Федеральное государственное бюджетное образовательное учреждение
высшего профессионального образования
«Московский государственный технический университет имени Н.Э. Баумана»
(МГТУ им. Н.Э. Баумана)

Лабораторная работа 4
по курсу «Технологии машинного обучения»

Выполнил
студент группы ИУ5-64
XXX

Москва, 2021

Цель работы

изучение линейных моделей, SVM и деревьев решений.

Задание

1. Выберите набор данных (датасет) для решения задачи классификации или регрессии.
2. В случае необходимости проведите удаление или заполнение пропусков и кодирование категориальных признаков.
3. С использованием метода train_test_split разделите выборку на обучающую и тестовую.
4. Обучите следующие модели:
    - одну из линейных моделей;
    - SVM;
    - дерево решений.
5. Оцените качество моделей с помощью двух подходящих для задачи метрик. Сравните качество полученных моделей.

Дополнительные задания

1. Проведите эксперименты с важностью признаков в дереве решений.
2. Визуализируйте дерево решений.

Ход работы

In [1]:
```
# Загрузка данных
import pandas as pd
data = pd.read_csv("../2/melbourne_housing.csv")
```

In [2]:
```
display(data.dtypes), display(data.head()), display(data.isnull().sum());
```

```
Suburb            object
Address           object
Rooms              int64
Type              object
Price            float64
Method            object
SellerG           object
Date              object
Distance         float64
Postcode         float64
Bedroom2         float64
Bathroom         float64
Car              float64
Landsize         float64
BuildingArea     float64
YearBuilt        float64
CouncilArea       object
Lattitude        float64
Longtitude       float64
Regionname        object
Propertycount    float64
dtype: object
```

	Suburb	Address	Rooms	Type	Price	Method	SellerG	Date	Distance	Postcode	...	Bathroom	Car	Landsize	BuildingArea
0	Abbotsford	68 Studley St	2	h	NaN	SS	Jellis	3/09/2016	2.5	3067.0	...	1.0	1.0	126.0	NaN
1	Abbotsford	85 Turner St	2	h	1480000.0	S	Biggin	3/12/2016	2.5	3067.0	...	1.0	1.0	202.0	NaN
2	Abbotsford	25 Bloomburg St	2	h	1035000.0	S	Biggin	4/02/2016	2.5	3067.0	...	1.0	0.0	156.0	79.0
3	Abbotsford	18/659 Victoria St	3	u	NaN	VB	Rounds	4/02/2016	2.5	3067.0	...	2.0	1.0	0.0	NaN
4	Abbotsford	5 Charles St	3	h	1465000.0	SP	Biggin	4/03/2017	2.5	3067.0	...	2.0	0.0	134.0	150.0

5 rows × 21 columns

```
Suburb               0
Address              0
Rooms                0
Type                 0
Price             7610
Method               0
SellerG              0
Date                 0
Distance             1
Postcode             1
Bedroom2          8217
Bathroom          8226
Car               8728
Landsize         11810
BuildingArea     21115
YearBuilt        19306
CouncilArea          3
Lattitude         7976
Longtitude        7976
Regionname           3
Propertycount        3
dtype: int64
```

In [3]:
```
import numpy as np
from sklearn.preprocessing import LabelEncoder

columns_and_types = {
  "Rooms": np.int64,
  "Type": None,
  "Price": np.int64,
  "Distance": np.float64,
```

```python
    "Postcode": np.int64,
    "Bedroom2": np.int64,
    "Bathroom": np.int64,
    "Car": np.int64,
    "Landsize": np.float64,
    "BuildingArea": np.float64,
    "YearBuilt": np.int64,
    "Lattitude": np.float64,
    "Longtitude": np.float64,
    "Propertycount": np.int64,
}

data = data[list(columns_and_types.keys())]
data.dropna(axis=0, how='any', inplace=True)
data = data.astype({k: v for k,v in columns_and_types.items() if v is not None})

type_encoder = LabelEncoder()
data["Type"] = type_encoder.fit_transform(data["Type"])
```

In [4]:

```python
display(data.shape), display(data.dtypes)
```

```
(8887, 14)


Rooms              int64
Type               int64
Price              int64
Distance         float64
Postcode           int64
Bedroom2           int64
Bathroom           int64
Car                int64
Landsize         float64
BuildingArea     float64
YearBuilt          int64
Lattitude        float64
Longtitude       float64
Propertycount      int64
dtype: object
```

Out[4]: (None, None)

In [5]:

```python
data.head()
```

Out[5]:

	Rooms	Type	Price	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	BuildingArea	YearBuilt	Lattitude	Longtitude	Propertyc
2	2	0	1035000	2.5	3067	2	1	0	156.0	79.0	1900	-37.8079	144.9934	4
4	3	0	1465000	2.5	3067	3	2	0	134.0	150.0	1900	-37.8093	144.9944	4
6	4	0	1600000	2.5	3067	3	1	2	120.0	142.0	2014	-37.8072	144.9941	4
11	3	0	1876000	2.5	3067	4	2	0	245.0	210.0	1910	-37.8024	144.9993	4
14	2	0	1636000	2.5	3067	2	1	2	256.0	107.0	1890	-37.8060	144.9954	4

In [6]:

```python
from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
for col in data.columns:
  if col != "Price":
    data[col] = scaler.fit_transform(data[[col]])
```

In [7]:

```python
data.head()
```

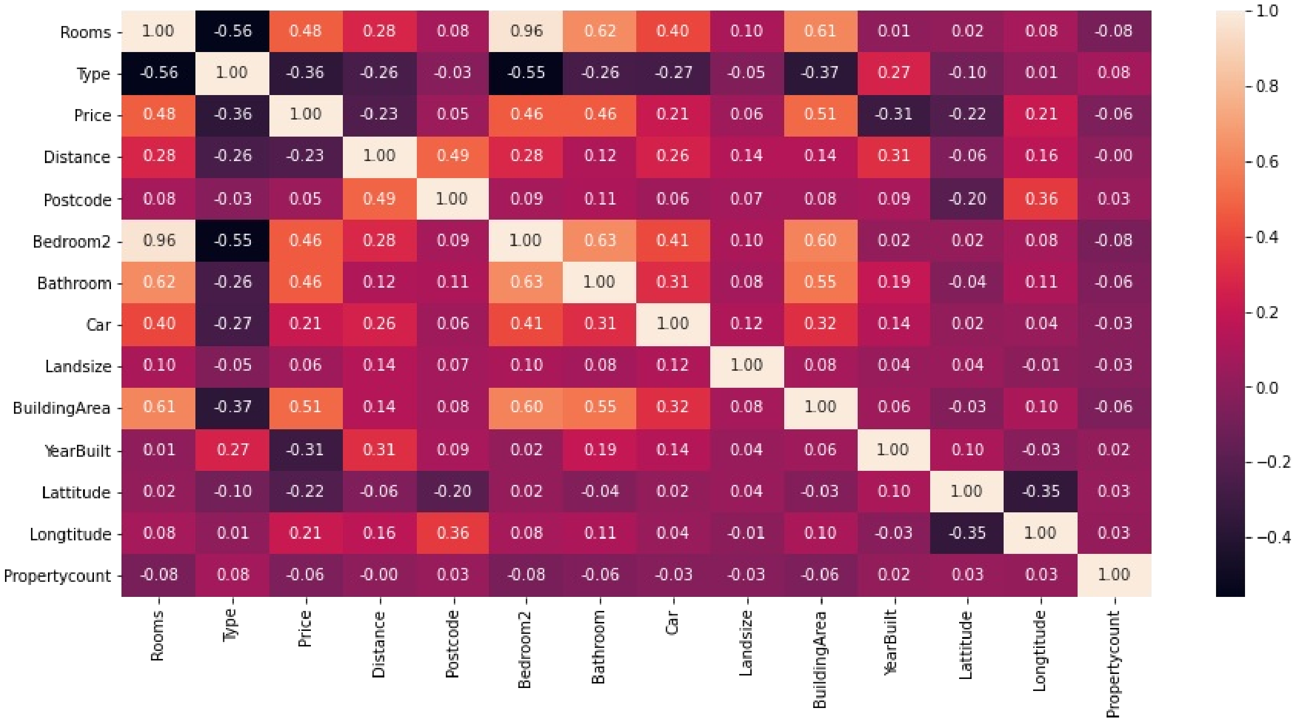
Out[7]:

	Rooms	Type	Price	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	BuildingArea	YearBuilt	Lattitude	Longtitu
2	-1.140264	-0.556327	1035000	-1.27695	-0.396621	-1.115905	-0.895892	-1.734910	-0.346267	-0.799693	-1.775256	-0.037540	0.0168
4	-0.102631	-0.556327	1465000	-1.27695	-0.396621	-0.080939	0.489973	-1.734910	-0.366997	0.007854	-1.775256	-0.053003	0.0252
6	0.935002	-0.556327	1600000	-1.27695	-0.396621	-0.080939	-0.895892	0.315512	-0.380188	-0.083137	1.302598	-0.029809	0.0227
11	-0.102631	-0.556327	1876000	-1.27695	-0.396621	0.954028	0.489973	-1.734910	-0.262404	0.690288	-1.505269	0.023204	0.0664
14	-1.140264	-0.556327	1636000	-1.27695	-0.396621	-1.115905	-0.895892	0.315512	-0.252039	-0.481224	-2.045243	-0.016556	0.0336

In [8]:

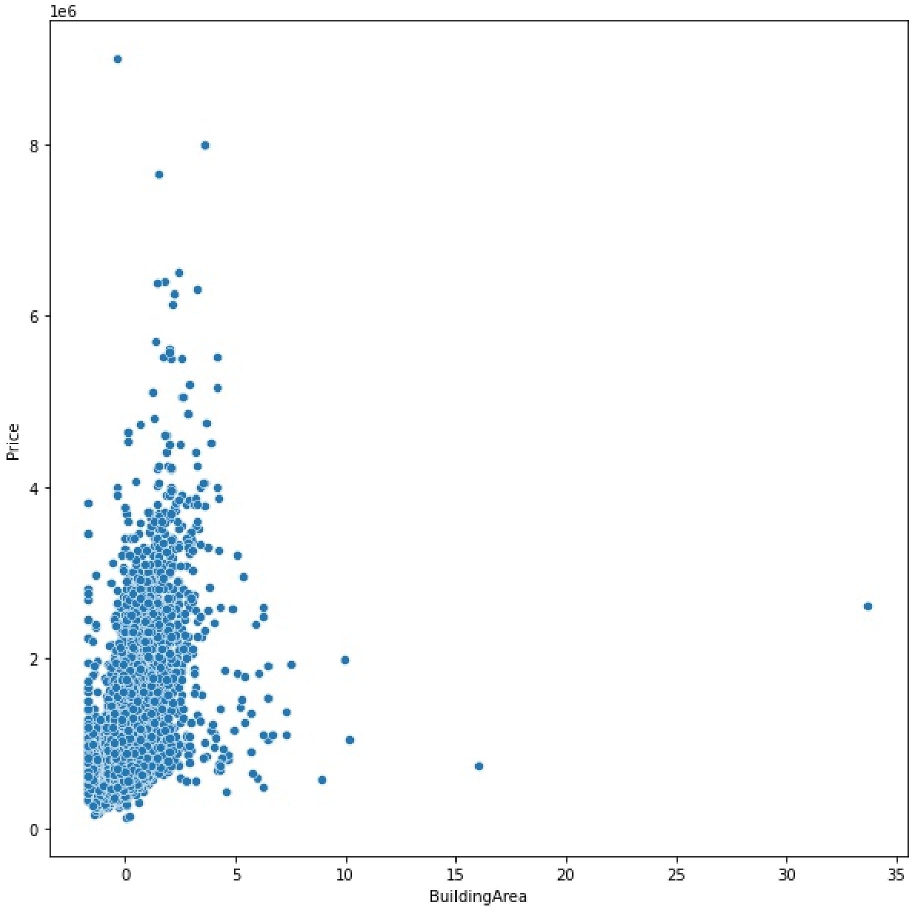
```python
import seaborn as sns
import matplotlib.pyplot as plt

fig, ax = plt.subplots(figsize=(15,7))
sns.heatmap(data.corr(method="pearson"), ax=ax, annot=True, fmt='.2f');
```



In [9]:

```python
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x="BuildingArea", y="Price", data=data);
```



Линейная регрессия

In [10]:

```python
from sklearn.model_selection import train_test_split
```

```
data_X = data.loc[:, [x for x in data.columns if x != "Price"]]
data_Y = data.loc[:, 'Price']
data_X_train, data_X_test, data_y_train, data_y_test = train_test_split(
  data_X,
  data_Y,
  test_size=0.2,
  random_state=1
)
```

In [11]:

```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score, mean_absolute_percentage_error

# Обучим линейную регрессию и сравним коэффициенты с рассчитанными ранее
reg1 = LinearRegression()
reg1.fit(data_X_train, data_y_train)
y_pred = reg1.predict(data_X_test)
r2_score(data_y_test, y_pred), mean_absolute_percentage_error(data_y_test, y_pred)
```

Out[11]:

```
(0.6175514371440386, 0.26894243290410874)
```

SVR

In [12]:

```
from sklearn.svm import SVR

svr = SVR(max_iter=10000, kernel="rbf", C=1e6)
svr.fit(data_X_train, data_y_train);
```

```
/usr/lib/python3.9/site-packages/sklearn/svm/_base.py:255: ConvergenceWarning: Solver terminated early (max_iter=
10000).  Consider pre-processing your data with StandardScaler or MinMaxScaler.
  warnings.warn('Solver terminated early (max_iter=%i).'
```

In [13]:

```
y_pred = svr.predict(data_X_test)
```

In [14]:

```
r2_score(data_y_test, y_pred), mean_absolute_percentage_error(data_y_test, y_pred)
```

Out[14]:

```
(0.8007830168563735, 0.15056431505942702)
```

Деревья решений

In [15]:

```
# Обучим дерево и предскажем результаты
from sklearn.tree import DecisionTreeRegressor

tree_regr = DecisionTreeRegressor(random_state=1, max_depth=7).fit(data_X_train, data_y_train)
y_test_predict = tree_regr.predict(data_X_test)
y_test_predict.shape
```

Out[15]:

```
(1778,)
```

In [16]:

```
r2_score(data_y_test, y_test_predict)
```

Out[16]:

```
0.6626220166750287
```

In [17]:

```
list(
  zip(
    data_X_train.columns.values,
    tree_regr.feature_importances_
  )
)
```

Out[17]:

```
[('Rooms', 0.005024582426006323),
 ('Type', 0.01650526758281762),
```

```
 ('Distance', 0.16679148277830835),
 ('Postcode', 0.09971740359027761),
 ('Bedroom2', 0.0006393899010610526),
 ('Bathroom', 0.011851644859025727),
 ('Car', 0.0),
 ('Landsize', 0.0506516356530368),
 ('BuildingArea', 0.4239520690926708),
 ('YearBuilt', 0.129300603225875),
 ('Lattitude', 0.06167573602026102),
 ('Longtitude', 0.032645389732301903),
 ('Propertycount', 0.0012447951383578269)]
```

In [18]:

```python
# Визуализация дерева
from sklearn.tree import export_graphviz
from io import StringIO
import pydot

def get_png_tree(tree_model_param, feature_names_param):
  dot_data = StringIO()
  export_graphviz(
    tree_model_param, out_file=dot_data,
    feature_names=feature_names_param, filled=True,
    rounded=True, special_characters=True
  )
  (graph,) = pydot.graph_from_dot_data(dot_data.getvalue())
  return graph.create_png()
```

In [19]:

```python
tree_regr_depth3 = DecisionTreeRegressor(
  random_state=1,
  max_depth=3
).fit(data_X_train, data_y_train)
tree_regr_depth3
```

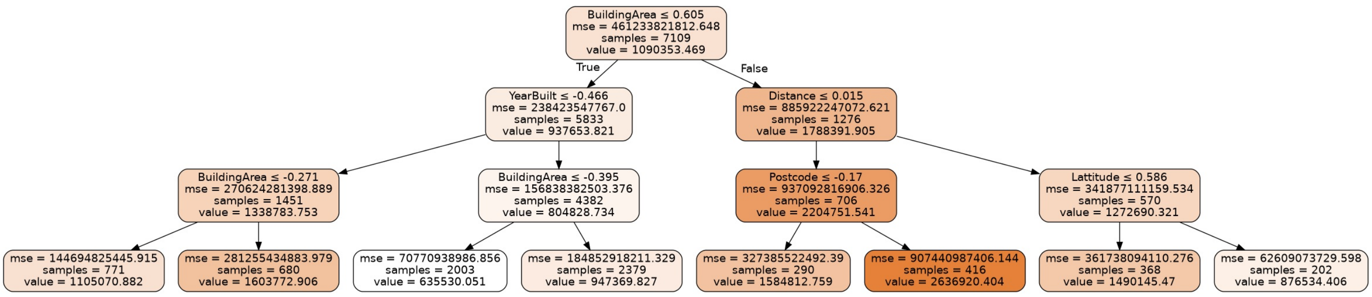
Out[19]:

```
DecisionTreeRegressor(max_depth=3, random_state=1)
```

In [20]:

```python
from IPython.display import Image
Image(get_png_tree(tree_regr_depth3, [x for x in data.columns if x != "Price"]))
```

Out[20]:



In [ ]:

Loading [MathJax]/jax/output/CommonHTML/fonts/TeX/fontdata.js