# pandas-demo

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— layout: single classes: wide categories: [python, social statistics] tags: [python, pandas] layout: single classes: wide categories: [python, social statistics] tags: [python, pandas, jupyter-lab] —

## 1 Getting started with Python pandas

### 1.1 What is pandas?

Pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language.

#### 1.1.1 Ask Python itself what is pandas!

[11]:
```python
import pandas
pandas?
```

```
Type:        module
String form: <module 'pandas' from '/home/fabian/.local/lib/python3.9/
↪site-packages/pandas/__init__.py'>
File:        ~/.local/lib/python3.9/site-packages/pandas/__init__.py
Docstring:
pandas - a powerful data analysis and manipulation library for Python
=====================================================================

**pandas** is a Python package providing fast, flexible, and expressive data
structures designed to make working with "relational" or "labeled" data both
easy and intuitive. It aims to be the fundamental high-level building block for
doing practical, **real world** data analysis in Python. Additionally, it has
the broader goal of becoming **the most powerful and flexible open source data
analysis / manipulation tool available in any language**. It is already well on
its way toward this goal.

Main Features
-------------
Here are just a few of the things that pandas does well:

  - Easy handling of missing data in floating point as well as non-floating
    point data.
  - Size mutability: columns can be inserted and deleted from DataFrame and
    higher dimensional objects
```

```
- Automatic and explicit data alignment: objects can be explicitly aligned
  to a set of labels, or the user can simply ignore the labels and let
  `Series`, `DataFrame`, etc. automatically align the data for you in
  computations.
- Powerful, flexible group by functionality to perform split-apply-combine
  operations on data sets, for both aggregating and transforming data.
- Make it easy to convert ragged, differently-indexed data in other Python
  and NumPy data structures into DataFrame objects.
- Intelligent label-based slicing, fancy indexing, and subsetting of large
  data sets.
- Intuitive merging and joining data sets.
- Flexible reshaping and pivoting of data sets.
- Hierarchical labeling of axes (possible to have multiple labels per tick).
- Robust IO tools for loading data from flat files (CSV and delimited),
  Excel files, databases, and saving/loading data from the ultrafast HDF5
  format.
- Time series-specific functionality: date range generation and frequency
  conversion, moving window statistics, date shifting and lagging.
```

Want to know more? Run `pandas??!`. To save some typing pandas can be imported as pd like `import pandas as pd`. So `pd??` will do it as well.

### 1.2 Go on with some real world example...

Now we import `os`, `plotly` (as plotly.express) and `pandas` modules than load our example `gapminder` dataset as `DataFrame`. Note: that this intro example is created as a jupyter-lab notebook, that is also exported to a python script. Results were exported to markdown and pdf. In order to render markdown correctly in Jekyll, some minor modification were needed. See the modified markdown file on github.

[1]:
```python
import os
import plotly.express as px
import pandas as pd
df = px.data.gapminder()  # n.b. there is a separate module for gapminder data
type(df)
```

[1]:
```
pandas.core.frame.DataFrame
```

[ ]:
```
Have a look at some attributes and descriptive statistics of our DataFrame.
```

[2]:
```python
df.head(5)
```

[2]:
```
       country continent  year  lifeExp       pop   gdpPercap iso_alpha  \
0  Afghanistan      Asia  1952   28.801   8425333  779.445314       AFG
1  Afghanistan      Asia  1957   30.332   9240934  820.853030       AFG
2  Afghanistan      Asia  1962   31.997  10267083  853.100710       AFG
3  Afghanistan      Asia  1967   34.020  11537966  836.197138       AFG
4  Afghanistan      Asia  1972   36.088  13079460  739.981106       AFG
```

```
   iso_num
0        4
1        4
2        4
3        4
4        4
```

[8]:
```
df.shape  #without parents!
```

[8]:
```
(1704, 8)
```

[5]:
```
pd.set_option('display.float_format', lambda x: '%.1f' % x)  # set number of␣
 ↪digits
df.describe()
```

[5]:
```
        year  lifeExp          pop  gdpPercap  iso_num
count 1704.0   1704.0       1704.0     1704.0   1704.0
mean  1979.5     59.5   29601212.3     7215.3    425.9
std     17.3     12.9  106157896.7     9857.5    248.3
min   1952.0     23.6      60011.0      241.2      4.0
25%   1965.8     48.2    2793664.0     1202.1    208.0
50%   1979.5     60.7    7023595.5     3531.8    410.0
75%   1993.2     70.8   19585221.8     9325.5    638.0
max   2007.0     82.6 1318683096.0   113523.1    894.0
```

[2]:
```
df["country"].value_counts()
```

[2]:
```
Nicaragua           12
Gambia              12
Rwanda              12
Cambodia            12
Congo, Dem. Rep.    12
                    ..
Sudan               12
Swaziland           12
Peru                12
Bulgaria            12
Costa Rica          12
Name: country, Length: 142, dtype: int64
```

[11]:
```
df["country"]
```

[11]:
```
0       Afghanistan
1       Afghanistan
2       Afghanistan
3       Afghanistan
4       Afghanistan
```

```
                 …
1699        Zimbabwe
1700        Zimbabwe
1701        Zimbabwe
1702        Zimbabwe
1703        Zimbabwe
Name: country, Length: 1704, dtype: object
```

### 1.3 Filtering DataFrame

1. Select the most recent year.

[14]:
```
df["year"].max()
```

[14]:
```
2007
```

Exclude all previous years and keep 2007 only with a query.

[15]:
```
df.query('year == 2007')
```

[15]:
```
                country continent  year  lifeExp       pop  gdpPercap  \
11          Afghanistan      Asia  2007     43.8  31889923      974.6
23              Albania    Europe  2007     76.4   3600523     5937.0
35              Algeria    Africa  2007     72.3  33333216     6223.4
47               Angola    Africa  2007     42.7  12420476     4797.2
59            Argentina  Americas  2007     75.3  40301927    12779.4
…                   …        …    …      …       …         …
1655            Vietnam      Asia  2007     74.2  85262356     2441.6
1667 West Bank and Gaza      Asia  2007     73.4   4018332     3025.3
1679        Yemen, Rep.      Asia  2007     62.7  22211743     2280.8
1691             Zambia    Africa  2007     42.4  11746035     1271.2
1703           Zimbabwe    Africa  2007     43.5  12311143      469.7

     iso_alpha  iso_num
11         AFG        4
23         ALB        8
35         DZA       12
47         AGO       24
59         ARG       32
…          …       …
1655       VNM      704
1667       PSE      275
1679       YEM      887
1691       ZMB      894
1703       ZWE      716

[142 rows x 8 columns]
```

We got a df with 142 rows which is equal to the number of countries. And this is so `True`.

[21]:
```
len(df.country.unique()) == len(df.query('year == 2007'))
```

[21]:
```
True
```

Which country has the lowest life expectancy in Europe in 2007? First print the value.

[26]:
```
df.query('year == 2007 & continent == "Europe"')["lifeExp"].min()
```

[26]:
```
71.777
```

What country has the highest life expectancy worldwide?

[21]:
```
maxLE = df['lifeExp'].max()
df[df['lifeExp'] == maxLE]
```

[21]:
```
    country continent  year  lifeExp        pop    gdpPercap iso_alpha  \
803   Japan      Asia  2007   82.603  127467972  31656.06806       JPN

     iso_num
803      392
```

What country has the highest life expectancy in each continent?

[24]:
```
df.groupby("continent").max("lifeExp")
```

[24]:
```
           year  lifeExp         pop     gdpPercap  iso_num
continent
Africa     2007   76.442   135031164   21951.21176      894
Americas   2007   80.653   301139947   42951.65309      862
Asia       2007   82.603  1318683096  113523.13290      887
Europe     2007   81.757    82400996   49357.19017      826
Oceania    2007   81.235    20434176   34435.36744      554
```

[25]:
```
df.groupby(['continent'], sort=False)['lifeExp'].max()
```

[25]:
```
continent
Asia        82.603
Europe      81.757
Africa      76.442
Americas    80.653
Oceania     81.235
Name: lifeExp, dtype: float64
```

Well, mission completed, but we are still lack the name of the countries :-( So copy paste from here.

[29]:
```
idx = df.groupby(['continent'])['lifeExp'].transform(max) == df['lifeExp']
df[idx]
```

[29]:
```
        country continent  year  lifeExp        pop     gdpPercap iso_alpha  \
71    Australia   Oceania  2007   81.235   20434176  34435.367440       AUS
```

```
251       Canada  Americas  2007    80.653   33390141  36319.235010        CAN
695      Iceland    Europe  2007    81.757     301931  36180.789190        ISL
803        Japan      Asia  2007    82.603  127467972  31656.068060        JPN
1271     Reunion    Africa  2007    76.442     798094   7670.122558        REU

      iso_num
71         36
251       124
695       352
803       392
1271      638
```

Now, look at the minimum values by continent! But remember to filter for the most recent data.

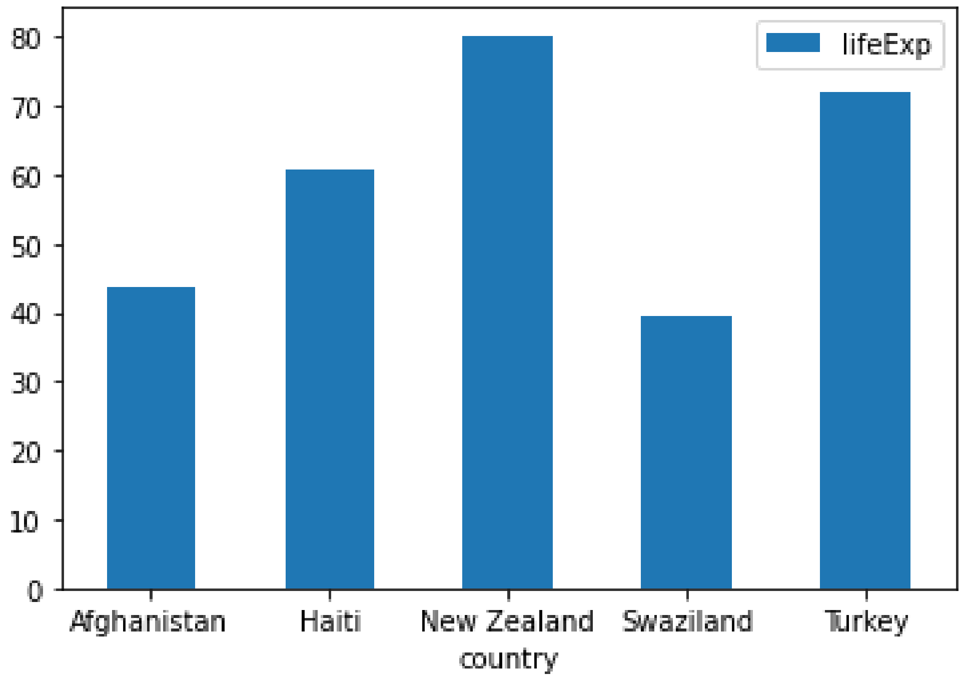
[31]:
```
df2 = df.query('year == 2007')
idx = df2.groupby(['continent'])['lifeExp'].transform(min) == df2['lifeExp']
df2[idx]
```

[31]:
```
          country continent  year  lifeExp       pop     gdpPercap iso_alpha  \
11    Afghanistan      Asia  2007   43.828  31889923    974.580338       AFG
647         Haiti  Americas  2007   60.916   8502814   1201.637154       HTI
1103  New Zealand   Oceania  2007   80.204   4115771  25185.009110       NZL
1463    Swaziland    Africa  2007   39.613   1133066   4513.480643       SWZ
1583       Turkey    Europe  2007   71.777  71158647   8458.276384       TUR

      iso_num
11          4
647       332
1103      554
1463      748
1583      792
```

So, Turkey had the lowest life expectancy in Europe according to the example dataset. Finally, a quick plot of the results with Pandas-only way (i.e. we shall not use `plotly` module).

[32]:
```
ax = df2[idx].plot.bar(x='country', y='lifeExp', rot=0)
```


lifeExp
80
70
60
50
40
30
20
10
0
Afghanistan
Haiti
New Zealand
Swaziland
Turkey
country