Московский государственный технический университет им. Н.Э. Баумана
Кафедра «Системы обработки информации и управления»

Лабораторная работа №2
по дисциплине

«Методы машинного обучения»

на тему

«Изучение библиотек обработки данных»

Выполнил:
студент группы ИУ5-22М
Вей Пхьоу Ту

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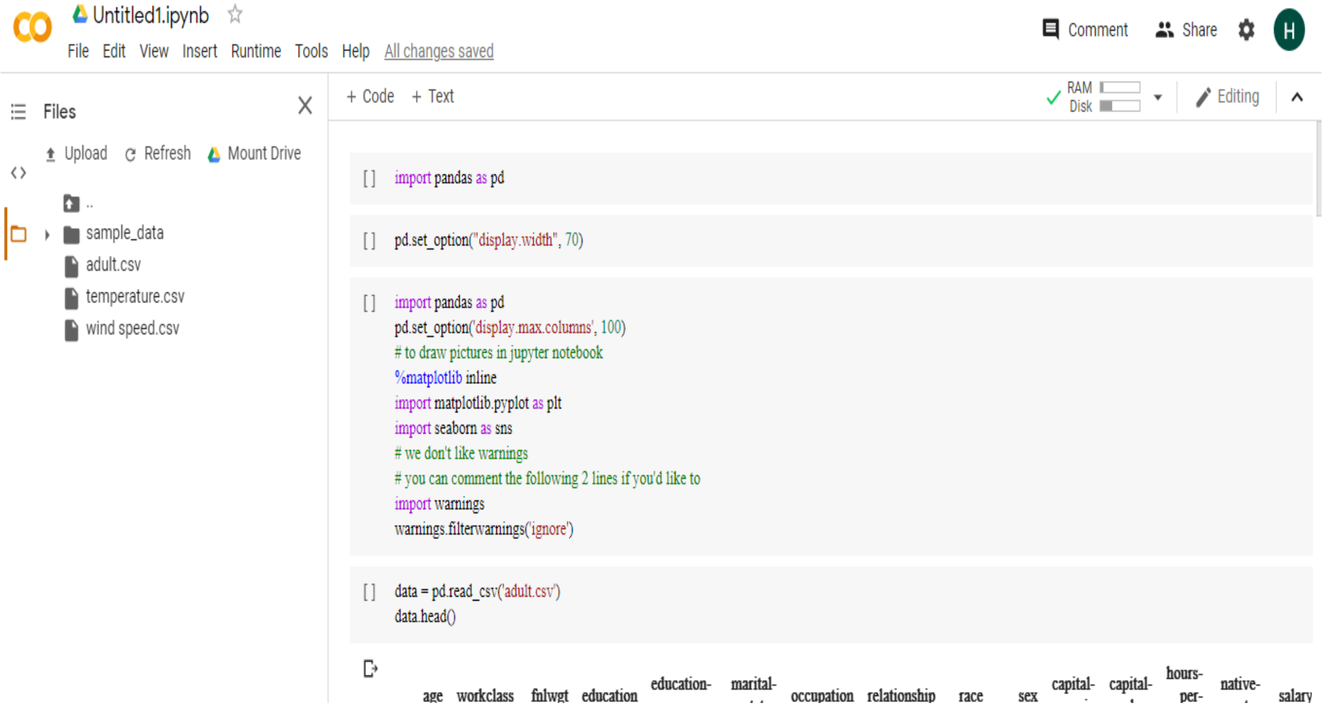
1. Цель лабораторной работы

Изучить библиотеки обработки данных Pandas и PandaSQL.



```
[ ] import pandas as pd
```

```
[ ] pd.set_option("display.width", 70)
```

```
[ ] import pandas as pd
    pd.set_option('display.max.columns', 100)
    # to draw pictures in jupyter notebook
    %matplotlib inline
    import matplotlib.pyplot as plt
    import seaborn as sns
    # we don't like warnings
    # you can comment the following 2 lines if you'd like to
    import warnings
    warnings.filterwarnings('ignore')
```

```
[ ] data = pd.read_csv('adult.csv')
    data.head()
```

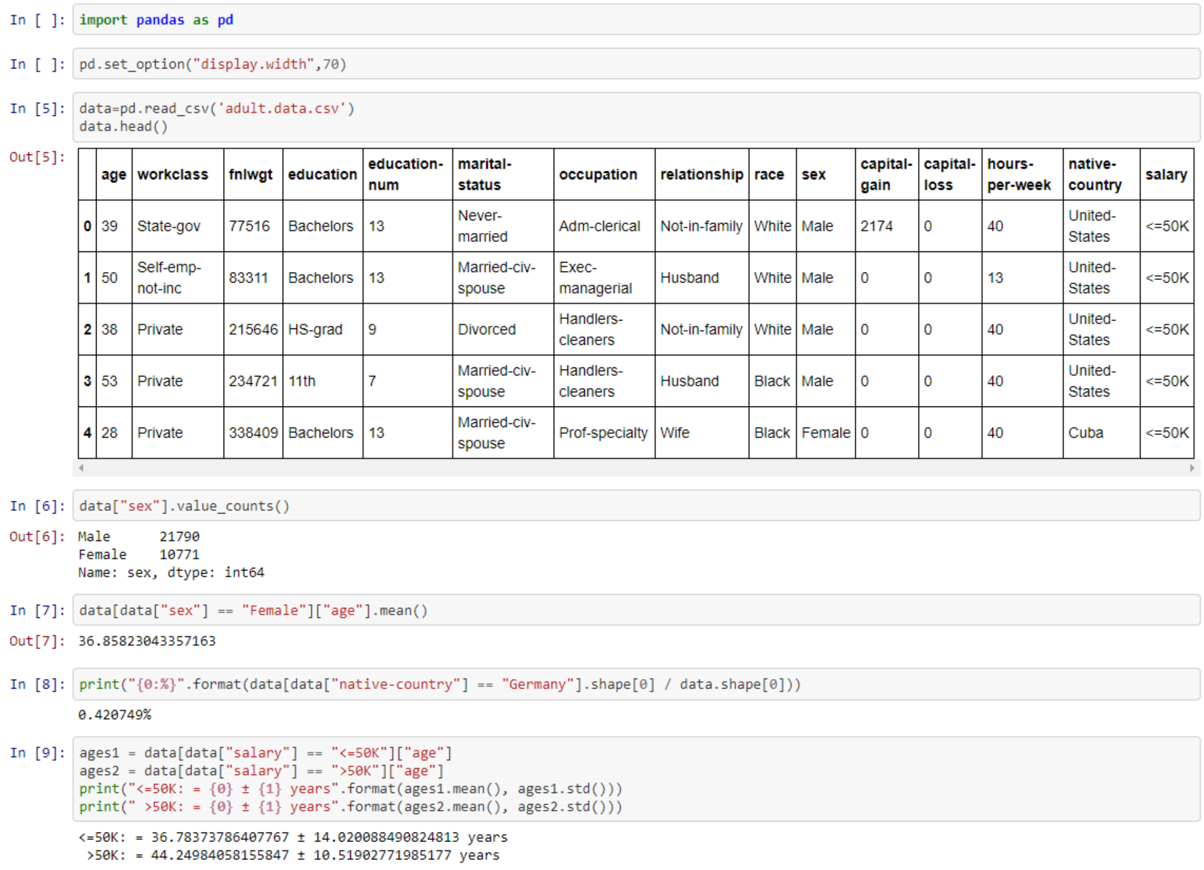
```
                                   education- marital-                                       capital- capital- hours-  native-
age workclass fnlwgt education                          occupation relationship race  sex                      per-            salary
```

2. Задание

Задание состоит из двух частей

2.1. Часть 1

Требуется выполнить первое демонстрационное задание под названием «Exploratory data analysis with Pandas» со страницы курса mlcourse.ai.



```
In [ ]: import pandas as pd
```

```
In [ ]: pd.set_option("display.width",70)
```

```
In [5]: data=pd.read_csv('adult.data.csv')
        data.head()
```

Out[5]:

	age	workclass	fnlwgt	education	education-num	marital-status	occupation	relationship	race	sex	capital-gain	capital-loss	hours-per-week	native-country	salary
0	39	State-gov	77516	Bachelors	13	Never-married	Adm-clerical	Not-in-family	White	Male	2174	0	40	United-States	<=50K
1	50	Self-emp-not-inc	83311	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	White	Male	0	0	13	United-States	<=50K
2	38	Private	215646	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family	White	Male	0	0	40	United-States	<=50K
3	53	Private	234721	11th	7	Married-civ-spouse	Handlers-cleaners	Husband	Black	Male	0	0	40	United-States	<=50K
4	28	Private	338409	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife	Black	Female	0	0	40	Cuba	<=50K

```
In [6]: data["sex"].value_counts()

Out[6]: Male      21790
        Female    10771
        Name: sex, dtype: int64
```

```
In [7]: data[data["sex"] == "Female"]["age"].mean()

Out[7]: 36.85823043357163
```

```
In [8]: print("{0:%}".format(data[data["native-country"] == "Germany"].shape[0] / data.shape[0]))

        0.420749%
```

```
In [9]: ages1 = data[data["salary"] == "<=50K"]["age"]
        ages2 = data[data["salary"] == ">50K"]["age"]
        print("<=50K: = {0} ± {1} years".format(ages1.mean(), ages1.std()))
        print(" >50K: = {0} ± {1} years".format(ages2.mean(), ages2.std()))

        <=50K: = 36.78373786407767 ± 14.020088490824813 years
         >50K: = 44.24984058155847 ± 10.51902771985177 years
```

In [14]:

```
high_educations = set(["Bachelors", "Prof-school", "Assoc-acdm",
"Assoc-voc", "Masters", "Doctorate"])
def high_educated(e):
  return e in high_educations
data[data["salary"] == ">50K"]["education"].map(high_educated).all()
```

Out[14]:

```
False
```

In [11]:

```
data.groupby(["race", "sex"])["age"].describe()
```

Out[11]:

		count	mean	std	min	25%	50%	75%	max
race	**sex**								
Amer-Indian-Eskimo	**Female**	119.0	37.117647	13.114991	17.0	27.0	36.0	46.00	80.0
	Male	192.0	37.208333	12.049563	17.0	28.0	35.0	45.00	82.0
Asian-Pac-Islander	**Female**	346.0	35.089595	12.300845	17.0	25.0	33.0	43.75	75.0
	Male	693.0	39.073593	12.883944	18.0	29.0	37.0	46.00	90.0
Black	**Female**	1555.0	37.854019	12.637197	17.0	28.0	37.0	46.00	90.0
	Male	1569.0	37.682600	12.882612	17.0	27.0	36.0	46.00	90.0
Other	**Female**	109.0	31.678899	11.631599	17.0	23.0	29.0	39.00	74.0
	Male	162.0	34.654321	11.355531	17.0	26.0	32.0	42.00	77.0
White	**Female**	8642.0	36.811618	14.329093	17.0	25.0	35.0	46.00	90.0
	Male	19174.0	39.652498	13.436029	17.0	29.0	38.0	49.00	90.0

In [12]:

```
data[(data["race"] == "Amer-Indian-Eskimo")
& (data["sex"] == "Male")]["age"].max()
```

Out[12]:

```
82
```

In [15]:

```
def is_married(m):
  return m.startswith("Married")
data["married"] = data["marital-status"].map(is_married)
(data[(data["sex"] == "Male") & (data["salary"] == ">50K")]
  ["married"].value_counts())
```

Out[15]:

```
True     5965
False     697
Name: married, dtype: int64
```

In [16]:

```
m = data["hours-per-week"].max()
print("Maximum is {} hours/week.".format(m))
people = data[data["hours-per-week"] == m]
c = people.shape[0]
print("{} people work this time at week.".format(c))
s = people[people["salary"] == ">50K"].shape[0]
print("{0:%} get >50K salary.".format(s / c))
```

```
Maximum is 99 hours/week.
85 people work this time at week.
29.411765% get >50K salary.
```

In [17]:

```
p = pd.crosstab(data["native-country"], data["salary"],
values=data['hours-per-week'], aggfunc="mean")
p
```

Out[17]:

salary	<=50K	>50K
native-country		
?	40.164760	45.547945
Cambodia	41.416667	40.000000
Canada	37.914634	45.641026
China	37.381818	38.900000
Columbia	38.684211	50.000000
Cuba	37.985714	42.440000
Dominican-Republic	42.338235	47.000000
Ecuador	38.041667	48.750000
El-Salvador	36.030928	45.000000
England	40.483333	44.533333
France	41.058824	50.750000
Germany	39.139785	44.977273
Greece	41.809524	50.625000
Guatemala	39.360656	36.666667
Haiti	36.325000	42.750000
Holand-Netherlands	40.000000	NaN
Honduras	34.333333	60.000000
Hong	39.142857	45.000000

In [18]:

```
p.loc["Japan"]
```

Out[18]:

```
salary
<=50K    41.000000
>50K     47.958333
Name: Japan, dtype: float64
```

In [19]:

```
p.loc["China"]
```

Out[19]:

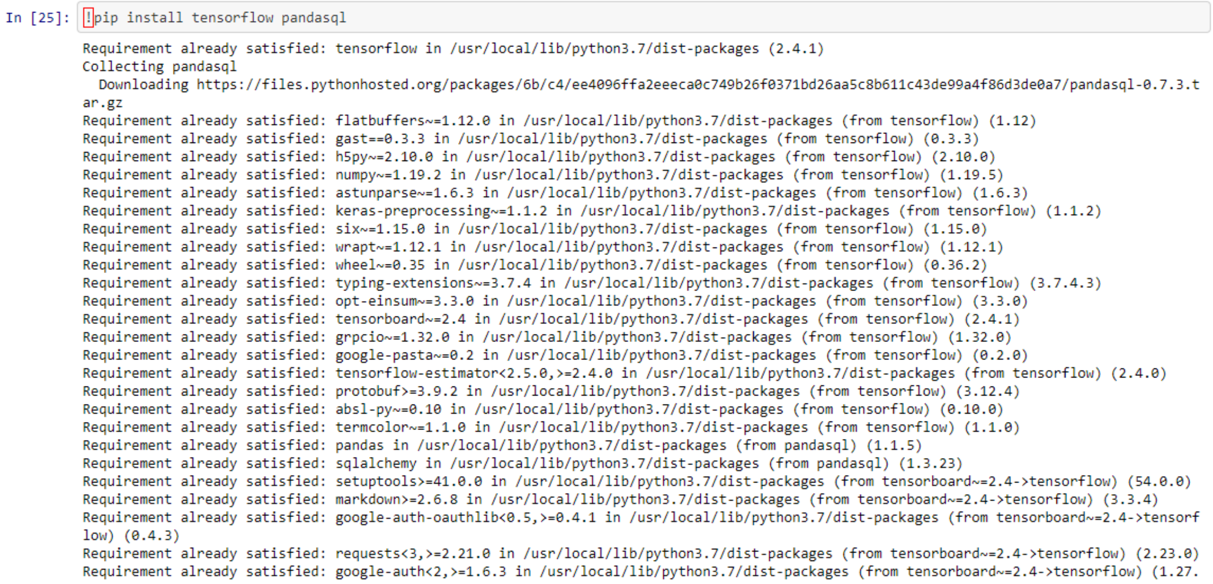
```
salary
<=50K    37.381818
>50K     38.900000
Name: China, dtype: float64
```

2.2. Часть 2

Требуется выполнить следующие запросы с использованием двух различных библиотек — Pandas и PandaSQL:

- один произвольный запрос на соединение двух наборов данных,
- один произвольный запрос на группировку набора данных с использованием функций агрегирования.

Также требуется сравнить время выполнения каждого запроса в Pandas и PandaSQL.



```
In [25]: !pip install tensorflow pandasql
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.7/dist-packages (2.4.1)
Collecting pandasql
  Downloading https://files.pythonhosted.org/packages/6b/c4/ee4096ffa2eeeca0c749b26f0371bd26aa5c8b611c43de99a4f86d3de0a7/pandasql-0.7.3.t
ar.gz
Requirement already satisfied: flatbuffers~=1.12.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.12)
Requirement already satisfied: gast==0.3.3 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.3.3)
Requirement already satisfied: h5py~=2.10.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (2.10.0)
Requirement already satisfied: numpy~=1.19.2 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.19.5)
Requirement already satisfied: astunparse~=1.6.3 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: keras-preprocessing~=1.1.2 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.1.2)
Requirement already satisfied: six~=1.15.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.15.0)
Requirement already satisfied: wrapt~=1.12.1 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.12.1)
Requirement already satisfied: wheel~=0.35 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.36.2)
Requirement already satisfied: typing-extensions~=3.7.4 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (3.7.4.3)
Requirement already satisfied: opt-einsum~=3.3.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: tensorboard~=2.4 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (2.4.1)
Requirement already satisfied: grpcio~=1.32.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.32.0)
Requirement already satisfied: google-pasta~=0.2 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: tensorflow-estimator<2.5.0,>=2.4.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (2.4.0)
Requirement already satisfied: protobuf>=3.9.2 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (3.12.4)
Requirement already satisfied: absl-py~=0.10 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (0.10.0)
Requirement already satisfied: termcolor~=1.1.0 in /usr/local/lib/python3.7/dist-packages (from tensorflow) (1.1.0)
Requirement already satisfied: pandas in /usr/local/lib/python3.7/dist-packages (from pandasql) (1.1.5)
Requirement already satisfied: sqlalchemy in /usr/local/lib/python3.7/dist-packages (from pandasql) (1.3.23)
Requirement already satisfied: setuptools>=41.0.0 in /usr/local/lib/python3.7/dist-packages (from tensorboard~=2.4->tensorflow) (54.0.0)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/dist-packages (from tensorboard~=2.4->tensorflow) (3.3.4)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /usr/local/lib/python3.7/dist-packages (from tensorboard~=2.4->tensorf
low) (0.4.3)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.7/dist-packages (from tensorboard~=2.4->tensorflow) (2.23.0)
Requirement already satisfied: google-auth<2,>=1.6.3 in /usr/local/lib/python3.7/dist-packages (from tensorboard~=2.4->tensorflow) (1.27.
```

In [26]:

```
from pandasql import sqldf
pysqldf = lambda q: sqldf(q, globals())
```

In [27]:

```
wind = (pd.read_csv('wind speed.csv', header=None, names=["row", "UNIX", "date","time", "speed", "text"])
.drop("text", axis=1))
temp = (pd.read_csv('temperature.csv', header=None, names=["row", "UNIX", "date", "time", "temperature", "text"])
.drop("text", axis=1))
```

In [28]:

```
wind.head()
```

Out[28]:

	row	UNIX	date	time	speed
0	1	1475315718	2016-09-30	23:55:18	7.87
1	2	1475315423	2016-09-30	23:50:23	7.87
2	3	1475315124	2016-09-30	23:45:24	9.00
3	4	1475314821	2016-09-30	23:40:21	13.50
4	5	1475314522	2016-09-30	23:35:22	15.75

In [29]:

```
wind.dtypes
```

Out[29]:

```
row          int64
UNIX         int64
date        object
time        object
speed      float64
dtype: object
```

In [30]:

```
temp.head()
```

Out[30]:

	row	UNIX	date	time	temperature
0	1	1475315718	2016-09-30	23:55:18	48
1	2	1475315423	2016-09-30	23:50:23	48
2	3	1475315124	2016-09-30	23:45:24	48
3	4	1475314821	2016-09-30	23:40:21	48
4	5	1475314522	2016-09-30	23:35:22	48

In [31]:

```
temp.dtypes
```

Out[31]:

```
row               int64
UNIX              int64
date             object
time             object
temperature       int64
dtype: object
```

In [32]:

```
wind.merge(temp[["UNIX", "temperature"]], on="UNIX").head()
```

Out[32]:

	row	UNIX	date	time	speed	temperature
0	1	1475315718	2016-09-30	23:55:18	7.87	48
1	2	1475315423	2016-09-30	23:50:23	7.87	48
2	3	1475315124	2016-09-30	23:45:24	9.00	48
3	4	1475314821	2016-09-30	23:40:21	13.50	48
4	5	1475314522	2016-09-30	23:35:22	15.75	48

In [36]:

```
%%timeit
wind.merge(temp[["UNIX", "temperature"]], on="UNIX")
```

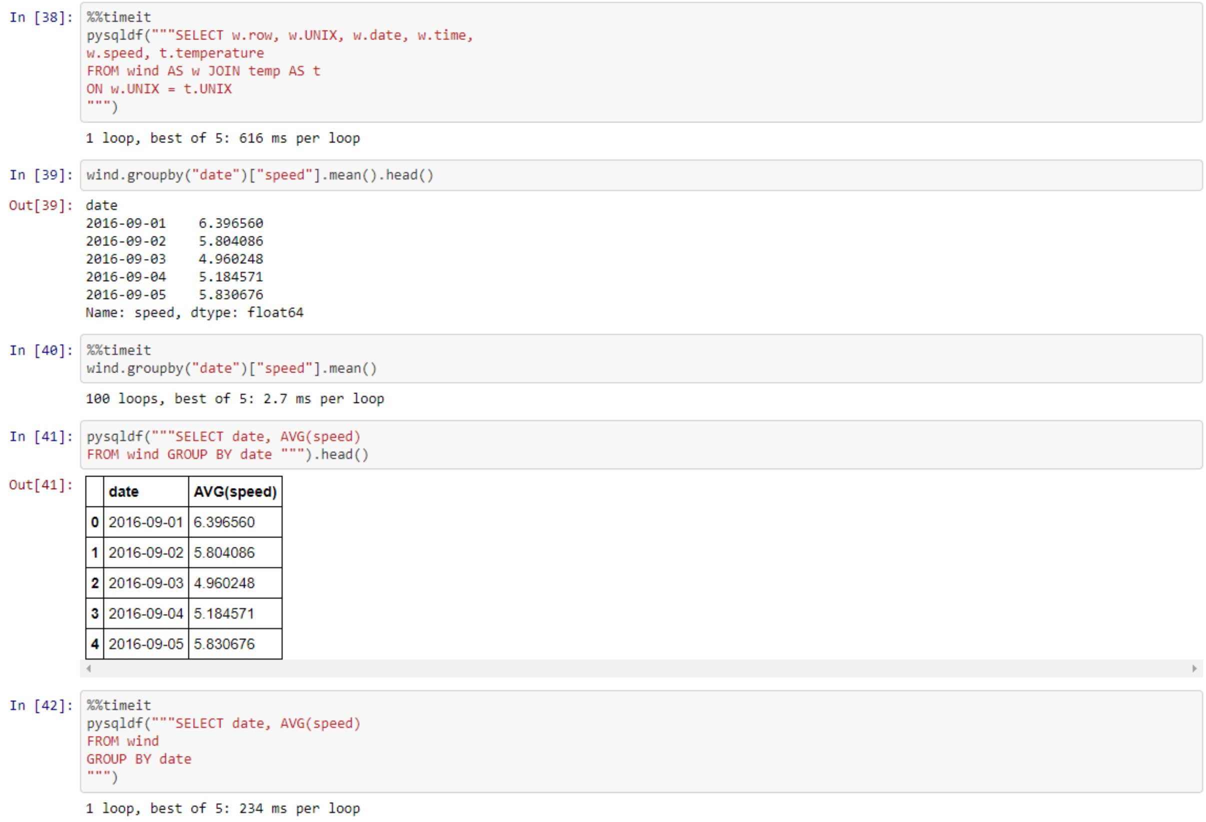
```
100 loops, best of 5: 8.51 ms per loop
```

In [37]:

```
pysqldf("""SELECT w.row, w.UNIX, w.date, w.time,
w.speed, t.temperature
FROM wind AS w JOIN temp AS t
ON w.UNIX = t.UNIX
""").head()
```

Out[37]:

	row	UNIX	date	time	speed	temperature
0	1	1475315718	2016-09-30	23:55:18	7.87	48
1	2	1475315423	2016-09-30	23:50:23	7.87	48
2	3	1475315124	2016-09-30	23:45:24	9.00	48
3	4	1475314821	2016-09-30	23:40:21	13.50	48
4	5	1475314522	2016-09-30	23:35:22	15.75	48



```
In [38]: %%timeit
         pysqldf("""SELECT w.row, w.UNIX, w.date, w.time,
         w.speed, t.temperature
         FROM wind AS w JOIN temp AS t
         ON w.UNIX = t.UNIX
         """)

         1 loop, best of 5: 616 ms per loop

In [39]: wind.groupby("date")["speed"].mean().head()

Out[39]: date
         2016-09-01    6.396560
         2016-09-02    5.804086
         2016-09-03    4.960248
         2016-09-04    5.184571
         2016-09-05    5.830676
         Name: speed, dtype: float64

In [40]: %%timeit
         wind.groupby("date")["speed"].mean()

         100 loops, best of 5: 2.7 ms per loop

In [41]: pysqldf("""SELECT date, AVG(speed)
         FROM wind GROUP BY date """).head()

Out[41]:
```

	date	AVG(speed)
0	2016-09-01	6.396560
1	2016-09-02	5.804086
2	2016-09-03	4.960248
3	2016-09-04	5.184571
4	2016-09-05	5.830676

```
In [42]: %%timeit
         pysqldf("""SELECT date, AVG(speed)
         FROM wind
         GROUP BY date
         """)

         1 loop, best of 5: 234 ms per loop
```

Список литературы

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[5] Team The IPython Development. IPython 7.3.0 Documentation [Electronic resource] // Read the Docs. — 2019. — Access mode: https://ipython.readthedocs.io/en/stable/ (online; accessed: 20.02.2019).