Python Package for World Wide Statistics Visualization

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Outline

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Motivation of this work

Many python packages for generating plots (matplotlib, plotly, etc.):

- Have lot of information to remember
- Have very long documentation
- Take time to get used to

What about aggregating all of these packages into one package that is :

- Task oriented
- Easy to use

Introduction

Quick Example

```python
from wwstatviz import Visualizer

v = Visualizer('/path/to/data.csv')
fig = v.choropleth(title = '...',
                   feature = 'GDP',
                   countries = ['FRA', 'USA', 'AFG', ...])
fig.save('/path/to/output_file.png')
```

```python
fig = v.heatmap(title = '...',
                features = 'all',
                countries = ['ALG', 'GER', 'SEN', ...])
fig.show() # for inline display (in browsers for example)
```

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API

Available plots in the current state are:

- choropleth: provides an easy way to visualize how an indicator varies accross a region;
- heatmap: used to visualize how correlated are variables;
- line plot: represents the time evolution of an indicator;
- histogram: plots the values of given indicators by country.

Package structure

```
wwstatviz
|-- __init__.py
|-- generators/
|   |-- __init__.py
|   |-- choropleth.py
|   |-- generator.py
|   |-- heatmap.py
|   `-- line.py
|-- io/
|   |-- __init__.py
|   |-- csvreader.py
|   |-- jsonreader.py
|   |-- iso.py
|   |-- reader.py
|   `-- writer.py
|-- figure.py
`-- visualizer.py
```

The Visualizer Class

Input Data

The constructor of the class takes as input a data file (in the CSV format):

- The first line must contain the header
- Each row must start with a country code (ISO-3166 2-digit or 3-digit)
- The columns represent the features of the data

Example:

```
,f1,f2,f3
AFG,0,1,2
BEL,5,4,3
FRA,6,7,8
SEN,12,13,14
USA,3,33,8
```

The Visualizer Class

Main functions

- The Visualizer class is the main interface of the API (it orchestrates the different tasks/actions).
- The constructor (__init__(self, data_path)) takes as inputs the path to the data file, and calls the corresponding reader from the "io" subpackage
- It contains functions (methods) for generating graphics (choropleth, histogram, etc.)
- These functions are simple calls to the Generators
- Each function returns a Figure object (for later use, show()/save())

Generators

About Generators:

- Generators are responsible for producing plots.
- Each generator should inherit from the base class “Generator” and must implement a “generate()” method
- The generator constructor takes as argument the different options to be used for generating the plots (e.g. whether or not to draw a legend, the countries to use, etc.)

Example:

```
class XYZGenerator(Generator): # class inheritance

    def __init__(self, ...): # this is the contructor
        ...

    # generate method must be implemented
    # and must return a figure
    def generate(self):
        ...
        return figure
```

Input/Output module

About the “io” module:

- The “io” module is responsible for:
  - reading data files from disk for different formats (csv, json, etc.)
  - writing generatred figures to disk
- It contains the base classes Reader and Writer
- For each data format, a reader submodule must be implemented
- Each reader submodule (e.g. csvreader) should implement a class that:
  - inherits from the base class “Reader”
  - implements a “read()” method

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Continuous Integration

- Automating integration of code changes
- From multiple collaborators
- Into a single project
- Avoid merge problems

Continuous Integration

wwstatviz

- Check requirements and install dependencies
- Test with pytest
- Check for PEP8

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Unit Testing

- **F**ast
- **I**solated
- **R**epetable
- **S**elf-validating
- **T**imely

Unit Tests

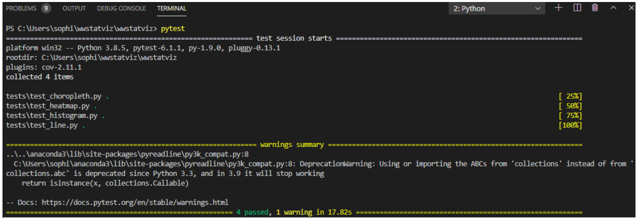
Unit Testing Using pytest

The tests are performed through assertions:

- Whether or not the figure is generated
- The instance of the generated plot (a matplotlib figure, a plotly figure, etc.)
- The writing of the generated figure in disk

Example:

```python
    v = Visualizer('/workspace/data/test_cc_3d.csv')
    fig = v.heatmap(title = 'This␣is␣a␣test␣heatmap',
                    xlabel = 'Countries', ylabel = 'Countries')
    assert fig.figure is not None
    assert isinstance(fig.figure, matplotlib.figure.Figure)
    fig.save('test_heatmap.png')
    assert Path('test_heatmap.png').is_file()
```



```
PS C:\Users\sophi\wwstatviz\wwstatviz> pytest
============================================================== test session starts ==============================================================
platform win32 -- Python 3.8.5, pytest-6.1.1, py-1.9.0, pluggy-0.13.1
rootdir: C:\Users\sophi\wwstatviz\wwstatviz
plugins: cov-2.11.1
collected 4 items

tests\test_choropleth.py .                                                                                                                 [ 25%]
tests\test_heatmap.py .                                                                                                                    [ 50%]
tests\test_histogram.py .                                                                                                                  [ 75%]
tests\test_line.py .                                                                                                                       [100%]

=============================================================== warnings summary ================================================================
..\..\anaconda3\lib\site-packages\pyreadline\py3k_compat.py:8
  C:\Users\sophi\anaconda3\lib\site-packages\pyreadline\py3k_compat.py:8: DeprecationWarning: Using or importing the ABCs from 'collections' instead of from '
collections.abc' is deprecated since Python 3.3, and in 3.9 it will stop working
    return isinstance(x, collections.Callable)

-- Docs: https://docs.pytest.org/en/stable/warnings.html
========================================================= 4 passed, 1 warning in 17.82s =========================================================
```

Figure: Unit Test Execution

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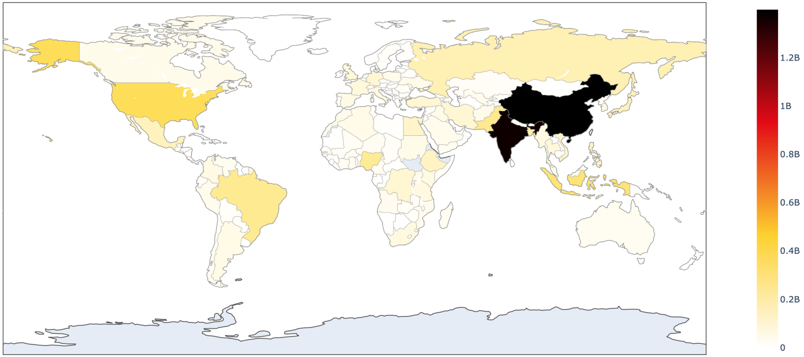
Choropleth

Generates a choropleth map of given list of countries and indicator.‘

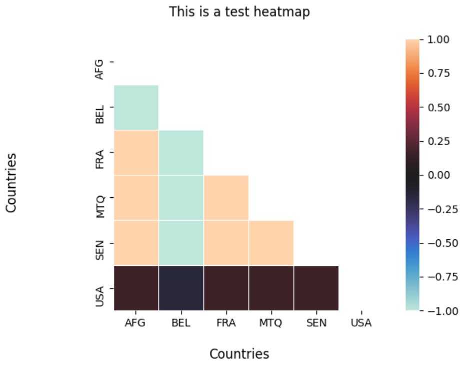
```
    v = Visualizer('path/to/file.csv')
    fig = v.choropleth(title = '...',
                       features = 'desired_feature',
                       countries = 'all')
    fig.show() # for inline display (in browsers for example)
```



Heatmap

Generates a heatmap correlation matrix and allows to show in a glance which countries are correlated.

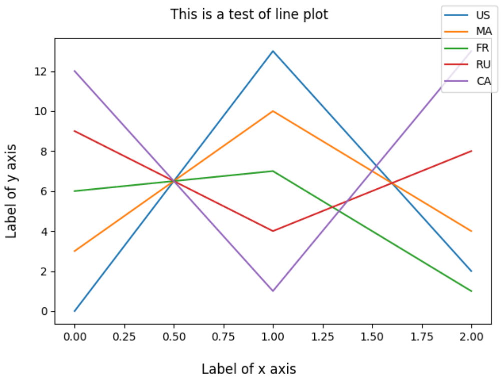
```
v = Visualizer('path/to/file.csv')
fig = v.heatmap(countries='all', features='all',
                  method='pearson', mask=True,
                  title='This␣is␣a␣test␣heatmap', xlabel='
                     Countries', ylabel='Countries')
fig.show() #for inline display (in browsers for example)
```



Time Series Plot

Generates a lineplot of given lists of countries and indicators.

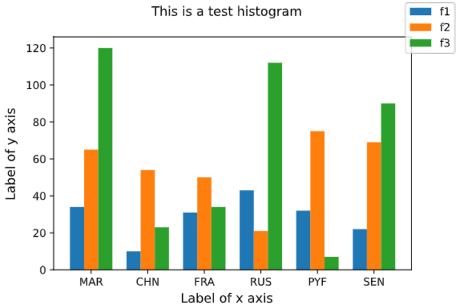
```
    v = Visualizer('path/to/file.csv')
    fig = v.line(countries='all', features='all',
              title='This is a test of line plot', xlabel='Label of x axis', ylabel='Label of y axis',
              legend=True)
    fig.show() # for inline display (in browsers for example)
```



Histogram

Generates a histogram of given lists of countries and indicators.

```
    v = Visualizer('path/to/file.csv')
    fig = v.histogram(countries=['MAR', 'CHN', 'FRA', 'RUS', 'PYF', 'SEN'],
                      features=['f1', 'f2', 'f3'],
                      title='This␣is␣a␣test␣histogram', xlabel='Label␣of␣x␣axis',
                      ylabel='Label␣of␣y␣axis',
                      legend=True)
    fig.show() # for inline display (in browsers for example)
```



Outline

A Web Application

We wanted to develop a Web Application that would :

- be coded using the Python package Flask;
- facilitate the displaying of the figures;
- save the user from writing any Python code.

Currently, the figures are showed:

- on a web page : choropleth map;
- in a Python Shell : heatmap, lineplot and histogram.

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Conclusion

What we have learned

- Learn more about geospatial visualization techniques;
- Create one package from several Python packages;
- Manipulate Python classes and link them.

What can be improved

- End the development of the web application;
- More custom options for the figures we are able to create.

Thank you for your attention!

You can get more information about wwstatviz on:

▸ wwstatviz github