Lecture 3

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

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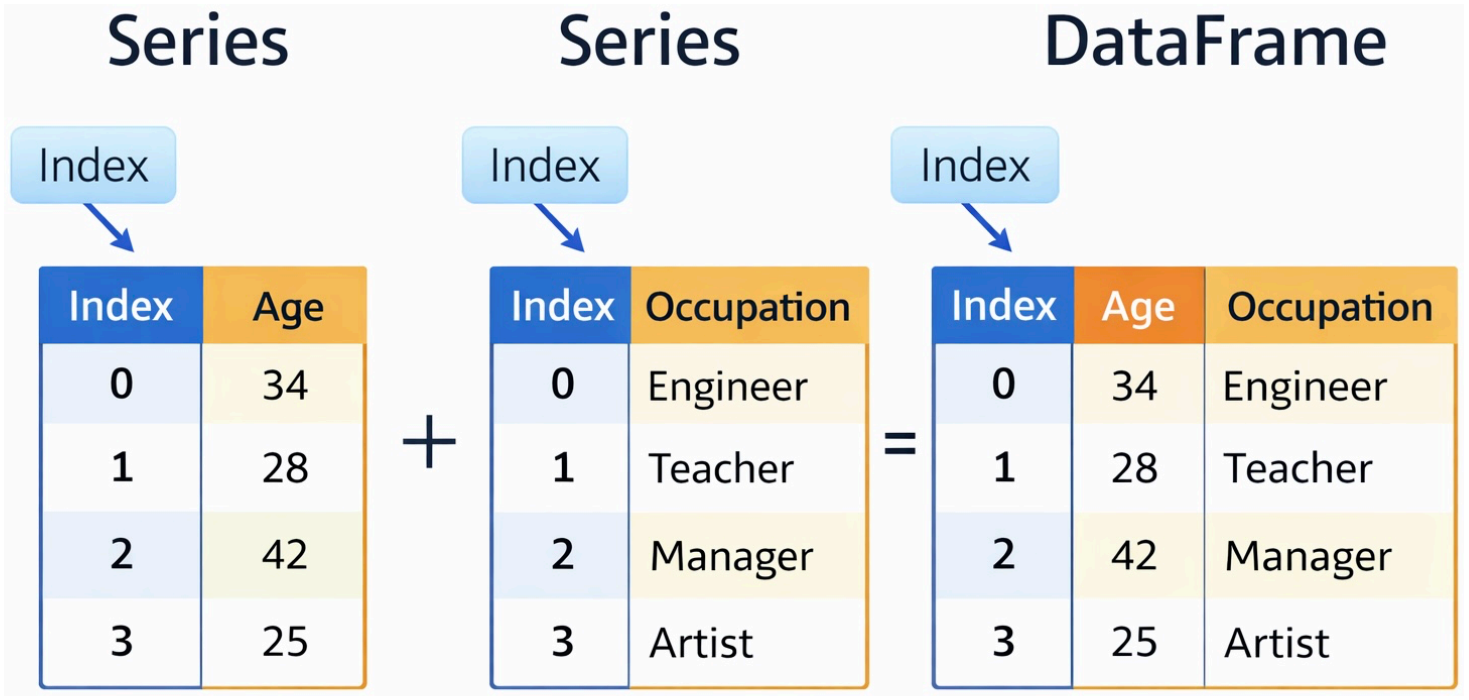
🐼 Pandas `Series` and `DataFrame`

Pandas `Series` and `DataFrame`



Index	Age
0	34
1	28
2	42
3	25

Index	Occupation
0	Engineer
1	Teacher
2	Manager
3	Artist

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0	34	Engineer
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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`

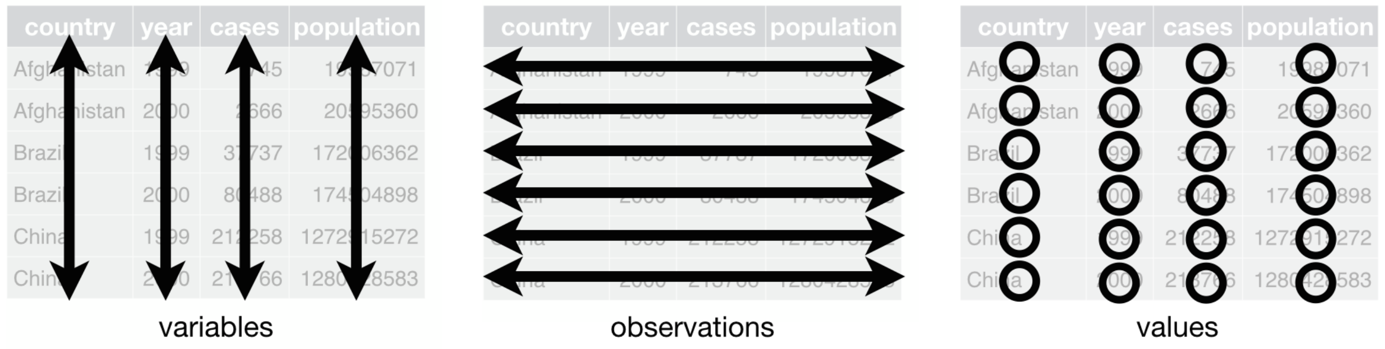
- **Columns** in a `DataFrame` represent attributes or characteristics measured across multiple *observations*.
- **Examples**:
  - *Student Data*: `Name`, `Age`, `Grade`, `Major`
  - *Employee Data*: `EmployeeID`, `Name`, `Age`, `Department`
  - *Customer Data*: `CustomerID`, `Name`, `Age`, `Income`,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

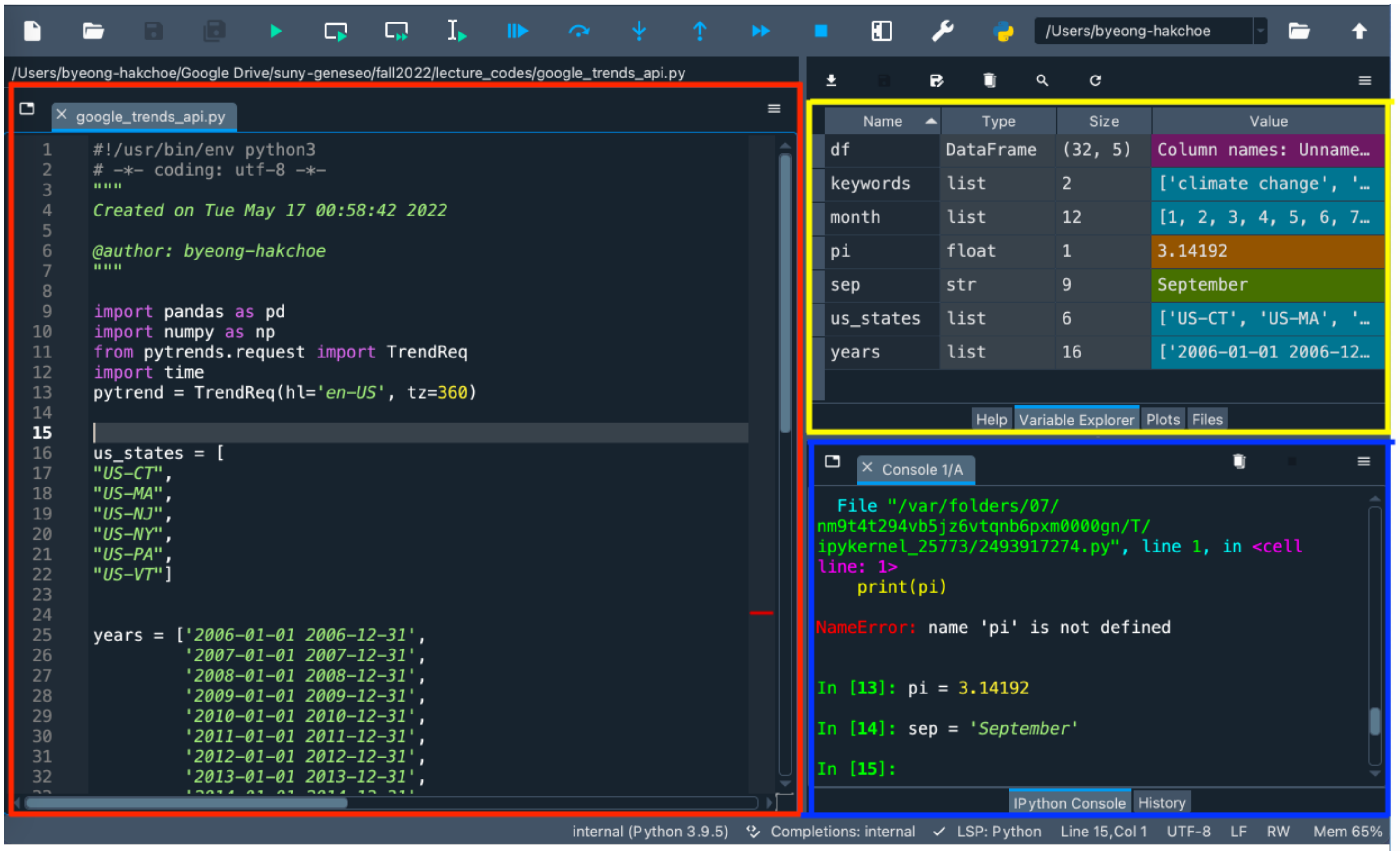
🟢 Anaconda Distribution

- **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



/Users/byeong-hakchoe/Google Drive/suny-geneseo/fall2022/lecture_codes/google_trends_api.py

```
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
Created on Tue May 17 00:58:42 2022

@author: byeong-hakchoe
"""

import pandas as pd
import numpy as np
from pytrends.request import TrendReq
import time
pytrend = TrendReq(hl='en-US', tz=360)

|
us_states = [
"US-CT",
"US-MA",
"US-NJ",
"US-NY",
"US-PA",
"US-VT"]


years = ['2006-01-01 2006-12-31',
         '2007-01-01 2007-12-31',
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         '2011-01-01 2011-12-31',
         '2012-01-01 2012-12-31',
         '2013-01-01 2013-12-31',
```

Name	Type	Size	Value
df	DataFrame	(32, 5)	Column names: Unname…
keywords	list	2	['climate change', '…
month	list	12	[1, 2, 3, 4, 5, 6, 7…
pi	float	1	3.14192
sep	str	9	September
us_states	list	6	['US-CT', 'US-MA', '…
years	list	16	['2006-01-01 2006-12…

```
  File "/var/folders/07/
nm9t4t294vb5jz6vtqnb6pxm0000gn/T/
ipykernel_25773/2493917274.py", line 1, in <cell
line: 1>
    print(pi)

NameError: name 'pi' is not defined


In [13]: pi = 3.14192

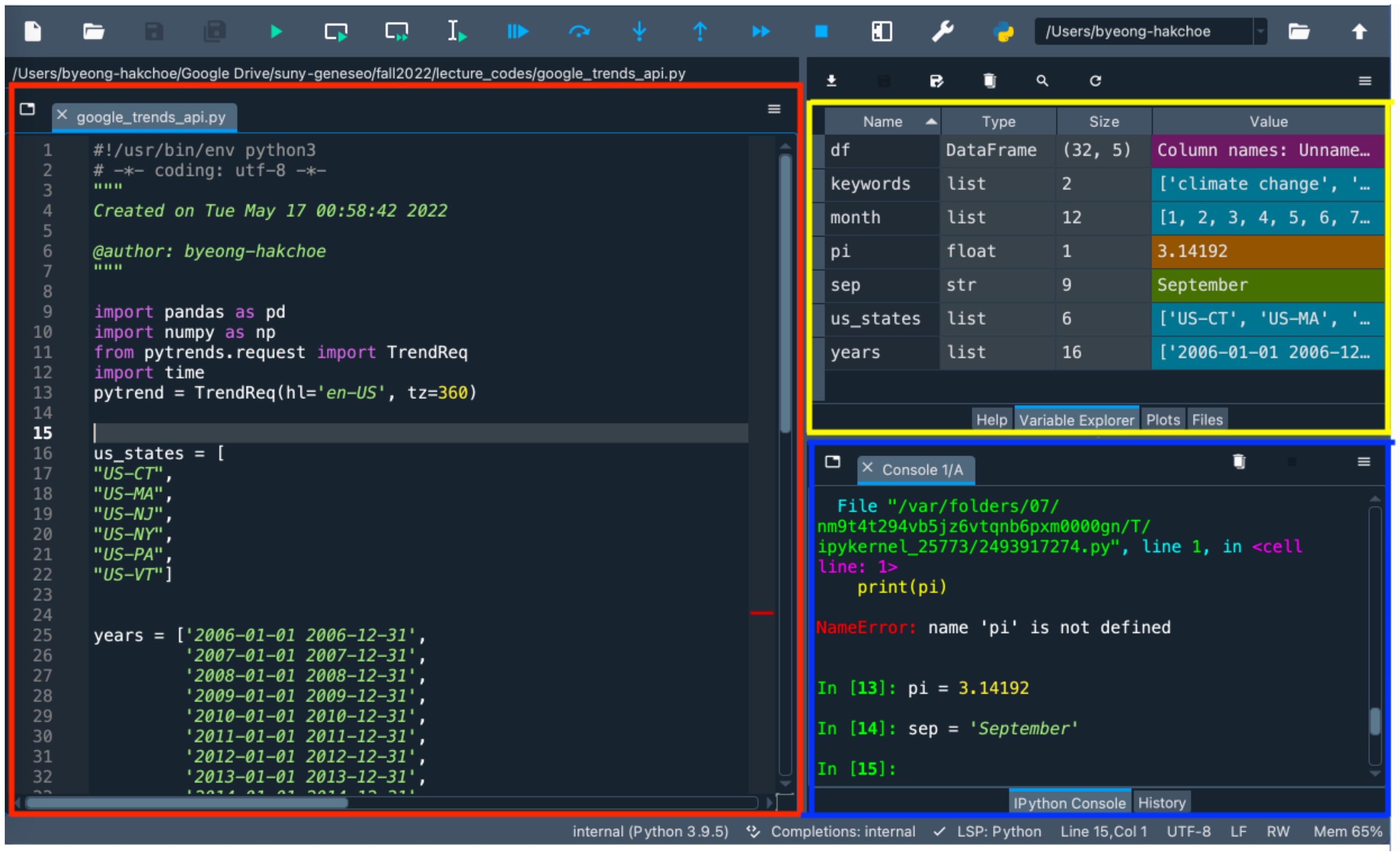
In [14]: sep = 'September'

In [15]:
```

internal (Python 3.9.5) Completions: internal LSP: Python Line 15,Col 1 UTF-8 LF RW Mem 65%

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

Console Pane



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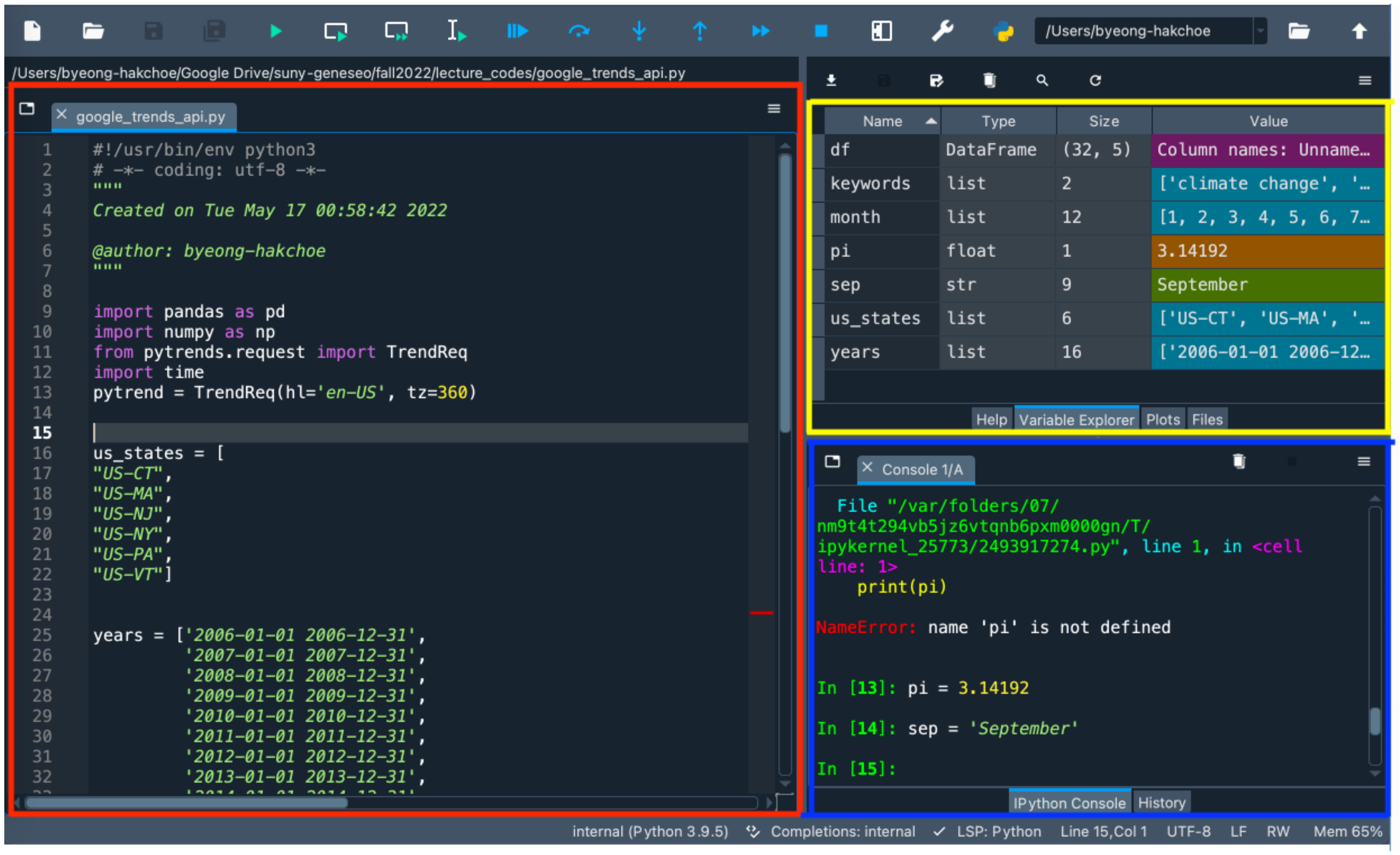
- From **Console Pane** (blue box), we can interact directly with the Python interpreter, and type commands where Python will immediately execute them.

🔍 Variable Explorer



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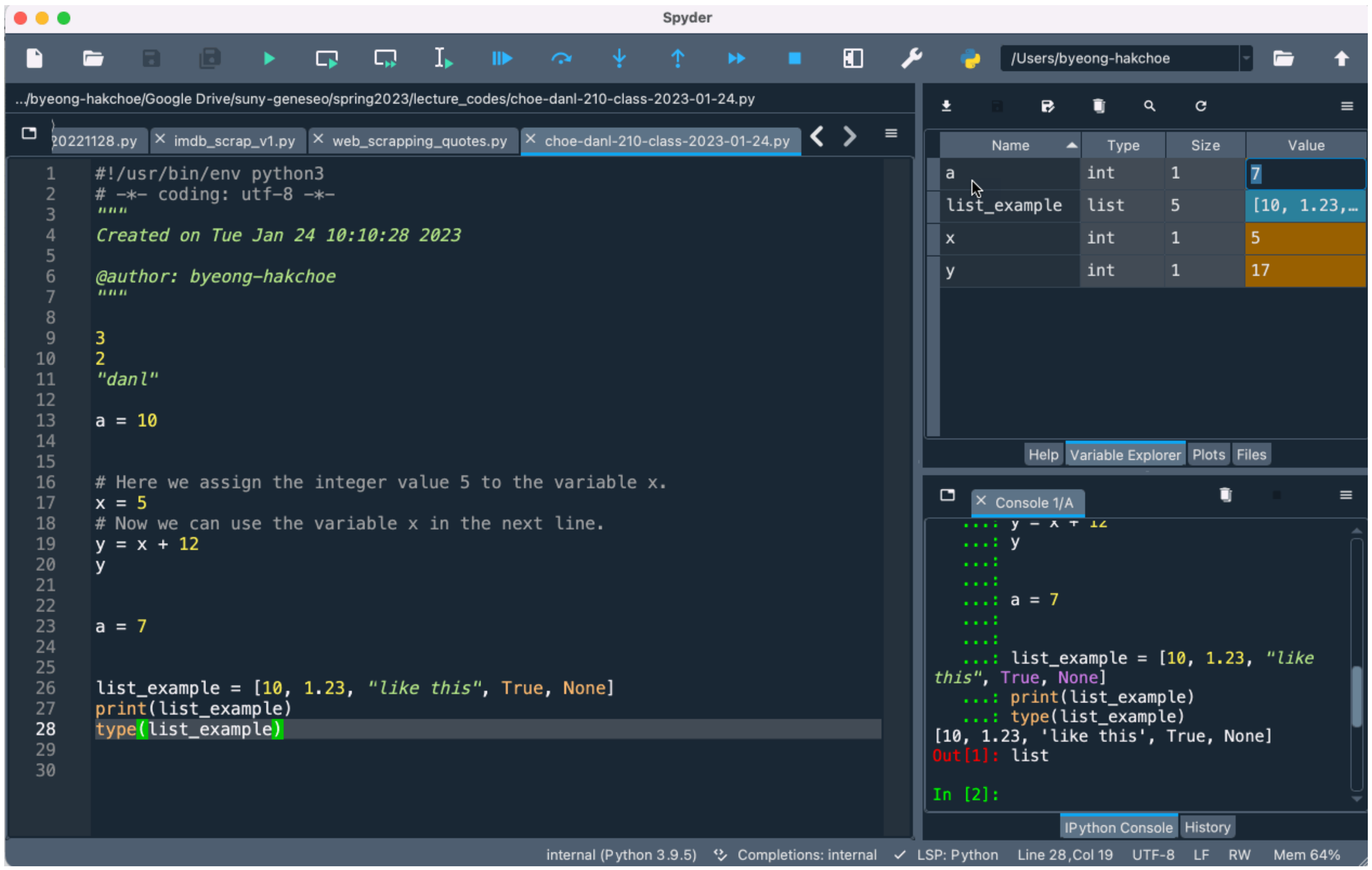
internal (Python 3.9.5)   Completions: internal   ✓ LSP: Python   Line 15,Col 1   UTF-8   LF   RW   Mem 65%
```

- 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



```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
Created on Tue Jan 24 10:10:28 2023

@author: byeong-hakchoe
"""

3
2
"danl"

a = 10


# Here we assign the integer value 5 to the variable x.
x = 5
# Now we can use the variable x in the next line.
y = x + 12
y


a = 7


list_example = [10, 1.23, "like this", True, None]
print(list_example)
type(list_example)
```

Name	Type	Size	Value
a	int	1	7
list_example	list	5	[10, 1.23,…
x	int	1	5
y	int	1	17

```
   ...: y = x + 12
   ...: y
   ...:
   ...:
   ...: a = 7
   ...:
   ...:
   ...: list_example = [10, 1.23, "like
this", True, None]
   ...: print(list_example)
   ...: type(list_example)
[10, 1.23, 'like this', True, None]
Out[1]: list

In [2]:
```

- 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**

```python
import pandas as pd

url = "https://www.nps.gov/orgs/1207/national-park-visitation-sets-new-record-as-ec
tables = pd.read_html(url)
len(tables)
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 ?

```python
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`

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

```python
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.

```python
# 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**!