Lecture 3

Data Collection I: `DataFrame`; Spyder IDE; Scrapping Web-tables with `pd.read_html()`

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🐼 Pandas `Series` and `DataFrame`

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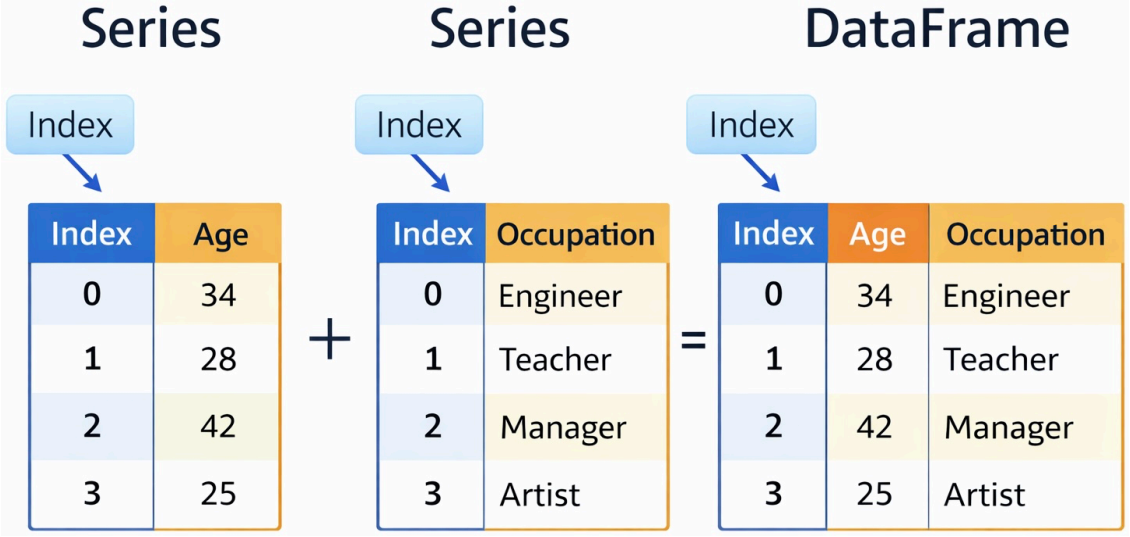


- `Series`: A one-dimensional object containing a sequence of values (like a list).
- `DataFrame`: A two-dimensional table made of multiple `Series` columns sharing a common *index*.

🧐 Observations in `DataFrame`

- **Rows** in a `DataFrame` represent individual units or entities for which data is collected.
- **Examples**:
  - *Student Information*: Each row = one student
  - *Employee Information*: Each row = one employee
  - *Daily S&P 500 Index Data*: Each row = one trading day
  - *Household Survey Data*: Each row = one household

Variables in `DataFrame`

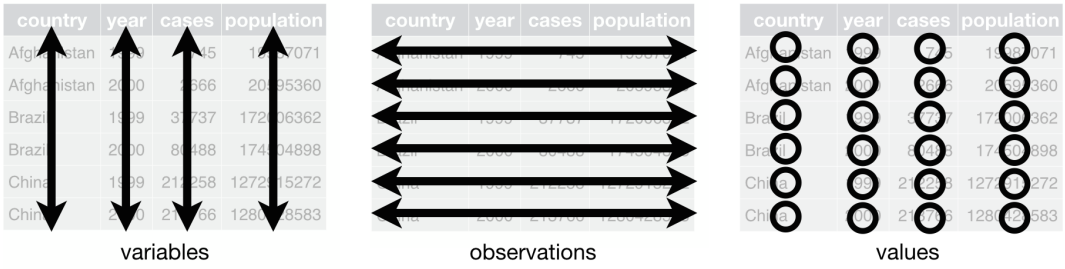
- **Columns** in a `DataFrame` represent attributes or characteristics measured across multiple *observations*.
- **Examples**:
  - *Student Data*: `Name`, `Age`, `Grade`, `Major`
  - *Employee Data*: `EmployeeID`, `Name`, `Age`, `Department`
  - *Customer Data*: `CustomerID`, `Name`, `Age`, `Income`, `HousingType`

Note

- In a `DataFrame`, a **variable** is a **column** of data.
- In general programming, a **variable** is the **name of an object**.

✨ Tidy `DataFrame`

Variables, Observations, and Values



- A `DataFrame` is *tidy* if it follows three rules:
  1. Each **variable** has its own *column*.
  2. Each **observation** has its own *row*.
  3. Each **value** has its own *cell*.
- A tidy `DataFrame` keeps your data organized, making it easier to understand, analyze, and share in any data analysis.

Spyder IDE

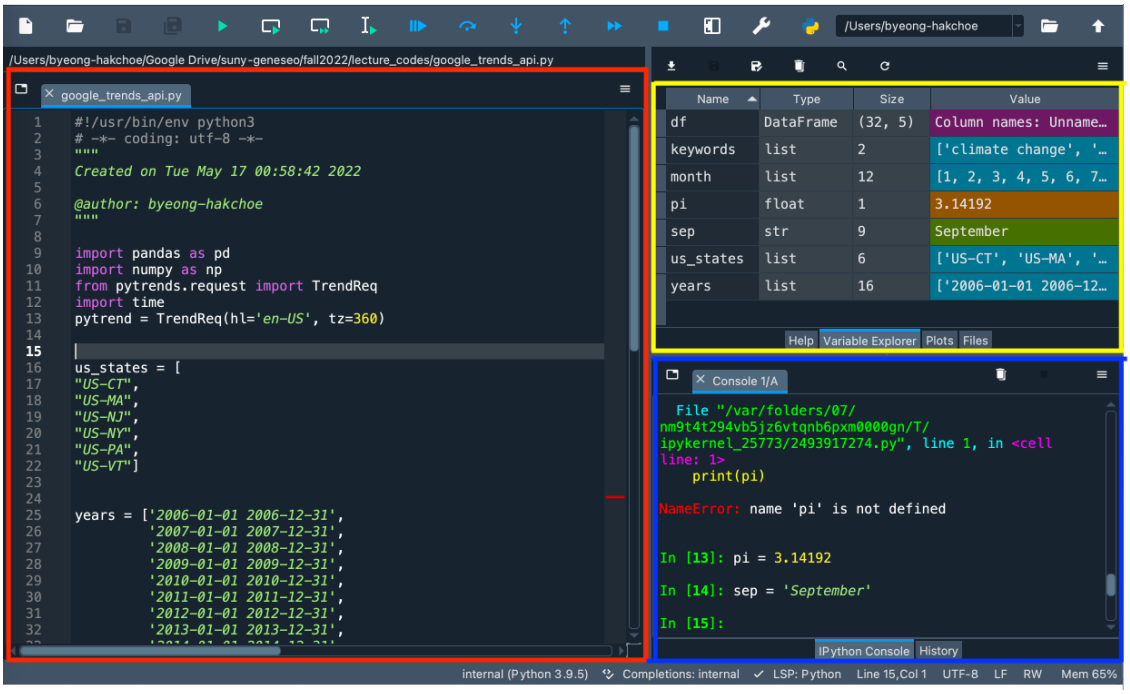
🟢 Anaconda Distribution

- **Anaconda is a free Python distribution** that includes Python, Conda (Python environment manager), and many commonly used data analytics packages.
- Install Anaconda from the official download page:
  - **Anaconda Distribution**
  - Click **Get Started**, then follow the installer steps for your operating system.

What is a Python Script?

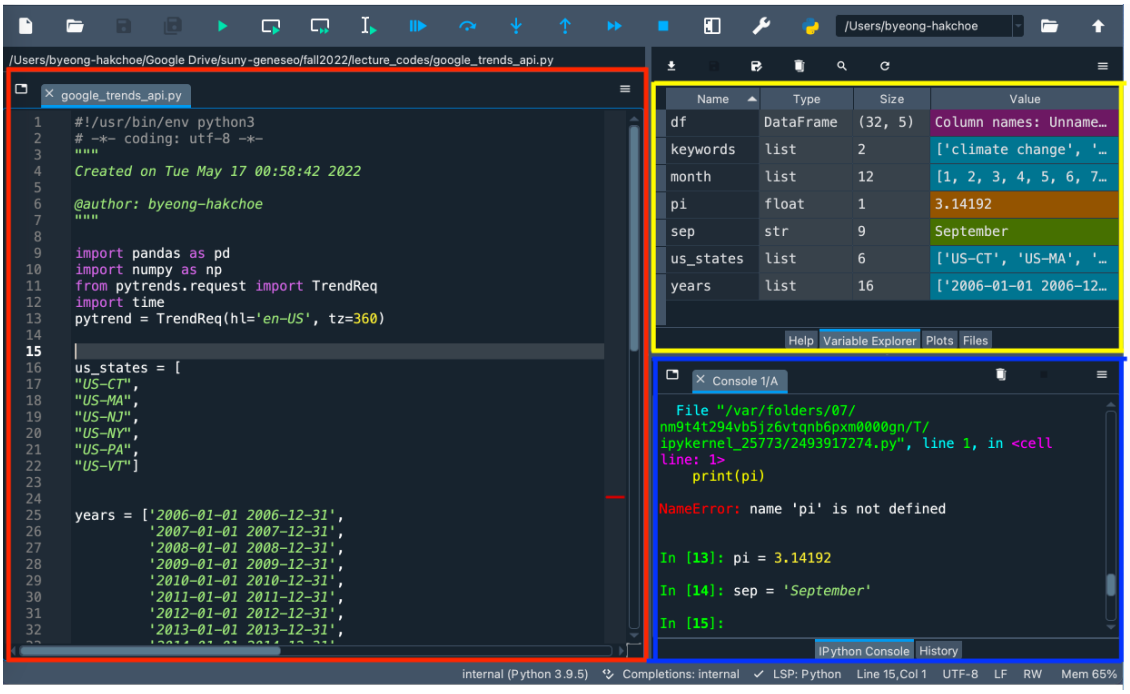
- A Python script (`*.py`) is a plain-text file that contains Python code you can run from your computer (or an IDE like Spyder).
  - It is the standard format for writing **reusable Python programs**, such as data-cleaning pipelines, web scrapers, and automation tasks.
  - Scripts are commonly used in real-world analytics and software projects.
  - Compared to notebooks, scripts are typically better for **organized, production-style code** (functions, modules, and repeatable workflows).
- For **data collection** topics, we will write and run Python scripts mainly in **Spyder**, using **Anaconda Distribution** as our Python environment.

Script Editor



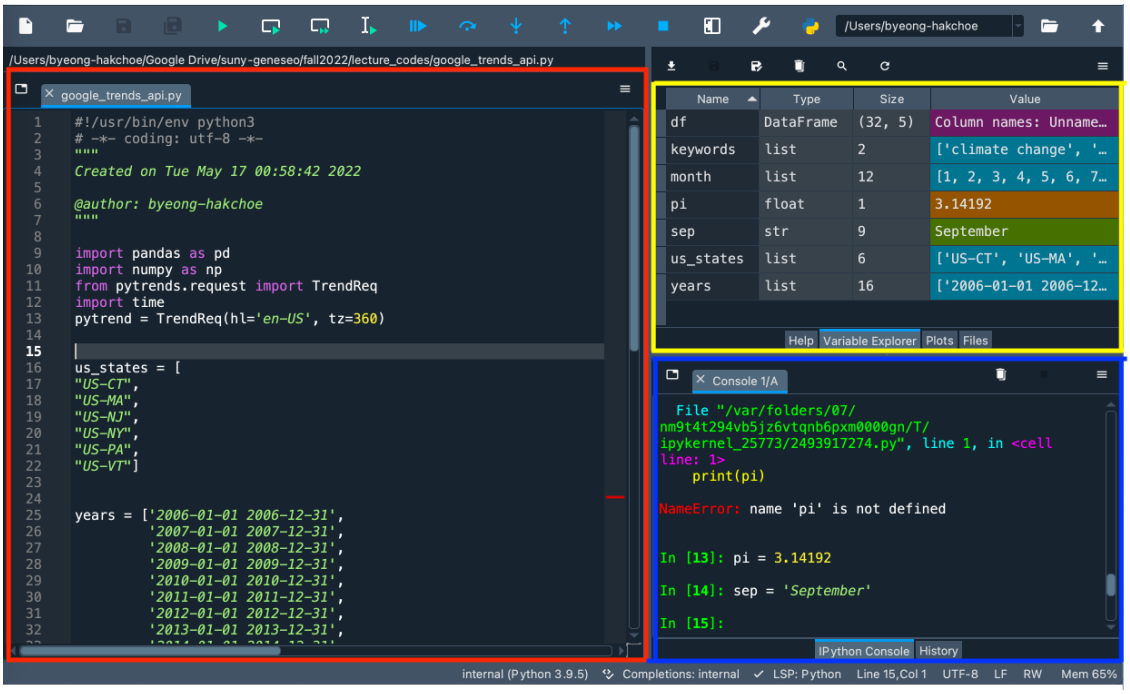
- From **Script Editor** (red box), we can create, open and edit files.

Console Pane



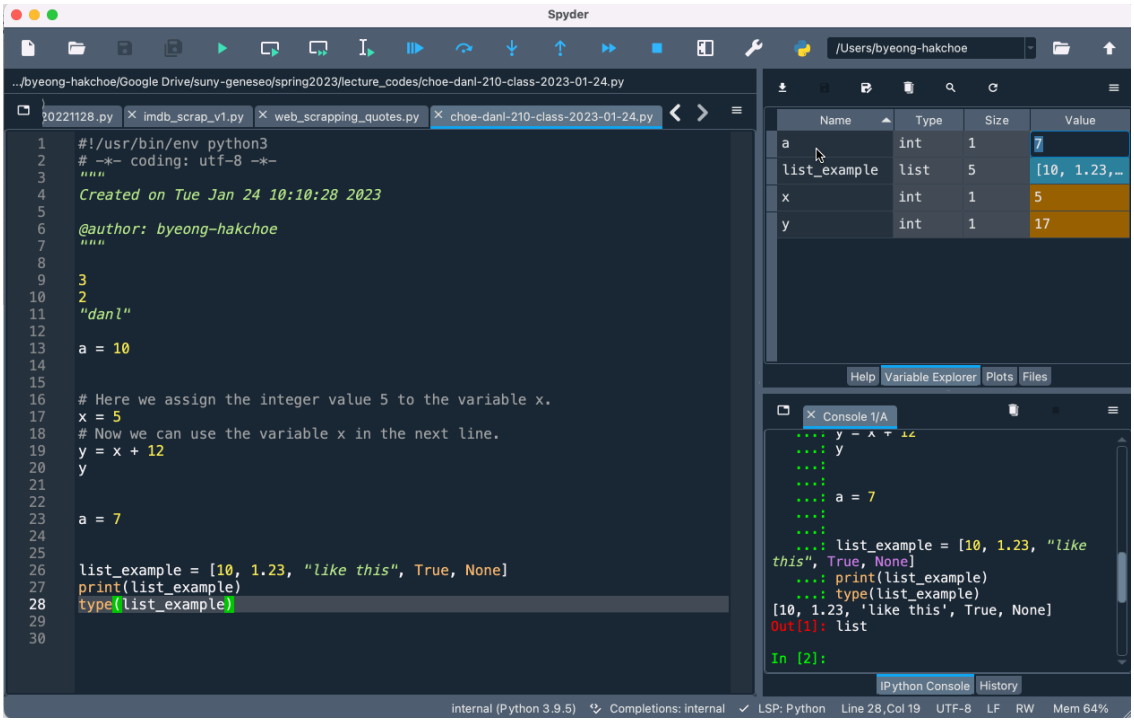
- From **Console Pane** (blue box), we can interact directly with the Python interpreter, and type commands where Python will immediately execute them.

🔍 Variable Explorer



- From **Variable Explorer** (yellow box), we can see the values of variables, data frames, and other objects that are currently stored in memory.

📦 Data Containers in Variable Explorer



- If we doucle-click the objects such as `list` and `DataFrame` objects, we can see what data are contained in such objects.

⌨️ Keyboard Shortcuts

- General shortcuts
  - **Undo**: Ctrl + z (command + z for Mac users)
  - **Redo**: Ctrl + Shift + z (command + shift + z for Mac users)
  - **Selection**: Ctrl + Shift + Arrow (⬆️ ➡️ ⬇️ ⬅️)
  - **Page Up/Down**: Fn + ⬆️ / ⬇️
- Default shortcuts
  - **Comment (#)**: Ctrl + 1 (command + 1 for Mac users)
  - **Block-comment**: Ctrl + 4 (command + 4 for Mac users)
  - **Run selection** (or **a current line**): F9
  - **Run cell**: Ctrl + Enter (# %% defines a **cell**)

💬 Comments, Code Cells, and Keyboard Shortcuts

```
# %%
# ============================================================================
# SECTION TITLE
# ============================================================================
a = 1
```

- The # mark is Spyder's **comment** character.
- It is recommended to use a **coding block** (defined by # %%) with **block commenting** (Ctrl/command + 4) for separating code sections.
- To set your keyboard shortcuts,
  - **Preferences** > **Keyboard Shortcuts** > **Search "run"** and/or **"comment"**
  - Set the shortcuts for (1) run selection; (2) run cell; (3) toggle comment; and (4) blockcomment
  - I use **command + return** for **running a current line (selection)**

🌐 Scrapping web tables with `pd.read_html()`

🌍 Scrapping Tables with `pd.read_html()`

- Let's scrap the two tables in the following webpage:
  - **National Park Visitation Sets New Record as Economic Engines**

```
1 import pandas as pd
2
3 url = "https://www.nps.gov/orgs/1207/national-park-visitation-sets-new-record-as-ec
4 tables = pd.read_html(url)
5 len(tables)
6 df_0 = tables[0]
```

- `read_html()` read HTML tables into a **list** of `DataFrame` objects.

🏷️ Setting Column Names

- How can we set the **first row** of a DataFrame as its **column names**?
- How can we **remove** the first row ?

```
df_0 = tables[0]
df_0.columns = df_0.iloc[0]  # Set the first row as column names
df_0 = df_0.iloc[1:]  # Keeps rows from position 1 onward
```

✅ *What is `DataFrame.iloc[]`?*

- **`DataFrame.iloc[...]`** is **integer-location indexing**:
  - It selects **rows by position** (0, 1, 2, …), not by index labels.
  - **Slicing works with `DataFrame.iloc[]`**
- `df_0.iloc[0]` returns the **first row** (position 0) as a **Series**.

⚙️ Dot Operators, Methods, and Attributes

⚫ Dot operator

- The dot operator (`DataFrame.`) is used for an **attribute** or a **method** on objects.

🛠️ Method

- A method (`DataFrame.METHOD()`) is a **function** that we can call on a `DataFrame` to perform operations, modify data, or derive insights.
  - e.g., `df.info()`

🏷️ Attribute

- An attribute (`DataFrame.ATTRIBUTE`) is a **property** that provides information about the `DataFrame`'s structure or content without modifying it.
  - e.g., `df.columns`

Getting a Summary of a `DataFrame`

```
df_0.info()     # method
df_0.count()    # method
```

```
df_0.shape      # attribute
df_0.columns    # attribute
```

- Every `DataFrame` object has a `.info()` method that provides a summary of a DataFrame:
  - Variable names (`.columns`)
  - Number of observations and variables (`.shape`)
  - Number of non-missing values in each variable (`.count()`)
    - Pandas often displays missing values as `NaN`.

📍 Absolute Pathnames

- An **absolute pathname** tells the computer the *exact location* of a file, starting from the very top folder of your computer.
  - This location never changes, no matter where you are working in Python.
- In Python, you can see the **working directory** — the folder where Python is currently "looking" for files — by running `os.getcwd()` in the **Console**.
- **Examples of an absolute pathname for `custdata_rev.csv`:**
  - On a Mac:
    `/Users/user/documents/data/custdata_rev.csv`
  - On Windows:
    `C:\\Users\\user\\Documents\\data\\custdata_rev.csv`
    - Note: In Windows, we use **double backslashes (`\\`)** because a single backslash (`\`) is treated as a special character in Python.

🔗 Relative Pathnames

- A **relative pathname** specifies the location of a file *relative to the working directory*.
- **Examples of a relative pathname for `custdata_rev.csv`:**
  - Absolute pathname: `/Users/user/documents/data/custdata_rev.csv`
  - Working directory: `/Users/user/documents/`
  - Relative pathname: `data/custdata_rev.csv`

📍📁 Finding the Absolute Path of a File/Folder

Windows 11

- **Step 1:** Navigate to your folder using File Explorer.
- **Step 2:** Right-click the desired file or folder.
- **Step 3:** Click **Copy as path**.
- **Step 4:** Paste the path into your Python script (**Ctrl + V**).
- **Step 5:** Adjust backslashes in the path:
  - **Option 1:** Replace backslashes (\) with forward slashes (/).
  - **Option 2:** Replace single backslashes (\) with double backslashes (\\).

Mac

- **Step 1:** Navigate to your folder using Finder.
- **Step 2:** Select the file or folder by clicking on it.
- **Step 3:** Copy the path (**Option + Command + C**).
- **Step 4:** Paste the path into your Python script (**Command + V**).

CSV Files

- A **CSV** (comma-separated values) file is a plain text file where each value is separated by a *comma*.
  - CSV files are widely used for storing data from spreadsheets and databases.

- **Example**
  - `https://bcdanl.github.io/data/tvshows.csv`

💾 Exporting a `DataFrame` as a CSV File with `to_csv()`

- To export `DataFrame` as a **CSV** file, we use the `to_csv()` method.
  - Before exporting, you can set the **working directory (WD)** to organize and manage the location of CSV files.
  - Create a `data` directory within your **WD**. This helps in keeping your data analysis and exports well-organized.

```
# Import the os module to interact with the operating system
import os

# Set the working directory path
wd_path = 'ABSOLUTE_PATHNAME_OF_YOUR_WORKING_DIRECTORY' # e.g., '/Users/bchoe/Docum
os.chdir(wd_path)  # Change the current working directory to wd_path
os.getcwd()  # Retrieve and return the current working directory

# index=False to not write the row index in the CSV output
df_0.to_csv('data/table.csv', index =False)
```

Scrapping Tables with `pd.read_html()`

Let's do **Classwork 3**!