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Кафедра «Системы обработки информации и управления»

Дисциплина «Технологии машинного обучения»

Отчёт

по лабораторной работе №2

«Изучение библиотек обработки данных»

Вариант 12

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Цель лабораторной работы:

Изучение библиотеки обработки данных Pandas.

Задание:

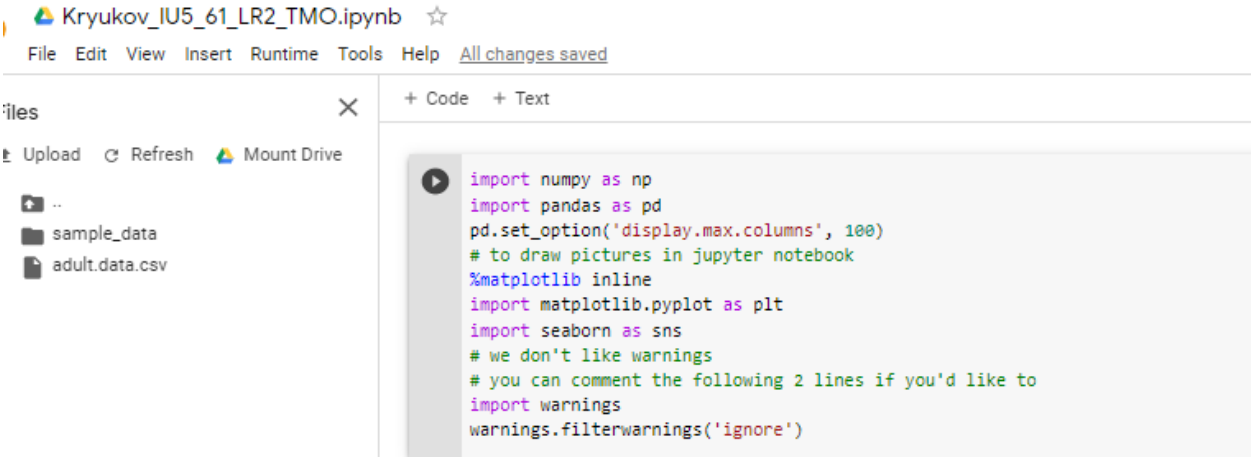
- Условие задания
  - https://nbviewer.jupyter.org/github/Yorko/mlcourse_open/blob/master/jupyter_english/assignments_demo/assignment01_pandas_uci_adult.ipynb?flush_cache=true
- Официальный датасет находится здесь, но данные и заголовки хранятся отдельно, что неудобно для анализа - https://archive.ics.uci.edu/ml/datasets/Adult
- Поэтому готовый набор данных для лабораторной работы удобнее скачать здесь - https://raw.githubusercontent.com/Yorko/mlcourse.ai/master/data/adult.data.csv (удобнее всего нажать на данной ссылке правую кнопку мыши и выбрать в контекстном меню пункт "сохранить ссылку", будет предложено сохранить файл в формате CSV)

Текст программы:

```
import numpy as np
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('/content/adult.data.csv')
data.head()


data['sex'].value_counts()


data.loc[data['sex'] == 'Female', 'age'].mean()


float((data['native-country'] == 'Germany').sum()) / data.shape[0]


ages1 = data.loc[data['salary'] == '>50K', 'age']
ages2 = data.loc[data['salary'] == '<=50K', 'age']
print("Average age of those, who recieve more than 50K per year : {0} +- {
1} years, less than 50K per year : {2} +- {3} years.".format(
    round(ages1.mean()), round(ages1.std(), 1),
```

```
    round(ages2.mean()), round(ages2.std(), 1)))

data.loc[data['salary'] == '>50K', 'education'].unique()

for (race, sex), s in data.groupby(['race', 'sex']):
    print("Race: {0}, sex: {1}".format(race, sex))
    print(s['age'].describe())

data.loc[(data['sex'] == 'Male') &
     (data['marital-status'].isin(['Never-married',
                                   'Separated',
                                   'Divorced',
                                   'Widowed'])), 'salary'].value_counts()

data.loc[(data['sex'] == 'Male') &
     (data['marital-
status'].str.startswith('Married')), 'salary'].value_counts()

data['marital-status'].value_counts()

max_load = data['hours-per-week'].max()
print("Maximum time = {0} hours./week.".format(max_load))

num_workers = data[data['hours-per-week'] == max_load].shape[0]
print("Number of workers, who work such a number of hours: {0}".format(num
_workers))

rich_share = float(data[(data['hours-per-week'] == max_load)
                  & (data['salary'] == '>50K')].shape[0]) / num_workaholics
print("Percentage of those who earn a lot (>50K) among them: {0}%".format(
int(100 * rich_share)))

for (country, salary), sub_df in data.groupby(['native-
country', 'salary']):
    print(country, salary, round(sub_df['hours-per-week'].mean(), 2))

pd.crosstab(data['native-country'], data['salary'],
            values=data['hours-per-week'], aggfunc=np.mean).T
```

Выполнение работы:




```
data = pd.read_csv('/content/adult.data.csv')
data.head()
```

	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

1. How many men and women (sex feature) are represented in this dataset?

```
data['sex'].value_counts()
```

```
Male      21790
Female    10771
Name: sex, dtype: int64
```

2. What is the average age (age feature) of women?

```
data.loc[data['sex'] == 'Female', 'age'].mean()
```

```
36.85823043357163
```

3. What is the percentage of German citizens (native-country feature)?

```
float((data['native-country'] == 'Germany').sum()) / data.shape[0]
```

```
0.004207487485028101
```

4. What are the mean and standard deviation of age for those who earn more than 50K per year (salary feature) and those who earn less than 50K per year?

m

```
ages1 = data.loc[data['salary'] == '>50K', 'age']
ages2 = data.loc[data['salary'] == '<=50K', 'age']
print("Average age of those, who recieve more than 50K per year : {0} +- {1} years, less than 50K per year : {2} +- {3} years.".format(
    round(ages1.mean()), round(ages1.std(), 1),
    round(ages2.mean()), round(ages2.std(), 1)))
```

```
Average age of those, who recieve more than 50K per year : 44 +- 10.5 years, less than 50K per year : 37 +- 14.0 years.
```

5. Is it true that people who earn more than 50K have at least high school education? (education – Bachelors, Prof-school, Assoc-acdm, Assoc-voc, Masters or Doctorate feature)

```
data.loc[data['salary'] == '>50K', 'education'].unique()
```

```
array(['HS-grad', 'Masters', 'Bachelors', 'Some-college', 'Assoc-voc',
       'Doctorate', 'Prof-school', 'Assoc-acdm', '7th-8th', '12th',
       '10th', '11th', '9th', '5th-6th', '1st-4th'], dtype=object)
```

Answer: No, it's not true

6. Display age statistics for each race (race feature) and each gender (sex feature). Use groupby() and describe(). Find the maximum age of men of Amer-Indian-Eskimo race.

```
for (race, sex), s in data.groupby(['race', 'sex']):
    print("Race: {0}, sex: {1}".format(race, sex))
    print(s['age'].describe())
```

```
Race: Amer-Indian-Eskimo, sex: Female
count    119.000000
mean      37.117647
std       13.114991
min       17.000000
25%       27.000000
50%       36.000000
75%       46.000000
max       80.000000
Name: age, dtype: float64
Race: Amer-Indian-Eskimo, sex: Male
count    192.000000
mean      37.208333
std       12.049563
min       17.000000
25%       28.000000
50%       35.000000
75%       45.000000
max       82.000000
Name: age, dtype: float64
Race: Asian-Pac-Islander, sex: Female
count    346.000000
mean      35.089595
std       12.300845
min       17.000000
25%       25.000000
50%       33.000000
75%       43.750000
max       75.000000
Name: age, dtype: float64
Race: Asian-Pac-Islander, sex: Male
count    693.000000
mean      39.073593
std       12.883944
min       18.000000
25%       29.000000
50%       37.000000
75%       46.000000
max       90.000000
Name: age, dtype: float64
Race: Black, sex: Female
count    1555.000000
mean       37.854019
std        12.637197
min        17.000000
25%        28.000000
50%        37.000000
75%        46.000000
max        90.000000
Name: age, dtype: float64
Race: Black, sex: Male
count    1569.000000
mean       37.682600
std        12.882612
min        17.000000
25%        27.000000
50%        36.000000
75%        46.000000
max        90.000000
Name: age, dtype: float64
Race: Other, sex: Female
count    109.000000
mean      31.678899
std       11.631599
min       17.000000
25%       23.000000
50%       29.000000
75%       39.000000
max       74.000000
Name: age, dtype: float64
Race: Other, sex: Male
count    162.000000
mean      34.654321
std       11.355531
min       17.000000
25%       26.000000
50%       32.000000
75%       42.000000
max       77.000000
Name: age, dtype: float64
Race: White, sex: Female
count    8642.000000
mean       36.811618
std        14.329093
min        17.000000
25%        25.000000
50%        35.000000
75%        46.000000
max        90.000000
Name: age, dtype: float64
Race: White, sex: Male
count    19174.000000
mean        39.652498
std         13.436029
min         17.000000
25%         29.000000
50%         38.000000
75%         49.000000
max         90.000000
Name: age, dtype: float64
```

Answer: maximum age of men of Amer-Indian-Eskimo race = 80

7. Among whom is the proportion of those who earn a lot (>50K) greater: married or single men (marital-status feature)? Consider as married those who have a marital-status starting with Married (Married-civ-spouse, Married-spouse-absent or Married-AF-spouse), the rest are considered bachelors.

```
data.loc[(data['sex'] == 'Male') &
     (data['marital-status'].isin(['Never-married',
                                   'Separated',
                                   'Divorced',
                                   'Widowed'])), 'salary'].value_counts()
```

```
<=50K    7552
>50K      697
Name: salary, dtype: int64
```

```
data.loc[(data['sex'] == 'Male') &
     (data['marital-status'].str.startswith('Married')), 'salary'].value_counts()
```

```
<=50K    7576
>50K     5965
Name: salary, dtype: int64
```

```
data['marital-status'].value_counts()
```

```
Married-civ-spouse       14976
Never-married            10683
Divorced                  4443
Separated                 1025
Widowed                    993
Married-spouse-absent      418
Married-AF-spouse           23
Name: marital-status, dtype: int64
```

8. What is the maximum number of hours a person works per week (hours-per-week feature)? How many people work such a number of hours, and what is the percentage of those who earn a lot (>50K) among them?

```
max_load = data['hours-per-week'].max()
print("Maximum time = {0} hours./week.".format(max_load))

num_workers = data[data['hours-per-week'] == max_load].shape[0]
print("Number of workers, who work such a number of hours: {0}".format(num_workers))

rich_share = float(data[(data['hours-per-week'] == max_load)
                & (data['salary'] == '>50K')].shape[0]) / num_workers
print("Percentage of those who earn a lot (>50K) among them: {0}%".format(int(100 * rich_share)))
```

```
Maximum time = 99 hours./week.
Number of workers, who work such a number of hours: 85
Percentage of those who earn a lot (>50K) among them: 29%
```

9. Count the average time of work (hours-per-week) for those who earn a little and a lot (salary) for each country (native-country). What will these be for Japan?

```
for (country, salary), sub_df in data.groupby(['native-country', 'salary']):
    print(country, salary, round(sub_df['hours-per-week'].mean(), 2))
```

```
? <=50K 40.16
? >50K 45.55
Cambodia <=50K 41.42
Cambodia >50K 40.0
Canada <=50K 37.91
Canada >50K 45.64
China <=50K 37.38
China >50K 38.9
Columbia <=50K 38.68
Columbia >50K 50.0
Cuba <=50K 37.99
Cuba >50K 42.44
Dominican-Republic <=50K 42.34
Dominican-Republic >50K 47.0
Ecuador <=50K 38.04
Ecuador >50K 48.75
El-Salvador <=50K 36.03
El-Salvador >50K 45.0
England <=50K 40.48
England >50K 44.53
France <=50K 41.06
France >50K 50.75
Germany <=50K 39.14
Germany >50K 44.98
Greece <=50K 41.81
Greece >50K 50.62
Guatemala <=50K 39.36
Guatemala >50K 36.67
Haiti <=50K 36.33
Haiti >50K 42.75
Holand-Netherlands <=50K 40.0
Honduras <=50K 34.33
Honduras >50K 60.0
Hong <=50K 39.14
Hong >50K 45.0
Hungary <=50K 31.3
Hungary >50K 50.0
India <=50K 38.23
India >50K 46.48
Iran <=50K 41.44
Iran >50K 47.5
Ireland <=50K 40.95
Ireland >50K 48.0
Italy <=50K 39.62
Italy >50K 45.4
Jamaica <=50K 38.24
Jamaica >50K 41.1
```

```
pd.crosstab(data['native-country'], data['salary'],
            values=data['hours-per-week'], aggfunc=np.mean).T
```

native-country	?	Cambodia	Canada	China	Columbia	Cuba	Dominican-Republic	Ecuador	El-Salvador	England	France	Germany	Greece
salary													
<=50K	40.164760	41.416667	37.914634	37.381818	38.684211	37.985714	42.338235	38.041667	36.030928	40.483333	41.058824	39.139785	41.809524
>50K	45.547945	40.000000	45.641026	38.900000	50.000000	42.440000	47.000000	48.750000	45.000000	44.533333	50.750000	44.977273	50.625000

:	Guatemala	Haiti	Holand-Netherlands	Honduras	Hong	Hungary	India	Iran	Ireland	Italy	Jamaica	Japan	Laos	Mexico	Nicaragua	Outlying-US(Guam-USVI-etc)	Peru	Philippines	Poland	Portugal	Puerto-Rico	Scotland	
:	39.360656	36.325	40.0	34.333333	39.142857	31.3	38.233333	41.44	40.947368	39.625	38.239437	41.000000	40.375	40.003279	36.09375	41.857143	35.068966	38.065693	38.166667	41.939394	38.470588	39.444444	:
)	36.666667	42.750	NaN	60.000000	45.000000	50.0	46.475000	47.50	48.000000	45.400	41.100000	47.958333	40.000	46.575758	37.50000	NaN	40.000000	43.032787	39.000000	41.500000	39.416667	46.666667	:

South	Taiwan	Thailand	Trinadad&Tobago	United-States	Vietnam	Yugoslavia
40.15625	33.774194	42.866667	37.058824	38.799127	37.193548	41.6
51.43750	46.800000	58.333333	40.000000	45.505369	39.200000	49.5