rk2

June 6, 2025

[53]:

1 5-22 2

[54]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from sklearn.ensemble import RandomForestClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report,␣
↪confusion_matrix
```

1.0.1

[55]:
```
df = pd.read_csv('Reviews.csv').head(100000)
print("        :", df.shape)
```

```
        : (100000, 10)
```

1.0.2

[56]:
```
df = df[df['Score'].isin([1, 5])]
df['sentiment'] = df['Score'].apply(lambda x: 1 if x == 5 else 0)#       ␣
↪
df = df[df['Score'].isin([1, 5])]
df['sentiment'] = df['Score'].apply(lambda x: 1 if x == 5 else 0)
```

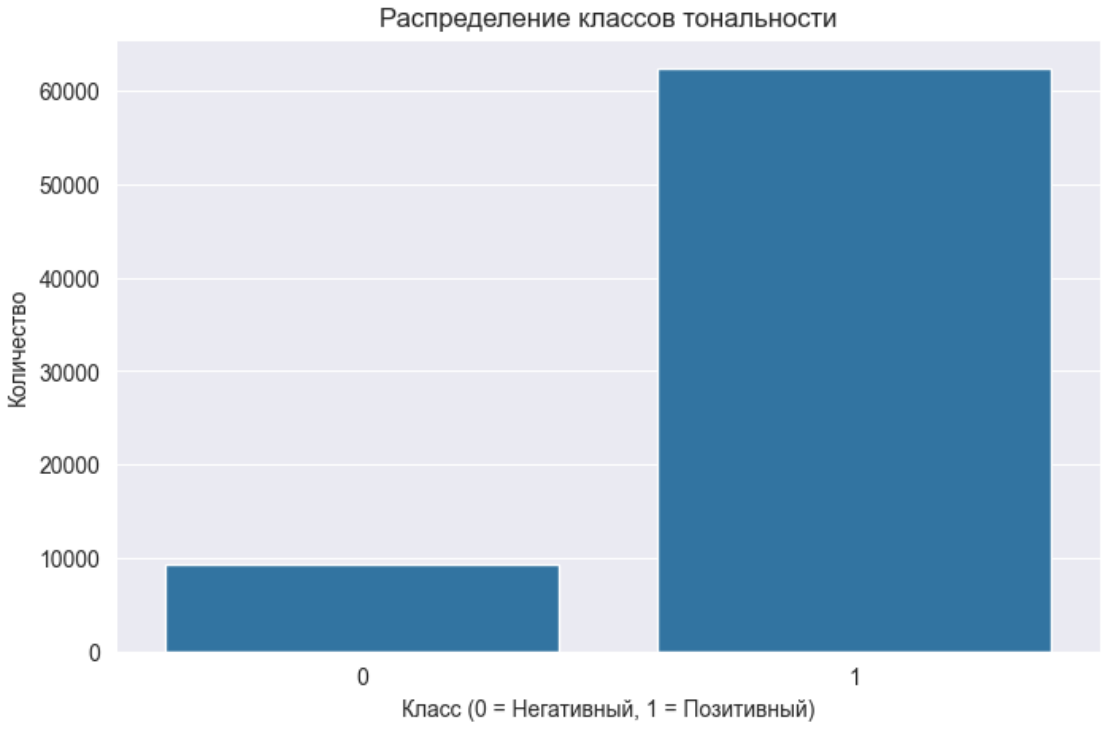
[57]:
```
#
df = df.dropna(subset=['Text'])
print("             :", df.shape)
```

```
             : (71730, 11)
```

[58]:
```
#
print("\n            :")
print(df['sentiment'].value_counts())
```

```
            :
sentiment
1    62412
0     9318
Name: count, dtype: int64
```

[59]:
```
plt.figure(figsize=(8, 5))
sns.countplot(x='sentiment', data=df)
plt.title('                    ')
plt.xlabel('    (0 =       , 1 =       )')
plt.ylabel('      ')
plt.savefig('sentiment_distribution.png', dpi=300)
plt.show()
```



1.0.3 2.

[60]:
```
def clean_text(text):
    text = text.lower()
    text = re.sub(r'<[^>]+>', '', text)  #       HTML-
    text = re.sub(r'[^a-z\s]', '', text)  #         ,
    text = re.sub(r'\s+', ' ', text).strip()  #
    return text

df['cleaned_text'] = df['Text'].apply(clean_text)
```

1.0.4 3.

[61]:
```
X = df['cleaned_text']
y = df['sentiment']
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.2, random_state=42, stratify=y
)
print(f"\n              : {X_train.shape[0]}")
print(f"             : {X_test.shape[0]}")
```

```
             : 57384
            : 14346
```

1.0.5 4.

[62]:
```
# 4.1. CountVectorizer
count_vectorizer = CountVectorizer(max_df=0.95, min_df=5, ngram_range=(1, 2),␣
 ↪stop_words='english')
X_train_count = count_vectorizer.fit_transform(X_train)
X_test_count = count_vectorizer.transform(X_test)
```

[63]:
```
# 4.2. TfidfVectorizer
tfidf_vectorizer = TfidfVectorizer(max_df=0.95, min_df=5, ngram_range=(1, 2),␣
 ↪stop_words='english')
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)
```

[64]:
```
print("\n          :")
print(f"CountVectorizer (train): {X_train_count.shape}")
print(f"CountVectorizer (test):  {X_test_count.shape}")
print(f"TfidfVectorizer (train): {X_train_tfidf.shape}")
print(f"TfidfVectorizer (test):  {X_test_tfidf.shape}")
```

```
          :
CountVectorizer (train): (57384, 66472)
```

```
CountVectorizer (test):  (14346, 66472)
TfidfVectorizer (train): (57384, 66472)
TfidfVectorizer (test):  (14346, 66472)
```

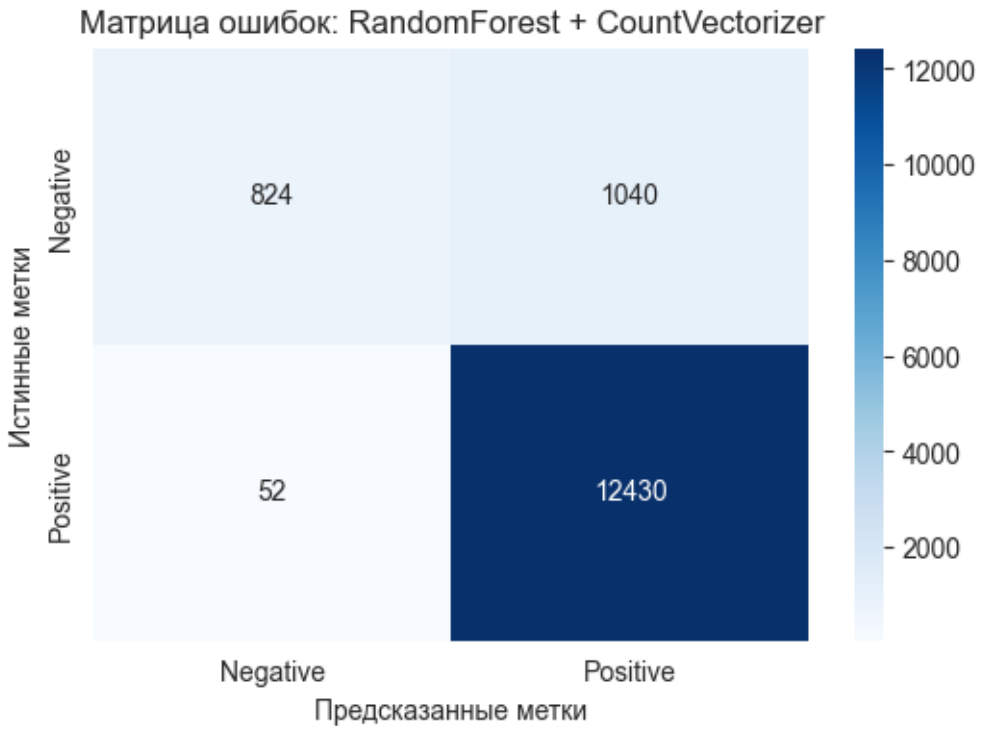
1.0.6 5.

[65]:
```
results = {}

def train_evaluate_model(model, X_train, y_train, X_test, y_test, model_name,␣
↪vectorizer_name):
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)

    accuracy = accuracy_score(y_test, y_pred)
    #                   , zero_division=0          Warning
    report = classification_report(y_test, y_pred, target_names=['Negative',␣
↪'Positive'], output_dict=True, zero_division=0)

    #
    #       labels=[0, 1]               ,                       y_pred
    #        ,    'Negative'    0,   'Positive'    1
    labels_for_cm = [0, 1]
    #      ,                  y_test   y_pred,
    #                           (          stratify)
    unique_test_labels = np.unique(y_test)
    unique_pred_labels = np.unique(y_pred)
    present_labels = sorted(list(set(unique_test_labels) |␣
↪set(unique_pred_labels)))

    #    present_labels              [0,1],               ,
    #            ,
    if not (0 in present_labels and 1 in present_labels):
        labels_for_cm_display = [target_names_list[i] for i in present_labels]␣
↪#       ['Negative', 'Positive']
    else:
        labels_for_cm_display = ['Negative', 'Positive']

    cm = confusion_matrix(y_test, y_pred, labels=labels_for_cm) #        [0,1]␣
↪
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
                xticklabels=labels_for_cm_display, #
                yticklabels=labels_for_cm_display)
    plt.title(f'        : {model_name} + {vectorizer_name}')
    plt.xlabel('           ')
    plt.ylabel('        ')
    plt.savefig(f'confusion_{model_name}_{vectorizer_name}.png', dpi=300)
```

```
    plt.show()

    print(f"\n{model_name} + {vectorizer_name}")
    print(f"Accuracy: {accuracy:.4f}")
    #
    print(classification_report(y_test, y_pred, target_names=['Negative',␣
 ↪'Positive'], zero_division=0))

    #                          'Positive'
    #        'Positive'          ,           ,     0
    precision_positive = report.get('Positive', {}).get('precision', 0)
    recall_positive = report.get('Positive', {}).get('recall', 0)
    f1_positive = report.get('Positive', {}).get('f1-score', 0)

    return {
        'model': model_name,
        'vectorizer': vectorizer_name,
        'accuracy': accuracy,
        'precision': precision_positive, #         'Positive'
        'recall': recall_positive,     #         'Positive'
        'f1': f1_positive              #         'Positive'
    }
```

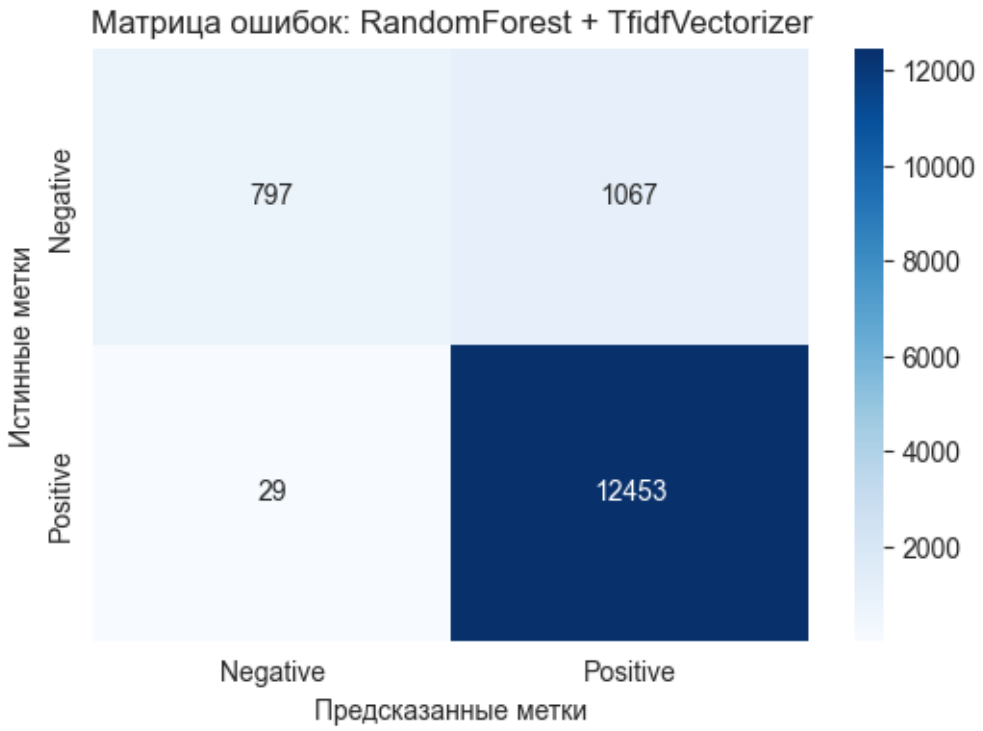
[66]:
```
# 5.1. RandomForestClassifier
rf_model = RandomForestClassifier(n_estimators=100, random_state=42, n_jobs=-1)
```

[67]:
```
#  CountVectorizer
if 'X_train_count' in locals() and 'X_test_count' in locals() and X_train_count.
 ↪shape[0] > 0 :
    results['rf_count'] = train_evaluate_model(
        rf_model, X_train_count, y_train, X_test_count, y_test,
        "RandomForest", "CountVectorizer"
    )
else:
    print("       RandomForest + CountVectorizer (X_train_count, X_test_count)␣
 ↪            .")
```




```
RandomForest + CountVectorizer
Accuracy: 0.9239
              precision    recall  f1-score   support

    Negative       0.94      0.44      0.60      1864
    Positive       0.92      1.00      0.96     12482

    accuracy                           0.92     14346
   macro avg       0.93      0.72      0.78     14346
weighted avg       0.93      0.92      0.91     14346
```

[68]:
```
#   TfidfVectorizer
if 'X_train_tfidf' in locals() and 'X_test_tfidf' in locals() and X_train_tfidf.
 ↪shape[0] > 0:
    results['rf_tfidf'] = train_evaluate_model(
        rf_model, X_train_tfidf, y_train, X_test_tfidf, y_test,
        "RandomForest", "TfidfVectorizer"
    )
else:
    print("       RandomForest + TfidfVectorizer (X_train_tfidf, X_test_tfidf)␣
 ↪            .")
```

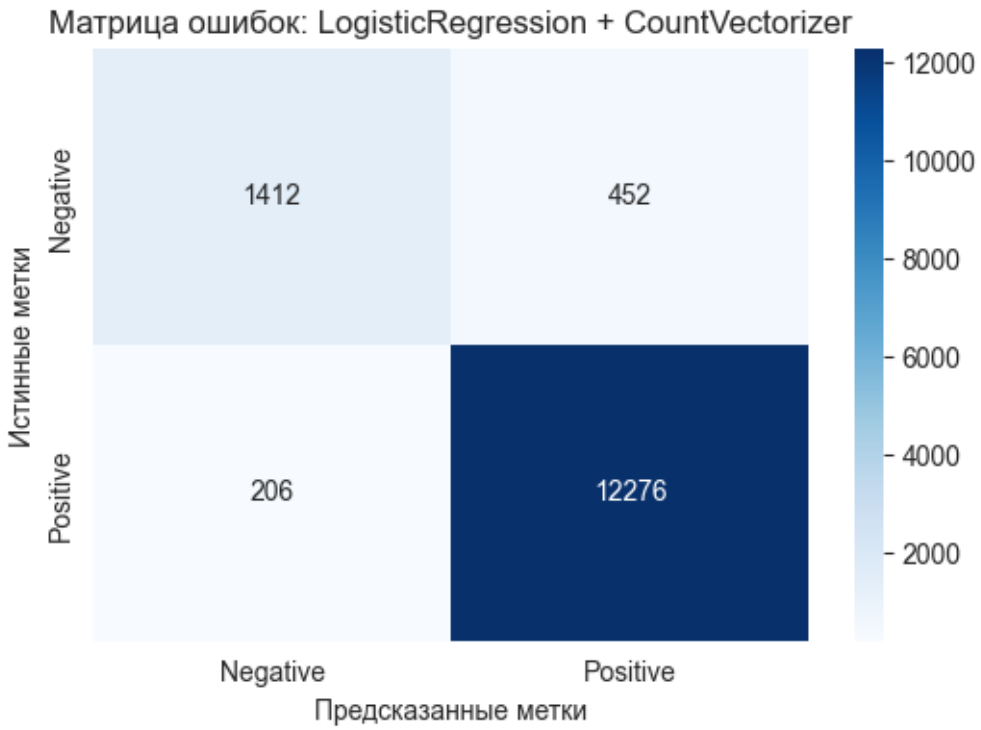



```
RandomForest + TfidfVectorizer
Accuracy: 0.9236
              precision    recall  f1-score   support

    Negative       0.96      0.43      0.59      1864
    Positive       0.92      1.00      0.96     12482

    accuracy                           0.92     14346
   macro avg       0.94      0.71      0.78     14346
weighted avg       0.93      0.92      0.91     14346
```

[69]:
```
# 5.2. LogisticRegression
lr_model = LogisticRegression(max_iter=1000, random_state=42,␣
 ↪solver='liblinear')
```

[70]:
```
#  CountVectorizer
if 'X_train_count' in locals() and 'X_test_count' in locals() and X_train_count.
 ↪shape[0] > 0 :
    results['lr_count'] = train_evaluate_model(
        lr_model, X_train_count, y_train, X_test_count, y_test,
        "LogisticRegression", "CountVectorizer"
```

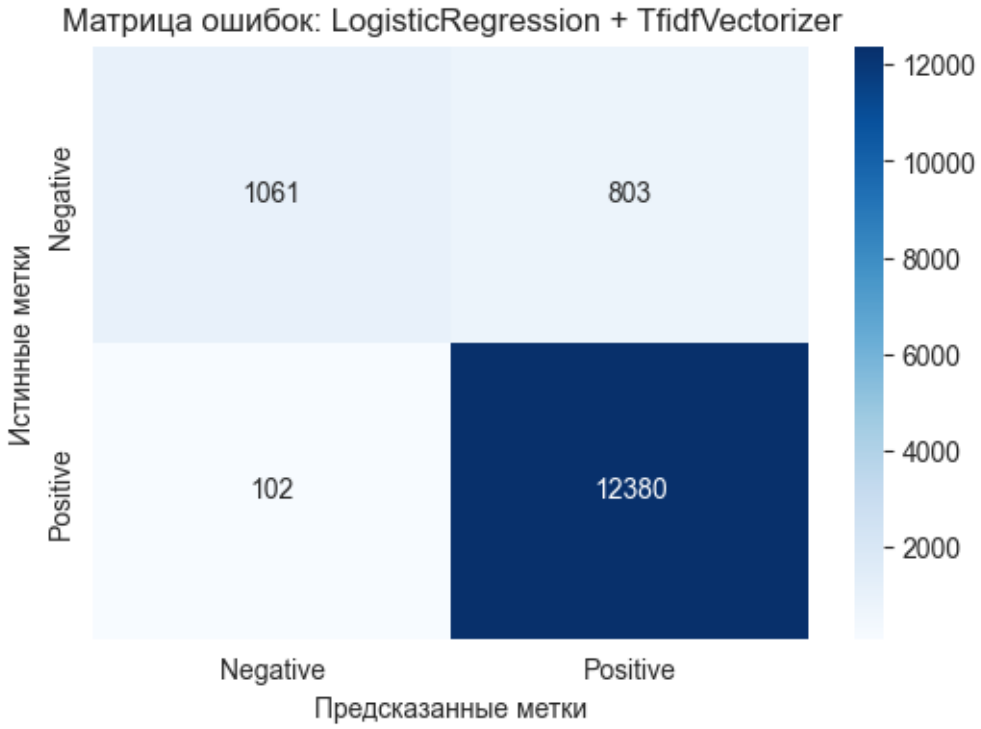
```
    )
else:
    print("       LogisticRegression + CountVectorizer (X_train_count,␣
 ↪X_test_count)              .")
```




```
LogisticRegression + CountVectorizer
Accuracy: 0.9541
              precision    recall  f1-score   support

    Negative       0.87      0.76      0.81      1864
    Positive       0.96      0.98      0.97     12482

    accuracy                           0.95     14346
   macro avg       0.92      0.87      0.89     14346
weighted avg       0.95      0.95      0.95     14346
```

[71]:
```
#  TfidfVectorizer
if 'X_train_tfidf' in locals() and 'X_test_tfidf' in locals() and X_train_tfidf.
 ↪shape[0] > 0:
    results['lr_tfidf'] = train_evaluate_model(
        lr_model, X_train_tfidf, y_train, X_test_tfidf, y_test,
```

```
        "LogisticRegression", "TfidfVectorizer"
    )
else:
    print("       LogisticRegression + TfidfVectorizer (X_train_tfidf,␣
 ↪X_test_tfidf)              .")
```




```
LogisticRegression + TfidfVectorizer
Accuracy: 0.9369
              precision    recall  f1-score   support

    Negative       0.91      0.57      0.70      1864
    Positive       0.94      0.99      0.96     12482

    accuracy                           0.94     14346
   macro avg       0.93      0.78      0.83     14346
weighted avg       0.94      0.94      0.93     14346
```

1.0.7 6.

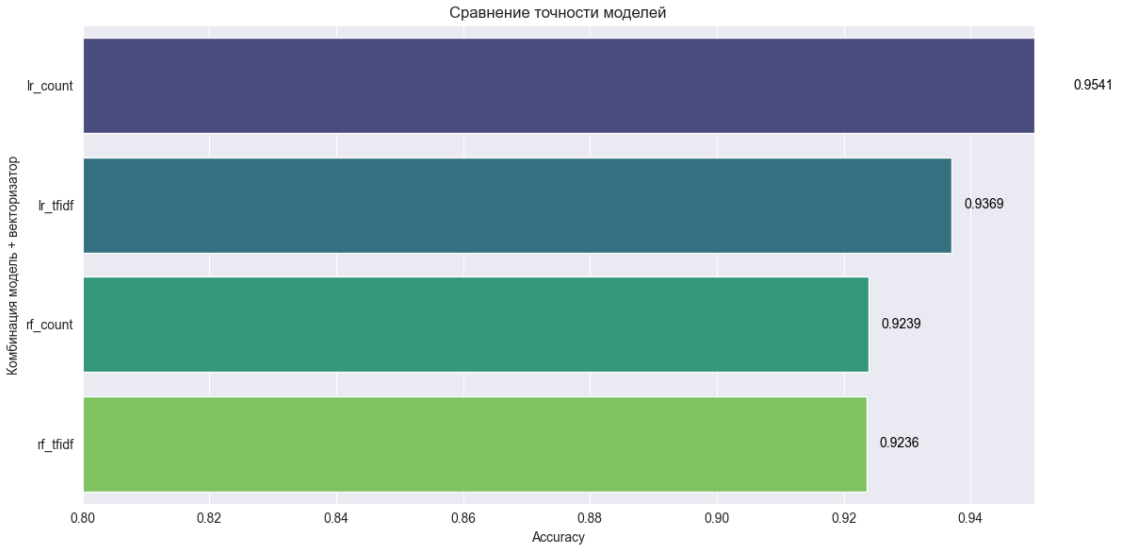
[72]:
```
results_df = pd.DataFrame(results).T
results_df = results_df.sort_values('accuracy', ascending=False)

print("\n               :")
print(results_df)
```

```
               :
                        model       vectorizer  accuracy precision    recall  \
lr_count  LogisticRegression  CountVectorizer  0.954134  0.964488  0.983496
lr_tfidf  LogisticRegression  TfidfVectorizer  0.936916  0.939088  0.991828
rf_count        RandomForest  CountVectorizer  0.923881  0.922791  0.995834
rf_tfidf        RandomForest  TfidfVectorizer  0.923602   0.92108  0.997677

                f1
lr_count  0.973899
lr_tfidf  0.964738
rf_count  0.957922
rf_tfidf  0.957849
```

1.0.8

[73]:
```
plt.figure(figsize=(12, 6))
sns.barplot(x='accuracy', y=results_df.index, data=results_df,␣
 ↪palette='viridis')
plt.title('               ')
plt.xlabel('Accuracy')
plt.xlim(0.8, 0.95)
plt.ylabel('           +       ')

for i, v in enumerate(results_df['accuracy']):
    plt.text(v + 0.002, i, f"{v:.4f}", color='black', va='center')

plt.tight_layout()
plt.savefig('accuracy_comparison.png', dpi=300)
plt.show()
```

```
C:\Users\Mihail\AppData\Local\Temp\ipykernel_16096\2085547180.py:2:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `y` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x='accuracy', y=results_df.index, data=results_df,
palette='viridis')
```



1.0.9 7.

[74]:
```
print("\n" + "="*80)
print("         :")
print("1.                          LogisticRegression + TfidfVectorizer")
print(f"           {results_df.iloc[0]['accuracy']:.4f}")
print("2.    LogisticRegression TF-IDF                    ,    CountVectorizer")
print("3.    RandomForestClassifier                          ")
print("4.                        (> 85% accuracy)")
print("5.              F1-                :")
print(f"   - LogisticRegression + TfidfVectorizer: {results_df.iloc[0]['f1']:.
  ↪4f}")
print("="*80)
```

```
================================================================================
         :
1.                          LogisticRegression + TfidfVectorizer
           0.9541
2.    LogisticRegression TF-IDF                    ,
CountVectorizer
3.    RandomForestClassifier
4.                        (> 85% accuracy)
5.              F1-                :
   - LogisticRegression + TfidfVectorizer: 0.9739
================================================================================
```