```python
# Импортируем все необходимые библиотеки

import pandas as pd
import numpy as np
from sqlalchemy import create_engine

from dotenv import load_dotenv
from catboost import CatBoostClassifier
import os
import gc
import warnings

warnings.filterwarnings("ignore")

# Загружаем переменные окружения из .env файла
load_dotenv()
```

```
True
```

```python
# Создаем URL для SQLAlchemy
SQLALCHEMY_DATABASE_URL = (
    f"postgresql://"
    f"{os.getenv('POSTGRES_USER')}:{os.getenv('POSTGRES_PASSWORD')}@"
    f"{os.getenv('POSTGRES_HOST')}:{os.getenv('POSTGRES_PORT')}/"
    f"{os.getenv('POSTGRES_DATABASE')}"
)
engine = create_engine(SQLALCHEMY_DATABASE_URL)
connection = engine.connect().execution_options(stream_results=True)

# Данные по пользователям

user_info = pd.read_sql("""SELECT * FROM public.user_data""",
con=connection)

user_info.head()
```

	user_id	gender	age	country	city	exp_group	os	source
0	200	1	34	Russia	Degtyarsk	3	Android	ads
1	201	0	37	Russia	Abakan	0	Android	ads
2	202	1	17	Russia	Smolensk	4	Android	ads
3	203	0	18	Russia	Moscow	1	iOS	ads
4	204	0	36	Russia	Anzhero-Sudzhensk	3	Android	ads

```python
# Посты и топики
```

```
posts_info = pd.read_sql(
    """SELECT * FROM
posts_info_deep_features_ruslan_prashchurovich""", con=connection
)

posts_info.head()
```

```
   post_id                                               text
topic  \
0        1  UK economy facing major risks\n\nThe UK manufa...
business
1        2  Aids and climate top Davos agenda\n\nClimate c...
business
2        3  Asian quake hits European shares\n\nShares in ...
business
3        4  India power shares jump on debut\n\nShares in ...
business
4        5  Lacroix label bought by US firm\n\nLuxury good...
business

   TextCluster  DistanceTo1thCluster  DistanceTo2thCluster  \
0           12              3.803364              3.641078
1           12              3.610889              3.381778
2           12              3.647826              3.428573
3           11              3.133031              3.879746
4           11              3.528582              3.251030

   DistanceTo3thCluster  DistanceTo4thCluster  DistanceTo5thCluster  \
0              3.503630              3.033075              2.276970
1              3.169918              2.885389              2.292614
2              3.177275              3.095651              3.101687
3              3.885824              3.391752              3.506583
4              3.060982              2.880629              3.147450

   DistanceTo6thCluster  DistanceTo7thCluster  DistanceTo8thCluster  \
0              3.463066              3.508869              3.406232
1              3.320669              3.285646              3.387437
2              3.435107              3.458061              3.546807
3              3.885024              4.156692              3.799252
4              3.021023              3.433394              3.007250

   DistanceTo9thCluster  DistanceTo10thCluster  DistanceTo11thCluster
\
0              3.463735               3.413809               2.417847

1              3.375190               3.364406               2.386165

2              3.416218               3.330880               2.493758

3              3.836481               3.627957               2.957552
```

```
4               3.059660                3.250440                2.337950


   DistanceTo12thCluster  DistanceTo13thCluster  DistanceTo14thCluster
\
0               1.983550               1.912621               3.475528

1               2.246995               1.478820               3.019533

2               1.920925               1.855948               3.039433

3               2.575662               2.617805               3.820382

4               1.870461               2.439339               2.901595


   DistanceTo15thCluster
0               2.879717
1               2.602994
2               2.946122
3               3.488249
4               2.430091
```

```
# Попробуем забрать, скажем, 9 миллионов

feed_data = pd.read_sql(
    """SELECT * FROM feed_data WHERE action = 'view' LIMIT 9000000""",
con=connection
)

feed_data.head()
```

```
             timestamp  user_id  post_id action  target
0 2021-12-08 22:04:36    42882     2735   view       0
1 2021-12-08 22:07:34    42882     7030   view       0
2 2021-12-08 22:09:35    42882     5254   view       0
3 2021-12-08 22:11:55    42882     6703   view       1
4 2021-12-08 22:13:37    42882     4919   view       0
```

```
# Воспроизведем датафрейм со всеми новыми фичами
df = pd.merge(feed_data, posts_info, on="post_id", how="left")
df = pd.merge(df, user_info, on="user_id", how="left")

df.head()
```

```
             timestamp  user_id  post_id action  target  \
0 2021-12-08 22:04:36    42882     2735   view       0
1 2021-12-08 22:07:34    42882     7030   view       0
2 2021-12-08 22:09:35    42882     5254   view       0
3 2021-12-08 22:11:55    42882     6703   view       1
```

```
4 2021-12-08 22:13:37    42882     4919   view       0

                                                text  topic
TextCluster  \
0  August 16 : Positive cases reported worldwide ...  covid
9
1  Two great stars and a legendary Director creat...  movie
5
2  There is a phrase by the experimental filmmake...  movie
7
3  This is part one of a short animation clip sho...  movie
7
4  Upon seeing this film once again it appeared i...  movie
7

   DistanceTo1thCluster  DistanceTo2thCluster  ...
DistanceTo13thCluster  \
0              3.022972              2.280955  ...
3.039004
1              2.315958              2.960218  ...
3.097284
2              2.597711              3.045479  ...
3.129618
3              2.814192              3.039721  ...
3.282229
4              2.434556              3.357298  ...
3.631477

   DistanceTo14thCluster  DistanceTo15thCluster  gender  age  country
\
0               3.507603               3.167144       1   22  Ukraine

1               2.671299               2.013590       1   22  Ukraine

2               3.293925               2.402410       1   22  Ukraine

3               3.584455               2.751610       1   22  Ukraine

4               3.467985               2.620096       1   22  Ukraine


         city  exp_group       os  source
0  Simferopol          0  Android     ads
1  Simferopol          0  Android     ads
2  Simferopol          0  Android     ads
3  Simferopol          0  Android     ads
4  Simferopol          0  Android     ads

[5 rows x 30 columns]
```

```python
# А еще научимся выделять признаки из даты
df["hour"] = pd.to_datetime(df["timestamp"]).apply(lambda x: x.hour)
df["month"] = pd.to_datetime(df["timestamp"]).apply(lambda x: x.month)

# Циклическое кодирование
df["hour_sin"] = np.sin(2 * np.pi * df["hour"] / 24)
df["hour_cos"] = np.cos(2 * np.pi * df["hour"] / 24)
df["month_sin"] = np.sin(2 * np.pi * df["month"] / 12)
df["month_cos"] = np.cos(2 * np.pi * df["month"] / 12)

df.head()
```

```
            timestamp  user_id  post_id action  target  \
0 2021-12-08 22:04:36    42882     2735   view       0
1 2021-12-08 22:07:34    42882     7030   view       0
2 2021-12-08 22:09:35    42882     5254   view       0
3 2021-12-08 22:11:55    42882     6703   view       1
4 2021-12-08 22:13:37    42882     4919   view       0

                                                text  topic
TextCluster  \
0  August 16 : Positive cases reported worldwide ...  covid
9
1  Two great stars and a legendary Director creat...  movie
5
2  There is a phrase by the experimental filmmake...  movie
7
3  This is part one of a short animation clip sho...  movie
7
4  Upon seeing this film once again it appeared i...  movie
7

   DistanceTo1thCluster  DistanceTo2thCluster  ...        city
exp_group  \
0              3.022972              2.280955  ...  Simferopol
0
1              2.315958              2.960218  ...  Simferopol
0
2              2.597711              3.045479  ...  Simferopol
0
3              2.814192              3.039721  ...  Simferopol
0
4              2.434556              3.357298  ...  Simferopol
0

        os  source  hour  month  hour_sin  hour_cos     month_sin
month_cos
0  Android     ads    22     12      -0.5  0.866025 -2.449294e-16
1.0
1  Android     ads    22     12      -0.5  0.866025 -2.449294e-16
```

```
1.0
2  Android     ads    22     12      -0.5  0.866025 -2.449294e-16
1.0
3  Android     ads    22     12      -0.5  0.866025 -2.449294e-16
1.0
4  Android     ads    22     12      -0.5  0.866025 -2.449294e-16
1.0

[5 rows x 36 columns]
```

```
# Уберем все ненужные колонки

df = df.drop(
    columns=[
        #    'timestamp',  # timestamp пока оставим
        "action",
        "text",
    ],
    axis=1,
)

# Почистим переменные

del user_info
del posts_info
del feed_data

gc.collect()
```

```
0
```

```
# За отсечку возьмем 2021-12-10

X_train = df[df.timestamp < "2021-12-10"].drop(
    columns=["timestamp", "target", "user_id", "post_id"], axis=1
)
X_test = df[df.timestamp >= "2021-12-10"].drop(
    columns=["timestamp", "target", "user_id", "post_id"], axis=1
)

y_train = df[df.timestamp < "2021-12-10"]["target"]
y_test = df[df.timestamp >= "2021-12-10"]["target"]

y_train.shape, y_test.shape
```

```
((7022750,), (1977250,))
```

```
object_cols = [
    "topic",
    "TextCluster",
    "gender",
```

```
    "country",
    "city",
    "exp_group",
    "hour",
    "month",
    "os",
    "source",
]

# Теперь обучим катбуст!

seed = 104773
catboost = CatBoostClassifier(
    iterations=150,
    learning_rate=1,
    depth=5,
    cat_features=object_cols,
    verbose=0,
    random_state=seed,
)

catboost.fit(X_train, y_train, eval_set=(X_test, y_test), verbose=25)
```

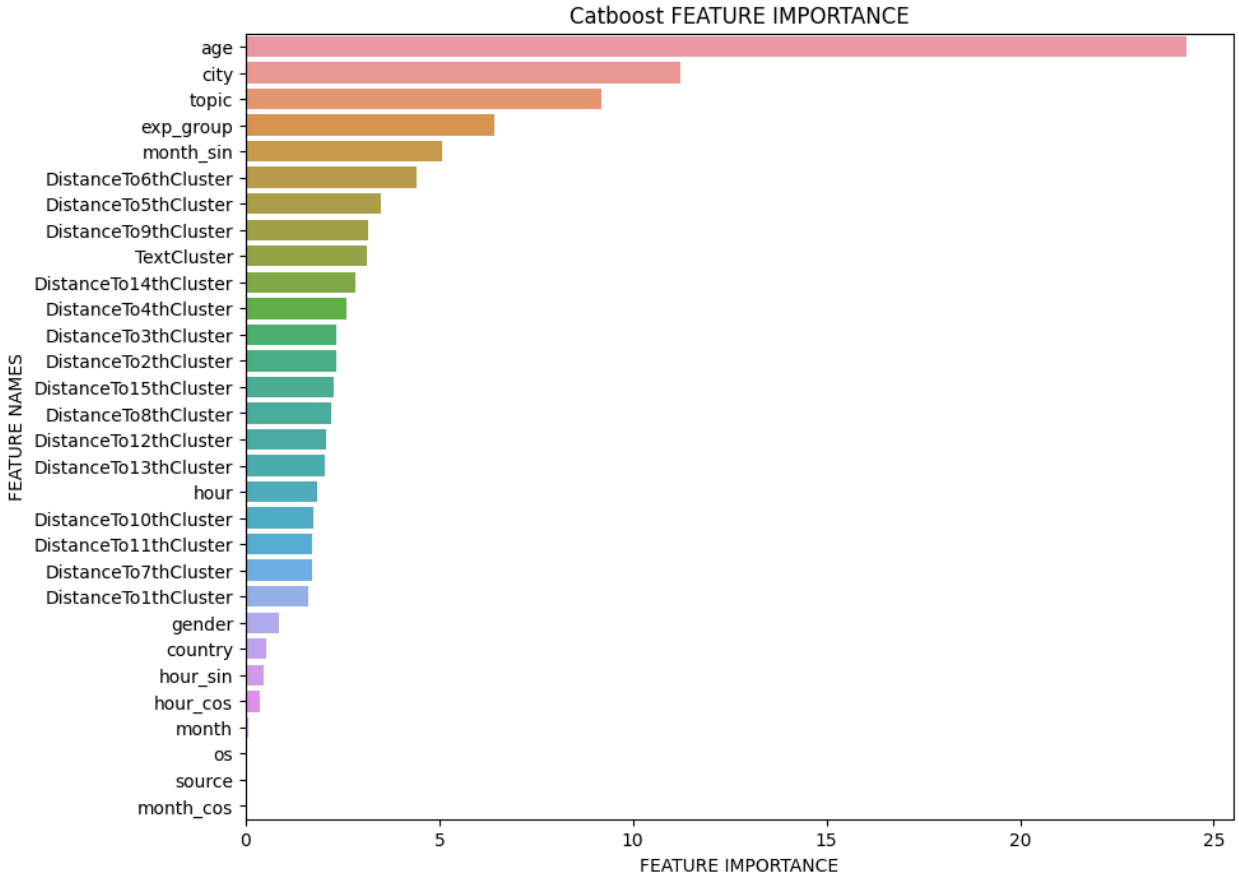
```
0:    learn: 0.3501954 test: 0.3979274 best: 0.3979274 (0)   total:
3.57s remaining: 8m 51s
25:   learn: 0.3336461 test: 0.3826401 best: 0.3826401 (25)  total: 1m
10s   remaining: 5m 35s
50:   learn: 0.3320140 test: 0.3813357 best: 0.3813357 (50)  total: 2m
15s   remaining: 4m 23s
75:   learn: 0.3309672 test: 0.3805449 best: 0.3805449 (75)  total: 3m
20s   remaining: 3m 15s
100:  learn: 0.3301099 test: 0.3798958 best: 0.3798958 (100) total: 4m
26s   remaining: 2m 9s
125:  learn: 0.3294021 test: 0.3793390 best: 0.3793390 (125) total: 5m
32s   remaining: 1m 3s
149:  learn: 0.3288363 test: 0.3788989 best: 0.3788989 (149) total: 6m
34s   remaining: 0us

bestTest = 0.3788988851
bestIteration = 149


<catboost.core.CatBoostClassifier at 0x7be05e2e1d10>
```

```
# Замерим качество работы такой модели
# Возьмем ROC-AUC
from sklearn.metrics import roc_auc_score

print(
    f"Качество на трейне: {roc_auc_score(y_train,
catboost.predict_proba(X_train)[:, 1])}"
```

```
)
print(
    f"Качество на тесте: {roc_auc_score(y_test,
catboost.predict_proba(X_test)[:, 1])}"
)
```

```
Качество на трейне: 0.7009932883886382
Качество на тесте: 0.66890297876064
```

```
# Из любопытства посмотрим на feature_importance

import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt


def plot_feature_importance(importance, names, model_type):

    # Создадим массивы важности и названий признаков
    feature_importance = np.array(importance)
    feature_names = np.array(names)

    # Создадим датафрейм из словаря
    data = {"feature_names": feature_names, "feature_importance":
feature_importance}
    fi_df = pd.DataFrame(data)

    # Отсортируем по важности
    fi_df.sort_values(by=["feature_importance"], ascending=False,
inplace=True)

    # Определим размер графика
    plt.figure(figsize=(10, 8))
    # Нарисуем
    sns.barplot(x=fi_df["feature_importance"],
y=fi_df["feature_names"])
    # Добавим подписи
    plt.title(model_type + " FEATURE IMPORTANCE")
    plt.xlabel("FEATURE IMPORTANCE")
    plt.ylabel("FEATURE NAMES")


plot_feature_importance(catboost.feature_importances_,
X_train.columns, "Catboost")
```




```
# Сохраним модель
catboost.save_model("catboost_model_advanced", format="cbm")
```