TASK

Datasets and DataFrames

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Introduction

WELCOME TO THE DATASETS AND DATAFRAMES TASK!

In the context of this task, when we refer to a dataset, we are referring to a collection of related data. This data can be manipulated in various ways programmatically. In this task, you will be using Pandas DataFrames to manipulate data.

JUPYTER

In this task, you will be using the Jupyter Notebook. This tool is **described as follows**: "The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualisations and narrative text. Uses include data cleaning and transformation, numerical simulation, statistical modelling, data visualisation, machine learning, and much more."

To use this tool, do the following:

1. **Install Jupyter**

   ● **Option 1: Installing Jupyter with pip**

   First, ensure that you have the latest pip; older versions may have trouble with some dependencies:

   ```
   pip3 install --upgrade pip
   ```

   Then install the Jupyter Notebook using:

   ```
   pip3 install jupyter
   ```

   ● **Option 2: Installing Jupyter using Anaconda**

   ○ Download **Anaconda**. We recommend downloading Anaconda's latest Python 3 version.

   ○ Install the version of Anaconda which you downloaded, following the instructions on the download page.

2. **Run the Jupyter Notebook**

   Once you have installed Jupyter, you can start the notebook server from the command line:

```
jupyter notebook
```

This will print some information about the notebook server in your terminal, including the URL of the web application. The notebook will then open in your browser.

Once the notebook has opened, you should see the dashboard showing the list of notebooks, files, and subdirectories in the directory you've opened. You can see an example of a Jupyter Notebook below:


To start a new notebook, click the **New** drop-down menu and click on **Python 3**.
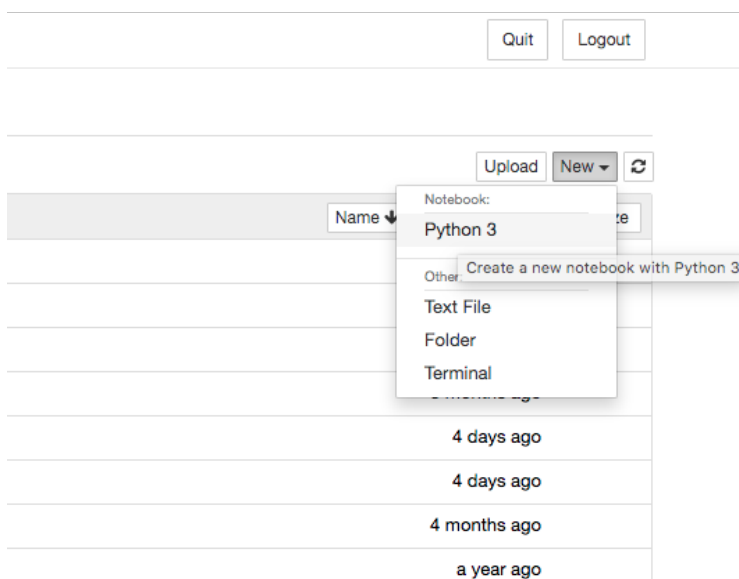
A new Jupyter notebook will look like the screenshot below. Make sure to change the name of the notebook to Data Sources.
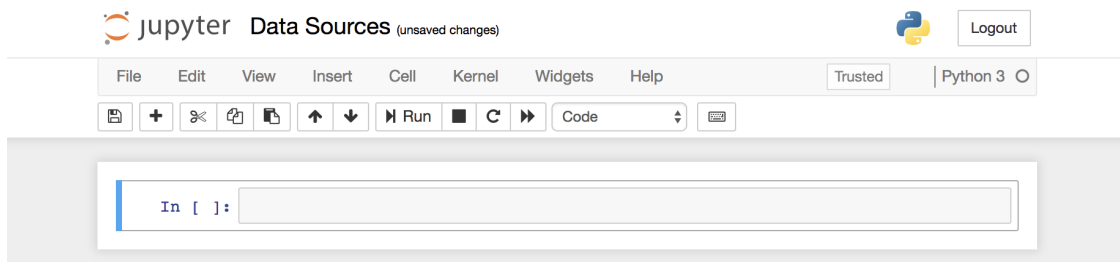
In Jupyter notebooks you can specify whether a cell contains code or Markdown. Markdown is a lightweight Markup language that is used to embed documentation or other textual information between code cells.
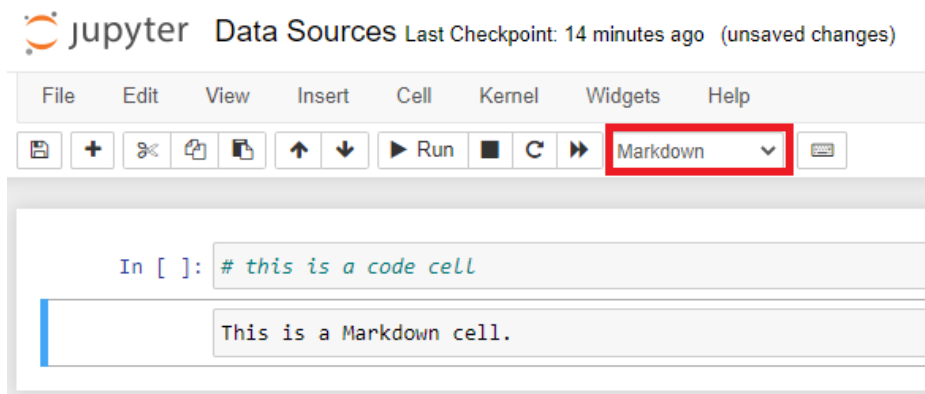
WHAT IS A PANDAS DATAFRAME?

The **pandas' library documentation** defines a DataFrame as a "two-dimensional, size-mutable, with labelled rows and columns".

Anatomy of a DataFrame

Image source: (Petrou, 2017)

In simple terms, think of a DataFrame as a table of data with the following characteristics (Lynn, 2018):

- "There can be multiple rows and columns in the data.
- Each row represents a sample of data,
- Each column contains a different variable that describes the samples (rows).
- The data in every column is usually the same type of data – e.g. numbers, strings, dates.
- Usually, unlike an Excel data set, DataFrames avoid having missing values, and there are no gaps and empty values between rows or columns."

You can read data from a .csv file into a DataFrame using the **read_csv()** function as shown below:

```
insurance_df = pd.read_csv("insurance.csv")
```

There are also other functions that can be used to read data from different sources into a pandas DataFrame. For example, **read_excel()** can be used to read data from an Excel spreadsheet file and **read_sql()** can be used to load data from a SQL database. Sometimes it is easier to extract data from other sources into a .csv file and then read it into a DataFrame.

SELECTING COLUMNS IN PANDAS

There are many ways to specify columns in pandas. The simplest way is to use dictionary notation for specific columns. In essence, pandas Dataframes can be thought of as dictionaries. The key is the column name and the value is the corresponding column values.

```
# Select only the species column
just_the_species = iris_df['species']
just_the_species.sample(5)
```

To select multiple columns, you simply need to specify a list of strings with each column name:

```
# Select columns with sepal and petal information
sepal_and_petal_info = iris_df[['sepal_length', 'sepal_width',
'petal_length', 'petal_width']]
sepal_and_petal_info.sample(5)
```

You can also choose specific values to be included in your search (i.e. omit certain rows from the results).

```
# Filter for specific values in a column
small_sepal_length = iris_df[iris_df['sepal_length'] < 4.8]
small_sepal_length.sample(5)
```

In essence, we are filtering the dataset for all entries where the `sepal_length` is less than 4.8.

BUILT-IN DATAFRAME METHODS

When attempting to gain insight into your data, it is often helpful to leverage built-in methods to process your data — for example, finding the mean or total of a column.

Here is a list of common build-in computational and statistical methods in pandas:

- **mean()**: mean for each column
- **min()**: minimum for each column
- **max()**: maximum for each column
- **std()**: standard deviation for each column
- **var()**: variance for each column
- **nunique()**: number of unique values in each column
- **count()**: number of cells for each column or row that are not empty or undefined (e.g. NaN)
- **sum()**: sum of values for each column or row

Explore the panda's documentation for a list of all methods relating to general computations and descriptive statistics.

GROUPING IN PANDAS

Data analysis can sometimes get complicated, and more advanced functionality is needed. Let's say you want to average the insurance charges of all people between the ages of 30 and 35. This can be done quite easily using:

```python
# Get people in the 30-35 age group
between_30_and_35 = insurance_df[(insurance_df['age'] > 30) &
(insurance_df['age'] < 35 )]

# Print mean charges for all people in the 30-35 age group
print(between_30_and_35['charges'].mean())
```

Alternatively, you can also use the pandas **DataFrame.query()** method that takes boolean strings as an argument as shown below:

```python
# Use the query method to get people in the 30-35 age group
between_30_and_35 = insurance_df.query("age > 30 and age < 35")

# Print mean charges for all people in the 30-35 age group
print(between_30_and_35['charges'].mean())
```

Now let's say you want to average the insurance charges of every person in each age group. This can still be done with the syntax you know, but it will take a lot of lines of code. This is bad because we want to keep our code simple and concise. Thankfully, pandas provide us with something that allows us to do this with one line of code:

```python
# Get the mean charges for each age
print(insurance_df.groupby('age')['charges'].mean())
```

This **groupby()** method tells the aggregation to work separately on each unique group specified.

For more information about working with Jupyter, please consult the first chapter ("**IPython: Beyond Normal Python**") in the book entitled, "**Python Data Science Handbook**" by Jake VanderPlas.

Extra resource

Instructions

- Follow the instructions in this task to install Jupyter Notebook.
- In your command line interface, change directory (**cd**) to the current folder.
- Open Jupyter Notebook by typing: `jupyter notebook`
- Within this task folder, you will find Jupyter notebook examples. You can open and explore them by going to Jupyter's home screen and double-clicking on the notebook.

  - **Dataset_Examples.ipynb** for Practical Task 1.
  - **Report_Example.ipynb** for Practical Task 2.

Practical Task 1

Open the **Datasets Task.ipynb** file and complete the following tasks in the notebook. Save your notebook to your task folder for submission.

1. Write the code that performs the action described in the following statements.
   a. Select the 'Limit' and 'Rating' columns of the first five observations
   b. Select the first five observations with 4 cards
   c. Sort the observations by 'Education'. Show users with a high education value first.
2. Write a short explanation in the form of a comment for the following lines of code.
   a. `df.iloc[:,:]`
   b. `df.iloc[5:,5:]`
   c. `df.iloc[:,0]`
   d. `df.iloc[9,:]`

Practical Task 2

Open and run the example file for this task in Jupyter Notebook before attempting this task. Follow these steps:

- Open the **Report.ipynb** in this folder.
- Create a DataFrame that contains the data in **balance.txt**.
- Write the code needed to produce a report that provides the following information:
    - Compare the average income based on ethnicity.
    - On average, do married or single people have a higher balance?
    - What is the highest income in our dataset?
    - What is the lowest income in our dataset?
    - How many cards do we have recorded in our dataset? (Hint: use **sum()**)
    - How many females do we have information for vs how many males? (Hint: use **count()**.

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REFERENCES

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