```
In [1]: # Загрузим обучающую и экзаменационную выборку
        ## Вариант №11: [misc.forsale, sci.med, talk.religion.misc]
```

```
In [2]: import warnings
        import nltk
        from sklearn.datasets import fetch_20newsgroups
        warnings.simplefilter(action='ignore', category=FutureWarning)
```

```
In [3]: categories = ['misc.forsale', 'sci.med', 'talk.religion.misc']
        remove = ['headers', 'footers', 'quotes']

        twenty_train_full = fetch_20newsgroups(subset='train', categories=categories, sh
        twenty_test_full = fetch_20newsgroups(subset='test', categories=categories, shuf
```

```
In [4]: twenty_train_full.data[0]
```

```
Out[4]: "\nNot to mention the thread about selling someone's wife. I am a guy, therefor
        e\nnot overly bummed by it, but a little common sense would dictate that this\n
        is offensive to many women, and not really necessary.\n\n-- \n-----------------
        -----------------------------------------------------\nScott Ferguson
        Exxon Research & Engineering Co.\nProject Engineer                        New Jer
        sey"
```

```
In [5]: twenty_test_full.data[0]
```

```
Out[5]: 'I have two brand new Dayna Etherprint Adapters (10baset) for sale.\nThey conve
        rt ethertalk to localtalk. This is useful when wanting to\nhook up a localtalk
        network printer to a ethertalk(10baset) network.\nThey sell for $350 each in Ma
        c Warehouse. Will take $100 each.\nGuaranteed.\n\nemail response to atg@virgini
        a.edu'
```

Применение стемминга

```
In [6]: import nltk
        from nltk import word_tokenize
        from nltk.stem import *

        nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\Vitaly\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
```

```
Out[6]: True
```

```
In [7]: def stemming(data):
            porter_stemmer = PorterStemmer()
            stem = []
            for text in data:
                nltk_tokens = word_tokenize(text)
                line = ''.join([' ' + porter_stemmer.stem(word) for word in nltk_tokens]
                stem.append(line)
            return stem
```

In [8]:
```
stem_train = stemming(twenty_train_full.data)
stem_test = stemming(twenty_test_full.data)
```

In [9]:
```
stem_train[0]
```

Out[9]:
```
" not to mention the thread about sell someon 's wife . i am a guy , therefor n
ot overli bum by it , but a littl common sens would dictat that thi is offens t
o mani women , and not realli necessari . -- -- -- -- -- -- -- -- -- -- -- -- -
- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- scott fe
rguson exxon research & engin co. project engin new jersey"
```

In [10]:
```
stem_test[0]
```

Out[10]:
```
' i have two brand new dayna etherprint adapt ( 10baset ) for sale . they conve
rt ethertalk to localtalk . thi is use when want to hook up a localtalk network
printer to a ethertalk ( 10baset ) network . they sell for $ 350 each in mac wa
rehous . will take $ 100 each . guarante . email respons to atg @ virginia.edu'
```

Векторизация выборки

Векторизация обучающей и тестовой выборки простым подсчетом слов (CountVectorizer) и значением max_features = 10.000

In [11]:
```
import numpy as np
from sklearn.feature_extraction.text import CountVectorizer
```

In [12]:
```
vect_without_stop = CountVectorizer(max_features=10000)
```

In [13]:
```
train_data = vect_without_stop.fit_transform(twenty_train_full.data)
test_data = vect_without_stop.transform(twenty_test_full.data)
```

In [14]:
```
def sort_by_tf(input_str):
    return input_str[1]

def top_terms(vector, data, count):
    x = list(zip(vector.get_feature_names_out(), np.ravel(data.sum(axis=0))))
    x.sort(key=sort_by_tf, reverse=True)
    return x[:count]
```

In [15]:
```
top_terms_without_stop = [{term[0]: term[1]} for term in top_terms(vect_without_
top_terms_without_stop

top_terms_without_stop_test = [{term[0]: term[1]} for term in top_terms(vect_wit
top_terms_without_stop_test
```

```
Out[15]: [{'the': 7706},
 {'of': 4314},
 {'to': 4227},
 {'and': 3922},
 {'in': 2670},
 {'is': 2596},
 {'that': 2302},
 {'for': 2017},
 {'it': 1819},
 {'you': 1541},
 {'have': 1230},
 {'with': 1157},
 {'are': 1149},
 {'this': 1149},
 {'not': 1084},
 {'or': 1009},
 {'be': 1002},
 {'as': 932},
 {'on': 926},
 {'if': 790}]
```

Отсечение стоп-слов

```
In [16]: vect_stop = CountVectorizer(max_features=10000, stop_words='english')
```

```
In [17]: train_data_stop = vect_stop.fit_transform(twenty_train_full.data)
         test_data_stop = vect_stop.transform(twenty_test_full.data)
```

```
In [18]: top_terms_stop = [{term[0]: term[1]} for term in top_terms(vect_stop, train_data
         top_terms_stop

         top_terms_stop_test = [{term[0]: term[1]} for term in top_terms(vect_stop, test_
         top_terms_stop_test
```

```
Out[18]: [{'00': 560},
 {'10': 351},
 {'god': 328},
 {'like': 314},
 {'new': 306},
 {'know': 301},
 {'don': 292},
 {'people': 288},
 {'just': 249},
 {'good': 242},
 {'20': 239},
 {'time': 228},
 {'edu': 220},
 {'50': 214},
 {'12': 212},
 {'does': 205},
 {'92': 204},
 {'use': 204},
 {'25': 202},
 {'medical': 201}]
```

Для данных после стемминга

Без стоп-слов

In [19]:
```
vect_stem_without_stop = CountVectorizer(max_features=10000)
```

In [20]:
```
train_data_without_stop_stem = vect_stem_without_stop.fit_transform(stem_train)
test_data_without_stop_stem = vect_stem_without_stop.transform(stem_test)
```

In [21]:
```
top_terms_stem = [{term[0]: term[1]} for term in top_terms(vect_stem_without_sto
top_terms_stem

top_terms_stem_test = [{term[0]: term[1]} for term in top_terms(vect_stem_withou
top_terms_stem_test
```

Out[21]:
```
[{'the': 7706},
 {'of': 4314},
 {'to': 4227},
 {'and': 3923},
 {'in': 2671},
 {'is': 2633},
 {'that': 2306},
 {'for': 2017},
 {'it': 1916},
 {'you': 1540},
 {'have': 1317},
 {'thi': 1199},
 {'are': 1167},
 {'with': 1157},
 {'be': 1143},
 {'not': 1116},
 {'or': 1009},
 {'on': 933},
 {'as': 931},
 {'do': 800}]
```

С использованием стоп-слов

In [22]:
```
vect_stem = CountVectorizer(max_features=10000, stop_words='english')
```

In [23]:
```
train_data_stop_stem = vect_stem.fit_transform(stem_train)
test_data_stop_stem = vect_stem.transform(stem_test)
```

In [24]:
```
top_terms_stop_stem = [{term[0]: term[1]} for term in top_terms(vect_stem, trair
top_terms_stop_stem

top_terms_stop_stem_test = [{term[0]: term[1]} for term in top_terms(vect_stem,
top_terms_stop_stem_test
```

```
Out[24]: [{'thi': 1199},
          {'wa': 689},
          {'00': 560},
          {'use': 521},
          {'ha': 498},
          {'god': 378},
          {'10': 351},
          {'ani': 347},
          {'like': 342},
          {'know': 330},
          {'hi': 325},
          {'new': 320},
          {'peopl': 289},
          {'doe': 276},
          {'time': 271},
          {'make': 265},
          {'say': 263},
          {'just': 249},
          {'good': 244},
          {'onli': 241}]
```

Векторизация выборки с помощью TfidfTransformer (TF и TF-IDF)

Без использования стоп-слов

```
In [25]: from sklearn.feature_extraction.text import TfidfTransformer
```

```
In [26]: tf = TfidfTransformer(use_idf=False)
         tfidf = TfidfTransformer(use_idf=True)
```

```
In [27]: train_data_tf = tf.fit_transform(train_data)
         test_data_tf = tf.transform(test_data)

         train_data_tfidf = tfidf.fit_transform(train_data)
         test_data_tfidf = tfidf.transform(test_data)
```

```
In [28]: top_terms_tf = [{term[0]: term[1]} for term in top_terms(vect_without_stop, trai
         top_terms_tf

         top_terms_tf_test = [{term[0]: term[1]} for term in top_terms(vect_without_stop,
         top_terms_tf_test

         top_terms_tfidf = [{term[0]: term[1]} for term in top_terms(vect_without_stop, t
         top_terms_tfidf

         top_terms_tfidf_test = [{term[0]: term[1]} for term in top_terms(vect_without_st
         top_terms_tfidf_test
```

Out[28]:
```
[{'the': 103.92578878716677},
 {'to': 67.46243226585233},
 {'of': 62.14728629487148},
 {'and': 55.67573051098585},
 {'is': 47.115771882782795},
 {'that': 46.15570171423424},
 {'for': 45.38556743347154},
 {'you': 43.75246255205398},
 {'in': 43.31207482495192},
 {'it': 41.98574454787257},
 {'have': 32.082368823761044},
 {'or': 26.963146304013232},
 {'not': 26.798398081584132},
 {'this': 26.54414001492925},
 {'are': 26.139018385325716},
 {'with': 26.089883896229},
 {'be': 24.02821218376009},
 {'if': 23.8169899007375},
 {'on': 23.72047883885346},
 {'as': 21.37691832162967}]
```

С использованием стоп-слов

In [29]:
```
tf = TfidfTransformer(use_idf=False)
tfidf = TfidfTransformer(use_idf=True)
```

In [30]:
```
train_data_stop_tf = tf.fit_transform(train_data_stop)
test_data_stop_tf = tf.transform(test_data_stop)

train_data_stop_tfidf = tfidf.fit_transform(train_data_stop)
test_data_stop_tfidf = tfidf.transform(test_data_stop)
```

In [31]:
```
top_terms_stop_tf = [{term[0]: term[1]} for term in top_terms(vect_stop, train_d
top_terms_stop_tf

top_terms_stop_tf_test = [{term[0]: term[1]} for term in top_terms(vect_stop, te
top_terms_stop_tf_test

top_terms_stop_tfidf = [{term[0]: term[1]} for term in top_terms(vect_stop, trai
top_terms_stop_tfidf

top_terms_stop_tfidf_test = [{term[0]: term[1]} for term in top_terms(vect_stop,
top_terms_stop_tfidf_test
```

Out[31]:
```
[{'know': 16.24730869218536},
 {'like': 15.489751099616834},
 {'just': 14.386831590993486},
 {'don': 14.029111887245111},
 {'sale': 13.80560024422138},
 {'00': 13.797739615372626},
 {'god': 13.258610971213697},
 {'good': 12.953128824156405},
 {'new': 12.114588533328869},
 {'think': 11.774347917159494},
 {'mail': 11.7469651636439},
 {'people': 11.217160674133005},
 {'time': 10.76555628971949},
 {'does': 10.752805532883665},
 {'thanks': 10.731058363911187},
 {'ve': 10.416912964357634},
 {'used': 10.294090022947794},
 {'offer': 10.221700719462152},
 {'edu': 10.177793191710643},
 {'make': 10.132834220143167}]
```

Со стеммингом без стоп-слов

In [32]:
```
tf = TfidfTransformer(use_idf=False)
tfidf = TfidfTransformer(use_idf=True)
```

In [33]:
```
train_data_stem_tf = tf.fit_transform(train_data_without_stop_stem)
test_data_stem_tf = tf.transform(test_data_without_stop_stem)

train_data_stem_tfidf = tfidf.fit_transform(train_data_without_stop_stem)
test_data_stem_tfidf = tfidf.transform(test_data_without_stop_stem)
```

In [34]:
```
top_terms_stem_tf = [{term[0]: term[1]} for term in top_terms(vect_stem_without_
top_terms_stem_tf

top_terms_stem_tf_test = [{term[0]: term[1]} for term in top_terms(vect_stem_wit
top_terms_stem_tf_test

top_terms_stem_tfidf = [{term[0]: term[1]} for term in top_terms(vect_stem_witho
top_terms_stem_tfidf

top_terms_stem_tfidf_test = [{term[0]: term[1]} for term in top_terms(vect_stem_
top_terms_stem_tfidf_test
```

Out[34]:
```
[{'the': 102.4167020332997},
 {'to': 66.80087036635662},
 {'of': 61.0606141251206},
 {'and': 54.86535021843155},
 {'is': 47.55257992890465},
 {'that': 45.61780513240577},
 {'for': 44.97402862941401},
 {'you': 43.505968937738125},
 {'it': 43.107902079866456},
 {'in': 42.66363758672977},
 {'have': 33.69279408264143},
 {'not': 26.86917716237715},
 {'or': 26.76815482715484},
 {'thi': 26.448880489356604},
 {'are': 26.070506658760067},
 {'with': 25.715909070863507},
 {'be': 25.66065041027378},
 {'do': 23.831879096909034},
 {'if': 23.719008715916885},
 {'on': 23.57406476332026}]
```

Со стеммингом с использованием стоп-слов

In [35]:
```
tf = TfidfTransformer(use_idf=False)
tfidf = TfidfTransformer(use_idf=True)
```

In [36]:
```
train_data_stem_stop_tf = tf.fit_transform(train_data_stop_stem)
test_data_stem_stop_tf = tf.transform(test_data_stop_stem)

train_data_stem_stop_tfidf = tfidf.fit_transform(train_data_stop_stem)
test_data_stem_stop_tfidf = tfidf.transform(test_data_stop_stem)
```

In [37]:
```
top_terms_stem_stop_tf = [{term[0]: term[1]} for term in top_terms(vect_stem, tr
top_terms_stem_stop_tf

top_terms_stem_stop_tf_test = [{term[0]: term[1]} for term in top_terms(vect_ste
top_terms_stem_stop_tf_test

top_terms_stem_stop_tfidf = [{term[0]: term[1]} for term in top_terms(vect_stem,
top_terms_stem_stop_tfidf

top_terms_stem_stop_tfidf_test = [{term[0]: term[1]} for term in top_terms(vect_
top_terms_stem_stop_tfidf_test
```

```
Out[37]: [{'massag': 29.948081204577424},
          {'ll': 29.773079799267403},
          {'earn': 26.879153230636003},
          {'leadership': 26.70362435365944},
          {'sound': 23.870063892545577},
          {'pale': 22.13119244763357},
          {'grind': 21.984139363868216},
          {'tronic': 20.103879527019693},
          {'port': 20.08814309983904},
          {'typefont': 18.825287345123005},
          {'dylan': 17.934617752788245},
          {'endur': 17.86368099065268},
          {'gregori': 17.39807864633475},
          {'weather': 17.273875588234212},
          {'mildli': 17.20653379928399},
          {'00': 16.990129981097365},
          {'miner': 16.729737142292908},
          {'perciev': 15.708337776995725},
          {'whatsoev': 15.610096759328895},
          {'trash': 15.274593080166266}]
```

Составление таблицы

```
In [38]: import pandas as pd
```

```
In [39]: columns = pd.MultiIndex.from_product([['Count', 'TF', 'TF-IDF'], ['Без стоп-слов
```

Без стемминга

```
In [40]: df1 = pd.DataFrame(columns=columns)

         df1['Count', 'Без стоп-слов'] = top_terms_without_stop
         df1['TF', 'Без стоп-слов'] = top_terms_tf
         df1['TF-IDF', 'Без стоп-слов'] = top_terms_tfidf

         df1['Count', 'С стоп-словами'] = top_terms_stop
         df1['TF', 'С стоп-словами'] = top_terms_stop_tf
         df1['TF-IDF', 'С стоп-словами'] = top_terms_stop_tfidf

         df1
```

Out[40]:

	Count		TF			
	Без стоп-слов	С стоп-словами	Без стоп-слов	С стоп-словами	Без стоп-слов	С ст
0	{'the': 11301}	{'00': 640}	{'the': 410.6466942091253}	{'don': 42.19836218494229}	{'the': 158.7095535302558}	21.8024
1	{'of': 6613}	{'people': 517}	{'to': 251.7142371449254}	{'like': 41.94033888116838}	{'to': 100.59334482026873}	21.37696
2	{'to': 6208}	{'new': 504}	{'of': 224.7563651678267}	{'new': 38.49189557572986}	{'of': 96.82672169042559}	20.76657
3	{'and': 5710}	{'edu': 502}	{'and': 213.50667797912118}	{'know': 38.43222500691624}	{'and': 86.39016862609914}	20.6636
4	{'in': 3962}	{'don': 467}	{'is': 171.8087951834235}	{'just': 36.441798363953794}	{'is': 78.0737463854439}	20.30402
5	{'is': 3857}	{'like': 461}	{'in': 154.16287320333123}	{'people': 36.20820897355665}	{'it': 71.5159722499692}	19.78859
6	{'that': 3485}	{'good': 420}	{'for': 150.42899781013273}	{'edu': 34.694153609728126}	{'that': 69.39495091529038}	19.25880
7	{'it': 2943}	{'just': 417}	{'it': 144.3601581889401}	{'sale': 33.10807332706017}	{'in': 67.86182033825528}	18.97996
8	{'for': 2894}	{'know': 394}	{'that': 129.90078758447194}	{'good': 32.20601101295828}	{'for': 62.588326880465274}	18.70150
9	{'you': 2402}	{'10': 358}	{'you': 107.74646955575315}	{'think': 28.946781478743482}	{'you': 60.005846885521684}	18.18979
10	{'this': 1766}	{'use': 356}	{'with': 76.73952240379423}	{'does': 26.955539997275125}	{'this': 41.37365799621488}	16.80016
11	{'are': 1753}	{'god': 338}	{'have': 74.76904182863568}	{'time': 26.0987325817474}	{'are': 40.00414095201544}	16.52212
12	{'with': 1736}	{'time': 336}	{'this': 73.98236585775292}	{'offer': 25.200411794386508}	{'have': 39.4882262676624}	16.1261
13	{'not': 1711}	{'think': 328}	{'are': 72.37175564019299}	{'used': 25.15020882674478}	{'with': 38.8104458820901}	15.54847
14	{'have': 1632}	{'does': 313}	{'or': 70.35049990487211}	{'00': 22.847118231150784}	{'not': 38.444939640920175}	14.7777
15	{'be': 1555}	{'20': 285}	{'not': 65.67375220517485}	{'make': 22.24617480778731}	{'be': 37.677253780707396}	14.74316
16	{'or': 1504}	{'used': 275}	{'be': 63.48328583893221}	{'use': 21.080078313079557}	{'or': 37.30203300467406}	14.3792
17	{'as': 1433}	{'50': 261}	{'if': 57.567519020817166}	{'god': 21.00989280692224}	{'as': 32.73502619945886}	13.46644
18	{'on': 1314}	{'com': 259}	{'on': 54.056582370621975}	{'interested': 20.947258397082738}	{'if': 32.43874285684031}	13.310
19	{'but': 1143}	{'jesus': 258}	{'as': 50.53911703806337}	{'shipping': 20.37436327922064}	{'on': 31.670689631446457}	13.25565

```
In [41]: df2 = pd.DataFrame(columns=columns)

         df2['Count', 'Без стоп-слов'] = top_terms_without_stop_test
         df2['TF', 'Без стоп-слов'] = top_terms_tf_test
         df2['TF-IDF', 'Без стоп-слов'] = top_terms_tfidf_test

         df2['Count', 'С стоп-словами'] = top_terms_stop_test
         df2['TF', 'С стоп-словами'] = top_terms_stop_tf_test
         df2['TF-IDF', 'С стоп-словами'] = top_terms_stop_tfidf_test

         df2
```

Out[41]:

	Count		TF			
	Без стоп-слов	С стоп-словами	Без стоп-слов	С стоп-словами	Без стоп-слов	С ст
0	{'the': 7706}	{'00': 560}	{'the': 264.43850063653423}	{'like': 29.948081204577424}	{'the': 103.92578878716677}	16.2473
1	{'of': 4314}	{'10': 351}	{'to': 165.4520748999254}	{'know': 29.773079799267403}	{'to': 67.4624322658523}	15.48975
2	{'to': 4227}	{'god': 328}	{'of': 142.71459444454686}	{'don': 26.879153230636003}	{'of': 62.14728629487148}	14.38683
3	{'and': 3922}	{'like': 314}	{'and': 135.3763341296705}	{'just': 26.70362435365944}	{'and': 55.67573051098585}	14.02911
4	{'in': 2670}	{'new': 306}	{'for': 106.7211060032294}	{'sale': 23.870063892545577}	{'is': 47.115771882782795}	13.8056
5	{'is': 2596}	{'know': 301}	{'is': 102.38992170757815}	{'new': 22.13119244763357}	{'that': 46.15570171423424}	13.79773
6	{'that': 2302}	{'don': 292}	{'in': 96.31664067346627}	{'good': 21.984139363868216}	{'for': 45.38556743347154}	13.25861
7	{'for': 2017}	{'people': 288}	{'that': 85.72866577881462}	{'think': 20.103879527019693}	{'you': 43.75246255205398}	12.95312
8	{'it': 1819}	{'just': 249}	{'it': 84.31251661554674}	{'people': 20.08814309983904}	{'in': 43.31207482495192}	12.11458
9	{'you': 1541}	{'good': 242}	{'you': 76.62890164443824}	{'time': 18.825287345123005}	{'it': 41.98574454787257}	11.77434
10	{'have': 1230}	{'20': 239}	{'have': 59.782972354009544}	{'does': 17.934617752788245}	{'have': 32.082368823761044}	11.746
11	{'with': 1157}	{'time': 228}	{'with': 50.54776335071849}	{'edu': 17.86368099065268}	{'or': 26.963146304013232}	11.21716
12	{'are': 1149}	{'edu': 220}	{'or': 49.51766448693027}	{'god': 17.39807864633475}	{'not': 26.798398081584132}	10.7655
13	{'this': 1149}	{'50': 214}	{'this': 46.257322990834744}	{'used': 17.273875588234212}	{'this': 26.5441400149292}	10.75280
14	{'not': 1084}	{'12': 212}	{'are': 45.58212548464762}	{'mail': 17.20653379928399}	{'are': 26.139018385325716}	10.73105
15	{'or': 1009}	{'does': 205}	{'not': 44.61417757310946}	{'00': 16.990129981097365}	{'with': 26.089883896229}	10.41691
16	{'be': 1002}	{'92': 204}	{'if': 40.58806741479666}	{'make': 16.729737142292908}	{'be': 24.02821218376009}	10.29409
17	{'as': 932}	{'use': 204}	{'on': 39.910061357543114}	{'offer': 15.708337776995725}	{'if': 23.8169899007375}	10.22170
18	{'on': 926}	{'25': 202}	{'be': 39.15623548893515}	{'ve': 15.610096759328895}	{'on': 23.72047883885346}	10.17779
19	{'if': 790}	{'medical': 201}	{'as': 32.12860833436083}	{'thanks': 15.27459308016626}	{'as': 21.37691832162967}	10.13283

Со стеммингом

```
In [42]: df3 = pd.DataFrame(columns=columns)

         df3['Count', 'Без стоп-слов'] = top_terms_stem
         df3['TF', 'Без стоп-слов'] = top_terms_stem_tf
         df3['TF-IDF', 'Без стоп-слов'] = top_terms_stem_tfidf

         df3['Count', 'С стоп-словами'] = top_terms_stop_stem
         df3['TF', 'С стоп-словами'] = top_terms_stem_stop_tf
         df3['TF-IDF', 'С стоп-словами'] = top_terms_stem_stop_tfidf

         df3
```

Out[42]:

	Count		TF			
	Без стоп-слов	С стоп-словами	Без стоп-слов	С стоп-словами	Без стоп-слов	С ст
0	{'the': 11298}	{'thi': 1770}	{'the': 401.75578691089754}	{'earn': 42.19836218494229}	{'the': 157.79831839320482}	42.1983
1	{'of': 6613}	{'wa': 1069}	{'to': 246.39046279013354}	{'massag': 41.94033888116838}	{'to': 100.54188184209593}	41.9403
2	{'to': 6208}	{'use': 808}	{'of': 219.99708531926314}	{'pale': 38.49189557572986}	{'of': 96.36850919046363}	38.4918
3	{'and': 5712}	{'ha': 732}	{'and': 208.8810525625937}	{'ll': 38.43222500691624}	{'and': 86.04795469898639}	38.4322
4	{'in': 3964}	{'00': 640}	{'is': 171.1104805078897}	{'leadership': 36.441798363953794}	{'is': 79.0033745727237}	36.44179
5	{'is': 3922}	{'ani': 538}	{'in': 150.9005456172757}	{'port': 36.20820897355665}	{'it': 73.31936518758786}	36.2082
6	{'that': 3488}	{'new': 529}	{'it': 147.38739013572695}	{'endur': 34.694153609728126}	{'that': 69.29949321110132}	34.69415
7	{'it': 3111}	{'like': 518}	{'for': 146.88012385811385}	{'sound': 33.10807332706017}	{'in': 67.48075467301989}	33.1080
8	{'for': 2894}	{'peopl': 518}	{'that': 127.31873045176705}	{'grind': 32.20601101295828}	{'for': 62.181913294819346}	32.2060
9	{'you': 2401}	{'edu': 502}	{'you': 105.54217923935947}	{'tronic': 28.946781478743482}	{'you': 59.995166222979435}	28.94678
10	{'are': 1786}	{'hi': 498}	{'have': 79.37206678905693}	{'dylan': 26.955539997275125}	{'have': 41.708464124313906}	26.95553
11	{'not': 1780}	{'doe': 440}	{'with': 75.16031613421946}	{'typefont': 26.0987325817474}	{'thi': 41.41806858705026}	26.098
12	{'have': 1774}	{'know': 438}	{'thi': 72.6923434645989}	{'perciev': 25.200411794386508}	{'are': 40.730013978082994}	25.20041
13	{'thi': 1770}	{'good': 430}	{'are': 72.46612914192293}	{'weather': 25.15020882674478}	{'be': 40.60952442256573}	25.1502
14	{'be': 1764}	{'onli': 420}	{'be': 69.19071366723983}	{'00': 22.847118231150784}	{'not': 39.275869509026585}	22.84711
15	{'with': 1737}	{'just': 417}	{'or': 68.83200312335784}	{'miner': 22.24617480778731}	{'with': 38.75291671354243}	22.2461
16	{'or': 1504}	{'time': 414}	{'not': 66.22164742443427}	{'wear': 21.080078313079557}	{'or': 37.1367365602891}	21.08007
17	{'as': 1431}	{'say': 400}	{'if': 56.34259136328616}	{'gregori': 21.00989280692224}	{'do': 35.13133751221469}	21.0098
18	{'do': 1386}	{'think': 393}	{'do': 55.09326254250311}	{'join': 20.947258397082738}	{'as': 32.523517894221236}	20.94725
19	{'on': 1320}	{'make': 381}	{'on': 53.14025829598756}	{'stx': 20.37436327922064}	{'if': 32.50089178966867}	20.3743

```
In [43]: df4 = pd.DataFrame(columns=columns)

         df4['Count', 'Без стоп-слов'] = top_terms_stem_test
         df4['TF', 'Без стоп-слов'] = top_terms_stem_tf_test
         df4['TF-IDF', 'Без стоп-слов'] = top_terms_stem_tfidf_test

         df4['Count', 'С стоп-словами'] = top_terms_stop_stem_test
         df4['TF', 'С стоп-словами'] = top_terms_stem_stop_tf_test
         df4['TF-IDF', 'С стоп-словами'] = top_terms_stem_stop_tfidf_test

         df4
```

Out[43]:

	Count		TF			
	Без стоп-слов	С стоп-словами	Без стоп-слов	С стоп-словами	Без стоп-слов	С ст
0	{'the': 7706}	{'thi': 1199}	{'the': 257.92253141743}	{'massag': 29.948081204577424}	{'the': 102.4167020332997}	29.94808
1	{'of': 4314}	{'wa': 689}	{'to': 161.58217852697967}	{'ll': 29.773079799267403}	{'to': 66.80087036635662}	29.77307
2	{'to': 4227}	{'00': 560}	{'of': 138.969377940274}	{'earn': 26.879153230636003}	{'of': 61.0606141251206}	26.87915
3	{'and': 3923}	{'use': 521}	{'and': 131.9264434926551}	{'leadership': 26.70362435365944}	{'and': 54.86535021843155}	26.7036
4	{'in': 2671}	{'ha': 498}	{'for': 104.14329159064731}	{'sound': 23.870063892545577}	{'is': 47.55257992890465}	23.87006
5	{'is': 2633}	{'god': 378}	{'is': 102.16292180234682}	{'pale': 22.13119244763357}	{'that': 45.61780513240577}	22.1311
6	{'that': 2306}	{'10': 351}	{'in': 93.95093720037718}	{'grind': 21.984139363868216}	{'for': 44.97402862941401}	21.98413
7	{'for': 2017}	{'ani': 347}	{'it': 86.50120545821625}	{'tronic': 20.103879527019693}	{'you': 43.505968937738125}	20.10387
8	{'it': 1916}	{'like': 342}	{'that': 83.82705059369427}	{'port': 20.08814309983904}	{'it': 43.107902079866456}	20.0881
9	{'you': 1540}	{'know': 330}	{'you': 74.86410865202238}	{'typefont': 18.825287345123005}	{'in': 42.66363758672977}	18.82528
10	{'have': 1317}	{'hi': 325}	{'have': 63.54925811141936}	{'dylan': 17.934617752788245}	{'have': 33.69279408264143}	17.93461
11	{'thi': 1199}	{'new': 320}	{'with': 49.181030980627284}	{'endur': 17.86368099065268}	{'not': 26.86917716237715}	17.8636
12	{'are': 1167}	{'peopl': 289}	{'or': 48.393434221928636}	{'gregori': 17.39807864633475}	{'or': 26.76815482715484}	17.3980
13	{'with': 1157}	{'doe': 276}	{'thi': 45.45057235122236}	{'weather': 17.273875588234212}	{'thi': 26.448880489356604}	17.27387
14	{'be': 1143}	{'time': 271}	{'are': 45.28657427458017}	{'mildli': 17.20653379928399}	{'are': 26.070506658760067}	17.2065
15	{'not': 1116}	{'make': 265}	{'not': 44.53968532734706}	{'00': 16.990129981097365}	{'with': 25.715909070863507}	16.99012
16	{'or': 1009}	{'say': 263}	{'be': 42.71042458581328}	{'miner': 16.729737142292908}	{'be': 25.66065041027378}	16.72973
17	{'on': 933}	{'just': 249}	{'if': 39.69464615053347}	{'perciev': 15.708337776995725}	{'do': 23.831879096909034}	15.70833
18	{'as': 931}	{'good': 244}	{'on': 39.214057720326736}	{'whatsoev': 15.610096759328895}	{'if': 23.719008715916885}	15.61009
19	{'do': 800}	{'onli': 241}	{'do': 36.976857767659254}	{'trash': 15.274593080166266}	{'on': 23.57406476332026}	15.27459

Запись в файл

In [44]:
```
import openpyxl
```

In [45]:
```
writer = pd.ExcelWriter('result.xlsx', engine='openpyxl')

df1.to_excel(writer, sheet_name='Train, wo stem')
df2.to_excel(writer, sheet_name='Test, wo stem')
df3.to_excel(writer, sheet_name='Train, with stem')
df4.to_excel(writer, sheet_name='Test, with stem')

writer.save()
```

Конвейер

In [46]:
```
from sklearn.metrics import classification_report
from sklearn.naive_bayes import MultinomialNB
```

In [47]:
```
stop_words = [None, 'english']
max_features_values = [100, 500, 1000, 2000, 3000, 4000, 5000]
use_tf = [True, False]
use_idf = [True, False]
```

In [48]:
```
def prepare(data, max_feature, stop_word, use_tf, use_idf):
    tf = None
    cv = CountVectorizer(max_features=max_feature, stop_words=stop_word)
    cv.fit(data)
    if use_tf:
        tf = TfidfTransformer(use_idf=use_idf)
        tf.fit(cv.transform(data))
    return cv, tf
```

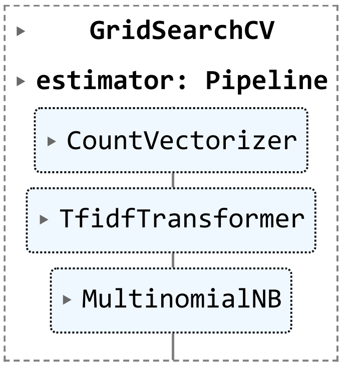
In [49]:
```
result = []

for max_features_value in max_features_values:
    for stop_word in stop_words:
        for ut in use_tf:
            for ui in use_idf:
                options = {}
                cv, tf = prepare(twenty_train_full.data, max_features_value, sto
                if tf:
                    clf = MultinomialNB()
                    clf.fit(tf.transform(cv.transform(twenty_train_full.data)),
                    prep_test = tf.transform(cv.transform(twenty_test_full.data)
                else:
                    clf = MultinomialNB()
                    clf.fit(cv.transform(twenty_train_full.data), twenty_train_f
                    prep_test = cv.transform(twenty_test_full.data)

                options['features'] = max_features_value
                options['stop_words'] = stop_word
                options['use_tf'] = ut
                options['use_idf'] = ui
                result_data = classification_report(clf.predict(prep_test), twer
                result_df = pd.DataFrame(result_data)
                result.append({
                    'df': result_df,
                    'options': options
                })
```

In [50]:
```
writer = pd.ExcelWriter('result_compare.xlsx', engine='openpyxl')

df = pd.DataFrame(columns=['Номер страницы', 'features', 'stop_words', 'use_tf',
for it, item in enumerate(result):
    for key, value in item['options'].items():
        df.at[it, key] = value
    df.at[it, 'Номер страницы'] = it

df.to_excel(writer, sheet_name='Оглавление')

for it, item in enumerate(result):
    df_new = pd.DataFrame(item['df'])
    df_new.to_excel(writer, sheet_name=f'Страница {it}')

writer.save()
```

In [51]:
```
from sklearn.pipeline import Pipeline

parameters = {
    'vect__max_features': max_features_values,
    'vect__stop_words': stop_words,
    'tfidf__use_idf': use_idf
}

text_clf = Pipeline([('vect', CountVectorizer()),
                     ('tfidf', TfidfTransformer()),
                     ('clf', MultinomialNB())])
```

In [52]:
```
from sklearn.model_selection import GridSearchCV

gscv = GridSearchCV(text_clf, param_grid=parameters)
gscv.fit(twenty_train_full.data, twenty_train_full.target)
```

Out[52]:



In [53]:
```
print(classification_report(gscv.predict(twenty_test_full.data), twenty_test_ful
              precision    recall  f1-score   support

           0       0.94      0.92      0.93       396
           1       0.91      0.82      0.86       441
           2       0.72      0.90      0.80       200

    accuracy                           0.87      1037
   macro avg       0.85      0.88      0.86      1037
weighted avg       0.88      0.87      0.87      1037
```

In [54]:
```
gscv.best_params_
```

Out[54]:
```
{'tfidf__use_idf': True,
 'vect__max_features': 2000,
 'vect__stop_words': 'english'}
```

In [54]:
```

```