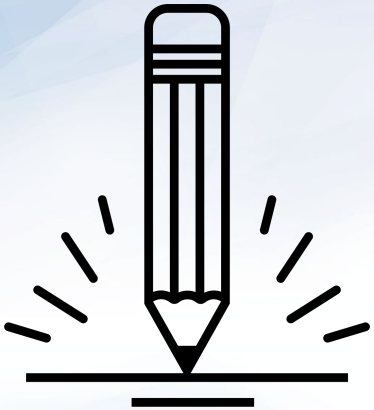
Modifying Columns

- To rename the columns within a DataFrame, use the `df.rename()` method and place `columns={}` within the parentheses.
- Inside of the dictionary, the keys should be references to the current columns and the values should be the desired column names.

In [5]:
```
# Using .rename(columns={}) in order to rename columns
renamed_df = organized_df.rename(columns={"Membership(Days)":"Membership in Days", "Weight":"Weigh
t in Pounds"})
renamed_df.head()
```

Out[5]:

	Name	Trainer	Weight in Pounds	Membership in Days
0	Gino Walker	Bettyann Savory	128	52
1	Hiedi Wasser	Mariah Barberio	180	70
2	Kerrie Wetzel	Gordon Perrine	193	148
3	Elizabeth Sackett	Pa Dargan	177	124
4	Jack Mitten	Blanch Victoria	237	186



Activity: Hey Arnold!

In this activity, you will be taking a pre-made DataFrame of “Hey Arnold!” characters and reorganizing it so that it is more understandable and organized.

Suggested Time:
10 Minutes

Activity: Hey Arnold!

Instructions:

- First, use Pandas to create a DataFrame with the following columns and values:
  - `Characters_in_show` : Arnold, Gerald, Helga, Phoebe, Harold, Eugene.
  - `color_of_hair` : blonde, black, blonde, black, unknown, red.
  - `Height` : average, tallish, tallish, short, tall, short.
  - `Football_Shaped_Head` : True, False, False, False, False, False.

- You'll note that the above column names are inconsistent and difficult to work with. Rename them to the following, respectively:
  - `Character`, `Hair Color`, `Height`, `Football Head`

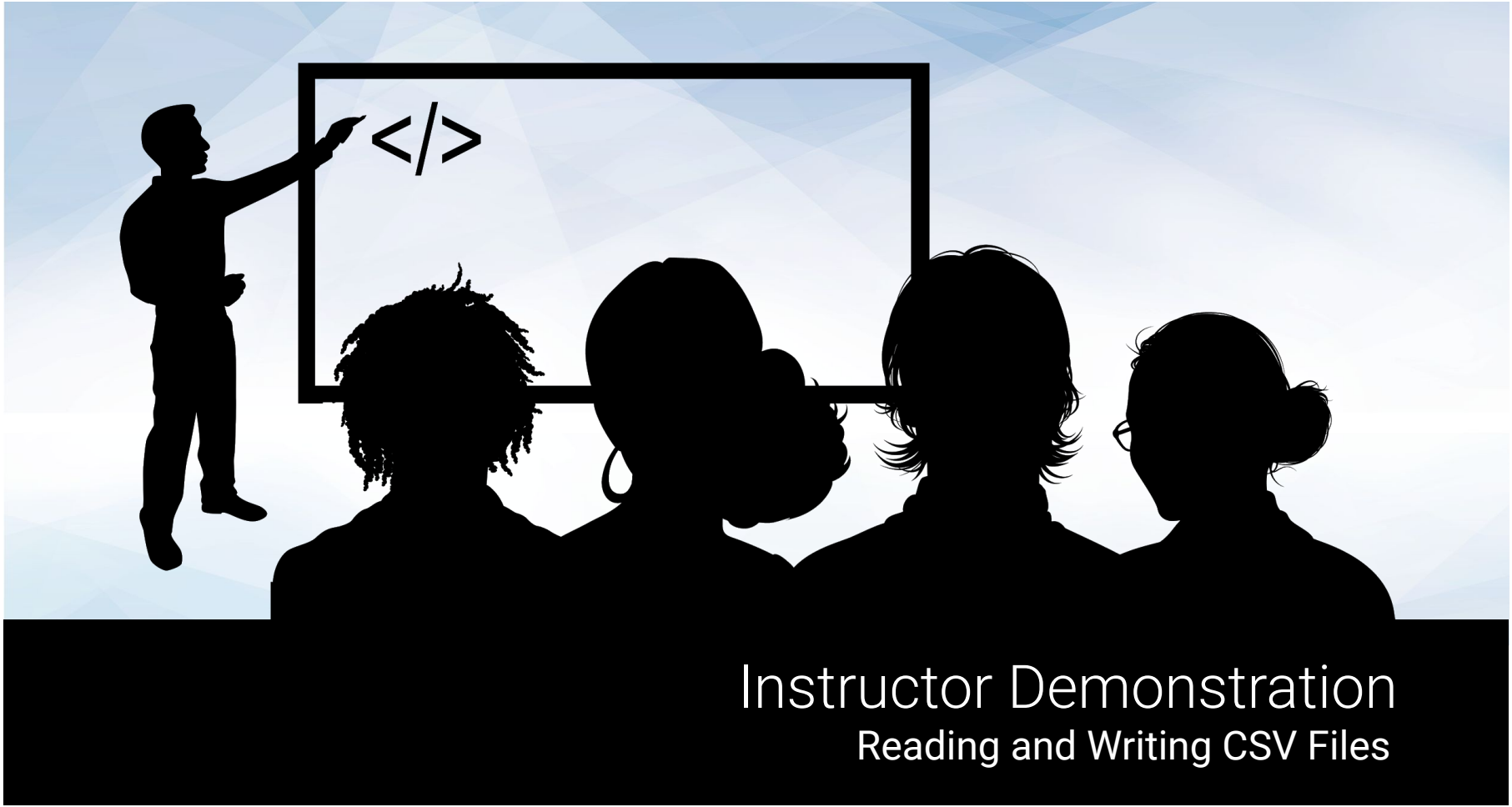
- Next, create a new table that contains all of the columns in the following order...
  - `Character`, `Football Head`, `Hair Color`, `Height`

Time’s Up! Let’s Review.

Countdown timer

15:00

(with alarm)



Instructor Demonstration

Reading and Writing CSV Files

Reading and Writing CSV Files

- A CSV file's path can be created and passed into the `pd.read_csv()` method, making certain to store the returned DataFrame within a variable.

```
In [3]: # Read our Data file with the pandas library
        # Not every CSV requires an encoding, but be aware this can come up
        file_one_df = pd.read_csv(file_one, encoding="ISO-8859-1")
```

```
In [4]: # Show just the header
        file_one_df.head()
```

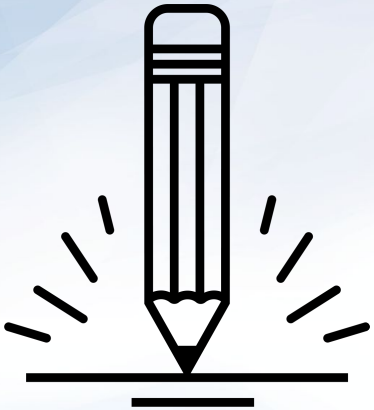
Out[4]:

	id	first_name	last_name	email	gender
0	1	David	Jordan	djordan0@home.pl	Male
1	2	Stephen	Riley	sriley1@hugedomains.com	Male
2	3	Evelyn	Grant	egrant2@livejournal.com	Female
3	4	Joe	Mendoza	jmendoza3@un.org	Male
4	5	Benjamin	Rodriguez	brodriguez4@elpais.com	Male

Reading and Writing CSV Files

- It is just as easy to write to a CSV file as it is to read from one. Simply use the `df.to_csv()` method, passing the path to the desired output file. By using the index and header parameters, programmers can also manipulate whether they would like the index or header for the table to be passed as well.

In [8]:
```
# Export file as a CSV, without the Pandas index, but with the header
file_one_df.to_csv("Output/fileOne.csv", index=False, header=True)
```



Activity: GoodReads Part I

In this activity, you will take a large CSV of books, read it into Jupyter Notebook using Pandas, clean up the columns, and then write their modified DataFrame to a new CSV file.

Suggested Time:
20 Minutes

Activity: GoodReads Part I

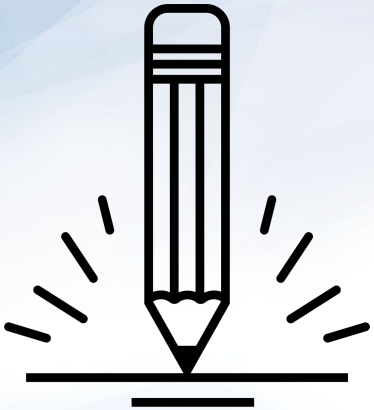
Instructions:

- Read in the GoodReads CSV using Pandas.
- Remove unnecessary columns from the DataFrame so that only the following columns remain: `isbn`, `original_publication_year`, `original_title`, `authors`, `ratings_1`, `ratings_2`, `ratings_3`, `ratings_4`, and `ratings_5`
- Rename the columns to the following: `ISBN`, `Publication Year`, `Original Title`, `Authors`, `One Star Reviews`, `Two Star Reviews`, `Three Star Reviews`, `Four Star Reviews`, and `Five Star Reviews`
- Write the DataFrame into a new CSV file.

- **Hints**:

  - The base CSV file uses UTF-8 encoding. Trying to read in the file using some other kind of encoding could lead to strange characters appearing within the dataset.

Time’s Up! Let’s Review.



Activity: GoodReads - Part II

In this activity, you will take the modify version of the GoodReads DataFrame and create a new summary DataFrame based upon that dataset using some of Pandas' built-in data functions.

Suggested Time:
20 Minutes

Activity: GoodReads Part II

Instructions:

- Using the modified DataFrame that was created earlier, create a summary table for the dataset that includes the following pieces of information...
- The count of unique authors within the DataFrame.
- The year of the earliest published book in the DataFrame.
- The year of the latest published book in the DataFrame.
- The total number of reviews within the DataFrame.

Time’s Up! Let’s Review.


The End