Pandas_tutorial

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This notebook is an introduction to the python packages **pandas** to handle dataframes.

1 Getting pandas

pandas can be installed like any python package with pip/pip3 :
pip install pandas
pip3 install pandas
It can be installed with aptitude on Linux :
sudo apt install python-pandas
sudo apt install python3-pandas
After installing pandas, it then needs to be imported :

```
In [148]: # importing pandas
          import pandas

          # importing other packages for fun
          import numpy as np
          import math
          import matplotlib.pyplot as plt
```

2 Creating a dataframe

Here is a dictionnary that we will then load in a pandas dataframe :

```
In [149]: ignite_data = {
              "name" : ["Ksenia", "Mariya", "Ariel", "Kenneth", "Toby", "Mattia", "Antonio", "
              "city" : ["Munich", "Sofia", "Munich", "Galway", "Porto", "Bristol", "Zagreb", "
              "project" : ["ESR1", "ESR15", "ESR10", "ESR7", "ESR3", "ESR8", "ESR13", "ESR5",
              "original_continent" : ["???", "Europe", "Asia", "America", "Asia", "Europe", "A
              "first_author_pub" : [3, 2, 2, 2, 3, 4, 7, 1, 3, 2, 2, 0],
              "other_author_pub" : [2, 2, 3, 1, 0, 1, 2, 10, 1, 4, 3, 4]
          }
```

This data was obtained from the future and indicates for each IGNITE ESR their name, PhD city, project, continent where they come from, their first author publications and other authorships. Since it is a dictionnary, you can take a look at its keys :

title

```
In [150]: ignite_data.keys()
```

```
Out[150]: dict_keys(['name', 'city', 'project', 'original_continent', 'first_author_pub', 'othe
```

Here is the "name" field :

```
In [151]: ignite_data["name"]
```

```
Out[151]: ['Ksenia',
           'Mariya',
           'Ariel',
           'Kenneth',
           'Toby',
           'Mattia',
           'Antonio',
           'Nadège',
           'Killian',
           'Ben',
           'Ramon',
           'Michi']
```

Now, this dictionnary can be loaded in a dataframe with the function DataFrame() :

```
In [152]: ignite_df = pandas.DataFrame(ignite_data)
          ignite_df
```

```
Out[152]:          city  first_author_pub     name original_continent  \
          0       Munich                 3   Ksenia                ???
```

```
1        Sofia                2   Mariya             Europe
2       Munich                2    Ariel               Asia
3       Galway                2  Kenneth            America
4        Porto                3     Toby               Asia
5      Bristol                4   Mattia             Europe
6       Zagreb                7  Antonio            America
7    Bruxelles                1   Nadège             Europe
8      Granada                3  Killian            America
9   Heidelberg                2      Ben            America
10      Munich                2    Ramon            America
11      Munich                0    Michi             Europe

    other_author_pub     project
0                  2        ESR1
1                  2       ESR15
2                  3       ESR10
3                  1        ESR7
4                  0        ESR3
5                  1        ESR8
6                  2       ESR13
7                 10        ESR5
8                  1       ESR14
9                  4        ESR9
10                 3        ESR2
11                 4  Babysitter
```

You may note that an index has been added to each line. You can check the index by calling nameofdataframe.index :

```
In [153]: ignite_df.index

Out[153]: RangeIndex(start=0, stop=12, step=1)
```

But here the dataframe does not quite look like what we want. The index should rather be replaced by the column names. This can be done by specifying the parameter 'index' when creating the dataframe :

```
In [154]: ignite_df = pandas.DataFrame(ignite_data, index=ignite_data["name"])
          ignite_df

Out[154]:                city  first_author_pub     name original_continent  \
          Ksenia       Munich                 3   Ksenia                ???
          Mariya        Sofia                 2   Mariya             Europe
          Ariel        Munich                 2    Ariel               Asia
          Kenneth      Galway                 2  Kenneth            America
          Toby          Porto                 3     Toby               Asia
          Mattia      Bristol                 4   Mattia             Europe
          Antonio      Zagreb                 7  Antonio            America
          Nadège    Bruxelles                 1   Nadège             Europe
```

```
Killian     Granada                 3  Killian            America
Ben      Heidelberg                 2      Ben            America
Ramon        Munich                 2    Ramon            America
Michi        Munich                 0    Michi             Europe

         other_author_pub     project
Ksenia                   2        ESR1
Mariya                   2       ESR15
Ariel                    3       ESR10
Kenneth                  1        ESR7
Toby                     0        ESR3
Mattia                   1        ESR8
Antonio                  2       ESR13
Nadège                  10        ESR5
Killian                  1       ESR14
Ben                      4        ESR9
Ramon                    3        ESR2
Michi                    4  Babysitter
```

This dataframe looks better, but there is now the extra column "name" and we would like to remove it. This can be done with drop() :

```
In [155]: ignite_df = ignite_df.drop("name", axis=1)
          ignite_df
```

```
Out[155]:               city  first_author_pub original_continent  other_author_pub  \
          Ksenia       Munich                 3                ???                 2
          Mariya        Sofia                 2             Europe                 2
          Ariel        Munich                 2               Asia                 3
          Kenneth      Galway                 2            America                 1
          Toby          Porto                 3               Asia                 0
          Mattia      Bristol                 4             Europe                 1
          Antonio      Zagreb                 7            America                 2
          Nadège    Bruxelles                 1             Europe                10
          Killian     Granada                 3            America                 1
          Ben      Heidelberg                 2            America                 4
          Ramon        Munich                 2            America                 3
          Michi        Munich                 0             Europe                 4

                     project
          Ksenia         ESR1
          Mariya        ESR15
          Ariel         ESR10
          Kenneth        ESR7
          Toby           ESR3
          Mattia         ESR8
          Antonio       ESR13
          Nadège         ESR5
```

```
Killian       ESR14
Ben            ESR9
Ramon          ESR2
Michi    Babysitter
```

3 Inspecting the dataframe

You can access the set of columns :

```
In [156]: ignite_df.columns

Out[156]: Index(['city', 'first_author_pub', 'original_continent', 'other_author_pub',
                 'project'],
                dtype='object')
```

As with Bash and R, the first lines of the dataframe can be displayed with head(), and the last lines with tail() (how convenient!) :

```
In [157]: ignite_df.head()

Out[157]:            city  first_author_pub original_continent  other_author_pub project
          Ksenia   Munich                 3                ???                 2    ESR1
          Mariya    Sofia                 2             Europe                 2   ESR15
          Ariel    Munich                 2               Asia                 3   ESR10
          Kenneth  Galway                 2            America                 1    ESR7
          Toby      Porto                 3               Asia                 0    ESR3

In [158]: ignite_df.tail()

Out[158]:               city  first_author_pub original_continent  other_author_pub  \
          Nadège    Bruxelles                 1             Europe                10
          Killian     Granada                 3            America                 1
          Ben      Heidelberg                 2            America                 4
          Ramon        Munich                 2            America                 3
          Michi        Munich                 0             Europe                 4

                     project
          Nadège         ESR5
          Killian       ESR14
          Ben            ESR9
          Ramon          ESR2
          Michi    Babysitter
```

4 Accessing data

You can access a line using its index with .loc[] :

```
In [159]: ignite_df.loc["Ksenia"] # calling line of "Ksenia"
```

```
Out[159]: city                  Munich
          first_author_pub           3
          original_continent       ???
          other_author_pub           2
          project                 ESR1
          Name: Ksenia, dtype: object
```

```
In [160]: ignite_df.loc["Antonio"] # calling line of "Antonio"
```

```
Out[160]: city                   Zagreb
          first_author_pub            7
          original_continent    America
          other_author_pub            2
          project                 ESR13
          Name: Antonio, dtype: object
```

A line can also be retrieved with the line number using iloc[]. For example, the line of "Antonio" is the sixth line :

```
In [161]: ignite_df.iloc[6] # calling line 6
```

```
Out[161]: city                   Zagreb
          first_author_pub            7
          original_continent    America
          other_author_pub            2
          project                 ESR13
          Name: Antonio, dtype: object
```

The results obtained with loc["Antonio"] and iloc[6] are the same.
You can also call a full column by specifiyng the name of the column in square brackets :

```
In [162]: ignite_df["city"]
```

```
Out[162]: Ksenia         Munich
          Mariya          Sofia
          Ariel          Munich
          Kenneth        Galway
          Toby            Porto
          Mattia        Bristol
          Antonio        Zagreb
          Nadège      Bruxelles
          Killian       Granada
          Ben        Heidelberg
          Ramon          Munich
          Michi          Munich
          Name: city, dtype: object
```

Calling the same column with .nameofthecolumn gives the same output :

```
In [199]: ignite_df.city
```

```
Out[199]: Ksenia         Munich
          Mariya          Sofia
          Ariel          Munich
          Kenneth        Galway
          Toby            Porto
          Mattia        Bristol
          Antonio        Zagreb
          Nadège      Bruxelles
          Killian       Granada
          Ben        Heidelberg
          Ramon          Munich
          Michi          Munich
          Name: city, dtype: object
```

The column can be put into a list with tolist() :

```
In [163]: ignite_df["city"].tolist()

Out[163]: ['Munich',
           'Sofia',
           'Munich',
           'Galway',
           'Porto',
           'Bristol',
           'Zagreb',
           'Bruxelles',
           'Granada',
           'Heidelberg',
           'Munich',
           'Munich']
```

Several columns can be displayed simultaneously.
Here, we select the columns "city" and "project" for all the students :

```
In [164]: ignite_df.loc[:, ["city", "project"]]

Out[164]:                city     project
          Ksenia       Munich        ESR1
          Mariya        Sofia       ESR15
          Ariel        Munich       ESR10
          Kenneth      Galway        ESR7
          Toby          Porto        ESR3
          Mattia      Bristol        ESR8
          Antonio      Zagreb       ESR13
          Nadège    Bruxelles        ESR5
          Killian     Granada       ESR14
          Ben      Heidelberg        ESR9
          Ramon        Munich        ESR2
          Michi        Munich  Babysitter
```

To specify that all the rows must be selected, the symbol ':' is used.
A set of students can be selected :

```
In [165]: ignite_df.loc[["Ben", "Killian"],["city", "project"]]
```

```
Out[165]:                city project
          Ben       Heidelberg    ESR9
          Killian      Granada   ESR14
```

And to get a specific value :

```
In [166]: ignite_df.loc["Ramon","original_continent"]
```

```
Out[166]: 'America'
```

Basically, to select your rows and columns, you can pass a list of rows and a list of columns. In R, it is the equivalent as selecting rows and columns with vectors.

5 Manipulating the dataframe

The dataframe can be sorted on specific values.
In this first example, the values are sorted according to the column "other_author_pub" :

```
In [167]: ignite_df.sort_values(by="other_author_pub")
```

```
Out[167]:                city  first_author_pub original_continent  other_author_pub  \
          Toby           Porto                 3               Asia                 0
          Kenneth       Galway                 2            America                 1
          Mattia       Bristol                 4             Europe                 1
          Killian      Granada                 3            America                 1
          Ksenia        Munich                 3                ???                 2
          Mariya         Sofia                 2             Europe                 2
          Antonio       Zagreb                 7            America                 2
          Ariel         Munich                 2               Asia                 3
          Ramon         Munich                 2            America                 3
          Ben       Heidelberg                 2            America                 4
          Michi         Munich                 0             Europe                 4
          Nadège     Bruxelles                 1             Europe                10

                     project
          Toby           ESR3
          Kenneth        ESR7
          Mattia         ESR8
          Killian       ESR14
          Ksenia         ESR1
          Mariya        ESR15
          Antonio       ESR13
          Ariel         ESR10
          Ramon          ESR2
```

```
Ben            ESR9
Michi     Babysitter
Nadège         ESR5
```

By default, the values are ascending.

In this second example, the values are sorted according to the column "first_author_pub", and the values are descending by setting the parameter 'ascending' to False :

```
In [168]: ignite_df.sort_values(by="first_author_pub", ascending=False)
```

```
Out[168]:                city  first_author_pub original_continent  other_author_pub  \
          Antonio       Zagreb                 7            America                 2
          Mattia       Bristol                 4             Europe                 1
          Ksenia        Munich                 3                ???                 2
          Toby           Porto                 3               Asia                 0
          Killian      Granada                 3            America                 1
          Mariya         Sofia                 2             Europe                 2
          Ariel         Munich                 2               Asia                 3
          Kenneth       Galway                 2            America                 1
          Ben       Heidelberg                 2            America                 4
          Ramon         Munich                 2            America                 3
          Nadège     Bruxelles                 1             Europe                10
          Michi         Munich                 0             Europe                 4

                       project
          Antonio        ESR13
          Mattia          ESR8
          Ksenia          ESR1
          Toby            ESR3
          Killian        ESR14
          Mariya         ESR15
          Ariel          ESR10
          Kenneth         ESR7
          Ben             ESR9
          Ramon           ESR2
          Nadège          ESR5
          Michi     Babysitter
```

6 Analyzing your data

The function describe() is similar to summary() in R : for columns that contain numerical values, it computes the number of values, mean, standard deviation, minimum, maximum and quartiles.

```
In [169]: ignite_df.describe()
```

```
Out[169]:        first_author_pub  other_author_pub
          count         12.000000         12.000000
          mean           2.583333          2.750000
```

```
std            1.729862          2.598076
min            0.000000          0.000000
25%            2.000000          1.000000
50%            2.000000          2.000000
75%            3.000000          3.250000
max            7.000000         10.000000
```

You can also compute these informations on each column.

Computing maximum on first_author_pub and other_author_pub :

```
In [170]: ignite_df["first_author_pub"].max()

Out[170]: 7

In [171]: ignite_df["other_author_pub"].max()

Out[171]: 10
```

Computing minimum on first_author_pub and other_author_pub :

```
In [172]: ignite_df["first_author_pub"].min()

Out[172]: 0

In [173]: ignite_df["other_author_pub"].min()

Out[173]: 0
```

The elements in the output of describe() can be

7 Exercise 1

What is the number of first_author_pub by Michi in ignite_df ? And the number of other_author_pub by Michi in ignite_df ?

What is the total number of first_author_pub from everybody? And other_author_pub?

Now, since Michi is the babysitter of all the ESR, we would like his first_author_pub count to be equal to the total number of first_author_pub. Change this value.

```
In [174]: # this is not the answer!
          ignite_data["first_author_pub"][11] = 31
          ignite_name = ignite_data["name"]
          del ignite_data["name"]
          ignite_df = pandas.DataFrame(ignite_data, index=ignite_name)

          # but this is what you are supposed to get
          ignite_df
```

```
Out[174]:              city  first_author_pub original_continent  other_author_pub  \
          Ksenia       Munich                 3                 ???                 2
          Mariya        Sofia                 2              Europe                 2
          Ariel        Munich                 2                Asia                 3
          Kenneth      Galway                 2             America                 1
          Toby          Porto                 3                Asia                 0
          Mattia      Bristol                 4              Europe                 1
          Antonio      Zagreb                 7             America                 2
          Nadège    Bruxelles                 1              Europe                10
          Killian     Granada                 3             America                 1
          Ben      Heidelberg                 2             America                 4
          Ramon        Munich                 2             America                 3
          Michi        Munich                31              Europe                 4

                       project
          Ksenia          ESR1
          Mariya         ESR15
          Ariel          ESR10
          Kenneth         ESR7
          Toby            ESR3
          Mattia          ESR8
          Antonio        ESR13
          Nadège          ESR5
          Killian        ESR14
          Ben             ESR9
          Ramon           ESR2
          Michi    Babysitter
```

8 Selecting elements with booleans

The data can be subsetted with a boolean.

For example, we can select all the lines of people who live in Munich. The condition will be whether the column 'city' is equal to "Munich" :

```
In [200]: ignite_df[ ignite_df.city == "Munich"]
```

```
Out[200]:           city  first_author_pub original_continent  other_author_pub  \
          Ksenia  Munich                 3                 ???                 2
          Ariel   Munich                 2                Asia                 3
          Ramon   Munich                 2             America                 3
          Michi   Munich                31              Europe                 4

                     project
          Ksenia        ESR1
          Ariel        ESR10
          Ramon         ESR2
          Michi   Babysitter
```

Here, to select people who have more than 2 first author publications :

```
In [205]: ignite_df[ ignite_df.first_author_pub > 2 ]
```

```
Out[205]:             city  first_author_pub original_continent  other_author_pub  \
          Ksenia    Munich                 3                ???                 2
          Toby       Porto                 3               Asia                 0
          Mattia   Bristol                 4             Europe                 1
          Antonio   Zagreb                 7            America                 2
          Killian  Granada                 3            America                 1
          Michi     Munich                31             Europe                 4

                      project
          Ksenia         ESR1
          Toby           ESR3
          Mattia         ESR8
          Antonio       ESR13
          Killian       ESR14
          Michi    Babysitter
```

Note that the output is exactly the same if you use .loc[] :

```
In [206]: ignite_df.loc[ ignite_df.first_author_pub > 2 ]
```

```
Out[206]:             city  first_author_pub original_continent  other_author_pub  \
          Ksenia    Munich                 3                ???                 2
          Toby       Porto                 3               Asia                 0
          Mattia   Bristol                 4             Europe                 1
          Antonio   Zagreb                 7            America                 2
          Killian  Granada                 3            America                 1
          Michi     Munich                31             Europe                 4

                      project
          Ksenia         ESR1
          Toby           ESR3
          Mattia         ESR8
          Antonio       ESR13
          Killian       ESR14
          Michi    Babysitter
```

To indicate the columns to display, .loc[] must be used. In this example, the "first_author_pub" and "other_author_pub" columns are displayed for all the lines where first_author_pub is strictly superior to 2 :

```
In [208]: ignite_df.loc[ ignite_df.first_author_pub > 2, ["first_author_pub", "other_author_pu
```

```
Out[208]:          first_author_pub  other_author_pub
          Ksenia                  3                 2
          Toby                    3                 0
```

```
Mattia                  4                 1
Antonio                 7                 2
Killian                 3                 1
Michi                  31                 4
```

Several conditions can be specified using & (and), | (or).

Here the people who have more than 2 first author publications and who are originally from Europe are selected :

```
In [198]: ignite_df[ ( ignite_df.first_author_pub > 2 ) & (ignite_df.original_continent=="Europ
```

```
Out[198]:            city  first_author_pub original_continent  other_author_pub  \
          Mattia  Bristol                 4             Europe                 1
          Michi    Munich                31             Europe                 4

                    project
          Mattia        ESR8
          Michi   Babysitter
```

Another example to select those who are originally from Asia or live in Sofia :

```
In [209]: ignite_df[ ( ignite_df.original_continent=="Asia" ) | (ignite_df.city=="Sofia") ]
```

```
Out[209]:           city  first_author_pub original_continent  other_author_pub project
          Mariya   Sofia                 2             Europe                 2   ESR15
          Ariel   Munich                 2               Asia                 3   ESR10
          Toby     Porto                 3               Asia                 0    ESR3
```

There is also a peculiar notation with '~' to select lines that do not fulfill a condition.

Here we select people who are not from Europe :

```
In [213]: ignite_df[ ~(ignite_df.original_continent=="Europe") ]
```

```
Out[213]:               city  first_author_pub original_continent  other_author_pub  \
          Ksenia       Munich                 3                ???                 2
          Ariel        Munich                 2               Asia                 3
          Kenneth      Galway                 2            America                 1
          Toby          Porto                 3               Asia                 0
          Antonio      Zagreb                 7            America                 2
          Killian     Granada                 3            America                 1
          Ben      Heidelberg                 2            America                 4
          Ramon        Munich                 2            America                 3

                  project
          Ksenia     ESR1
          Ariel     ESR10
          Kenneth    ESR7
          Toby       ESR3
          Antonio   ESR13
          Killian   ESR14
          Ben        ESR9
          Ramon      ESR2
```

This is equivalent to :

```
In [214]: ignite_df[ignite_df.original_continent!="Europe"]
```

```
Out[214]:              city  first_author_pub original_continent  other_author_pub  \
          Ksenia       Munich                 3                ???                 2
          Ariel        Munich                 2               Asia                 3
          Kenneth      Galway                 2            America                 1
          Toby          Porto                 3               Asia                 0
          Antonio      Zagreb                 7            America                 2
          Killian     Granada                 3            America                 1
          Ben      Heidelberg                 2            America                 4
          Ramon        Munich                 2            America                 3

                  project
          Ksenia      ESR1
          Ariel      ESR10
          Kenneth     ESR7
          Toby        ESR3
          Antonio    ESR13
          Killian    ESR14
          Ben         ESR9
          Ramon       ESR2
```

9 Exercise 2

1.Select the people who are originally from America.

2.Select the people who do not live in Munich.

3.What is the mean number of first_author_pub among people who are originally from America ?

4.Which people have a number of other_author_pub superior or equal to the average number of other_author_pub among all ESR ?

5.Which people have a number of first_author_pub superior or equal to the median number of first_author_pub and a a number of other_author_pub superior or equal to the median number of other_author_pub ?

10 Selecting elements with pattern matching

The function contains() can be used to look for a pattern in a string.

In the following example, the lines where the index contains the letter "a" are selected :

```
In [265]: ignite_df[ignite_df.index.str.contains("a")]
```

```
Out[265]:              city  first_author_pub original_continent  other_author_pub  \
          Ksenia       Munich                 3                ???                 2
          Mariya        Sofia                 2             Europe                 2
          Mattia      Bristol                 4             Europe                 1
```

```
Nadège   Bruxelles                1             Europe                10
Killian    Granada                3           America                 1
Ramon       Munich                2           America                 3

        project
Ksenia      ESR1
Mariya     ESR15
Mattia      ESR8
Nadège      ESR5
Killian    ESR14
Ramon       ESR2
```

11 Grouping

The data can be grouped on a specific criterion using groupby().

In the following example, the data is grouped according to the original_continent. Then, the sum is computed on columns where it is possible, meaning numerical columns :

```
In [226]: ignite_df.groupby("original_continent").sum()

Out[226]:                    first_author_pub  other_author_pub
          original_continent
          ???                               3                 2
          America                          16                11
          Asia                              5                 3
          Europe                           38                17
```

The lines are separated in 4 categories from original_continent : ???, America, Asia, Europe. The sum of first_author_pub and other_author_pub are computed for each category.

groupby() can also be used with a condition.

In the next example, the mean numbers of first_author_pub and other_author_pub is computed according to whether the person's city is Munich or not :

```
In [228]: ignite_df.groupby(ignite_df.city=="Munich").mean()

Out[228]:        first_author_pub  other_author_pub
          city
          False               3.0             2.625
          True                9.5             3.000
```

12 Apply()

The function apply() can be used to apply a function over the rows or columns of a dataframe.

The main parameters are the following :

func : the function to apply ; it can be an already existing function or a function that you write with lambda axis : 0 to compute over all the columns, 1 over all the lines

In the following example, the length of each column is computed by passing as arguments func=len and axis=0 :

```
In [267]: ignite_df.apply(func=len, axis=0)

Out[267]: city                 12
          first_author_pub     12
          original_continent   12
          other_author_pub     12
          project              12
          dtype: int64
```

In the next example, we iterate over the lines by setting axis=1. The function passed as argument is written with lambda. This is a function specially created to use in apply().

```
In [280]: ignite_df.apply(lambda x: print("{0} lives in {1}.".format(x.name, x.city)), axis=1 )

Ksenia lives in Munich.
Mariya lives in Sofia.
Ariel lives in Munich.
Kenneth lives in Galway.
Toby lives in Porto.
Mattia lives in Bristol.
Antonio lives in Zagreb.
Nadège lives in Bruxelles.
Killian lives in Granada.
Ben lives in Heidelberg.
Ramon lives in Munich.
Michi lives in Munich.


Out[280]: Ksenia     None
          Mariya     None
          Ariel      None
          Kenneth    None
          Toby       None
          Mattia     None
          Antonio    None
          Nadège     None
          Killian    None
          Ben        None
          Ramon      None
          Michi      None
          dtype: object
```

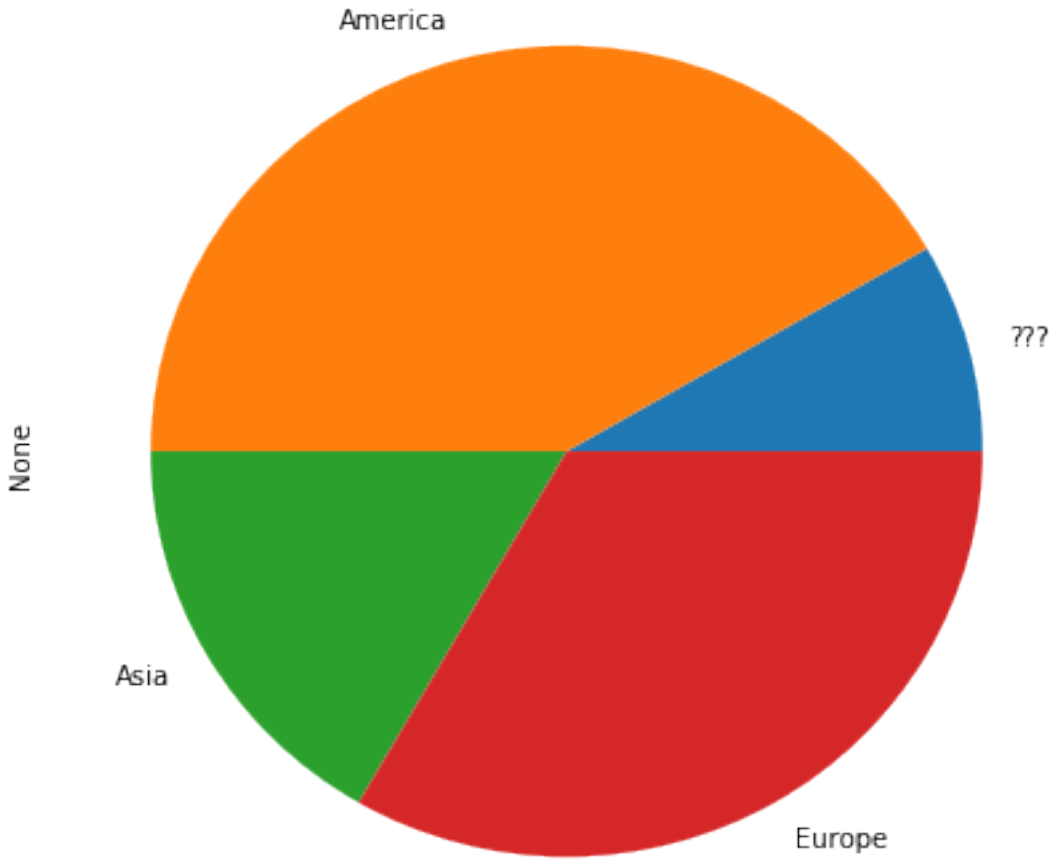
The function created with lamba prints for each line : 'name' lives in 'city'. The current line is identified by the variable x.

13 Plotting

Here are examples of plots you can generate with your pandas dataframe.

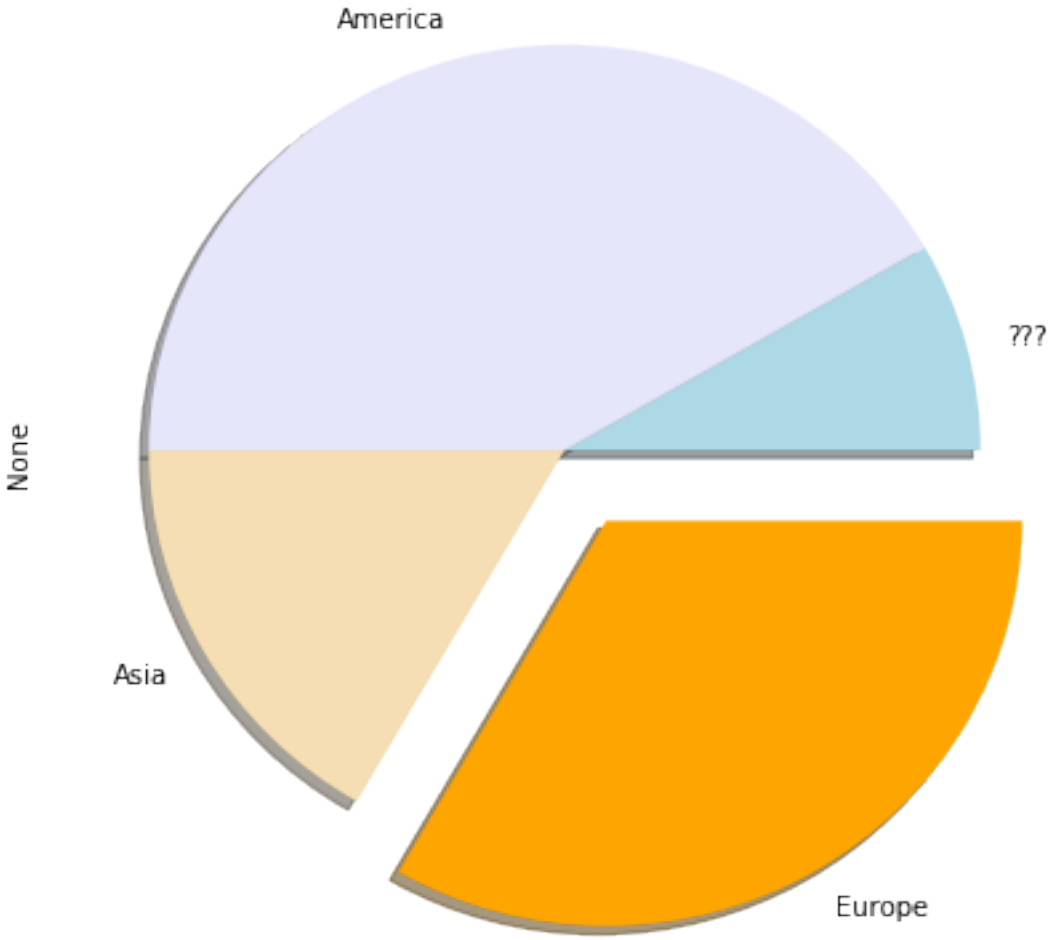
13.1 Pie

```
In [246]: ignite_pie = ignite_df.groupby("original_continent").size()
          ignite_pie.plot.pie(figsize=(7,7))

Out[246]: <matplotlib.axes._subplots.AxesSubplot at 0x7fcfa78824e0>
```



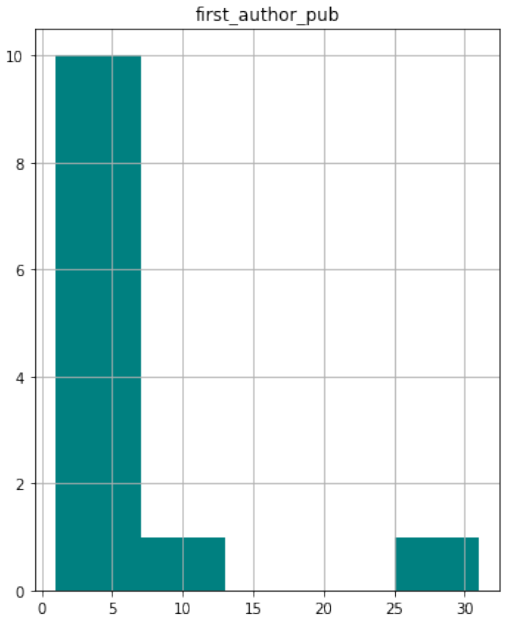
And then you can have fun with the parameters :

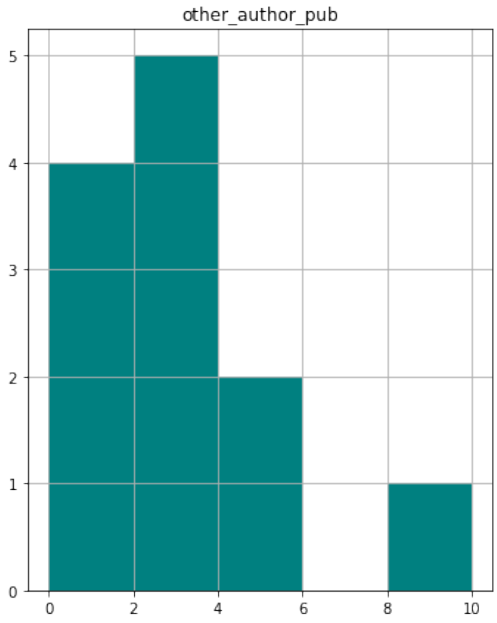
```
In [245]: ignite_pie.plot.pie(figsize=(7,7), explode=[0,0,0,0.2], colors=["lightblue", "lavend

Out[245]: <matplotlib.axes._subplots.AxesSubplot at 0x7fcfa7688b00>
```



13.2 Histogram

```
In [259]: ignite_df.hist(bins=5, color="teal", figsize=(13,7))

Out[259]: array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7fcfa6c2a828>,
                  <matplotlib.axes._subplots.AxesSubplot object at 0x7fcfa6a76fd0>]], dtype=obj
```


first_author_pub
10
8
6
4
2
0
0
5
10
15
20
25
30


other_author_pub
5
4
3
2
1
0
0
2
4
6
8
10