Importation des Libraires

In [40]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from wordcloud import WordCloud, STOPWORDS
import re
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.svm import LinearSVC
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifie
r
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_m
atrix,f1_score, roc_auc_score,recall_score, precision_score
from sklearn.model_selection import train_test_split
import xgboost as xgb
import lightgbm as lgb
from sentence_transformers import SentenceTransformer
from sklearn.model_selection import cross_val_score
import joblib
```

1-Exploration et Analyse des Données (EAD)

1. Analyse des colonnes et distribution des classes

In [41]:
```
train_data = pd.read_csv('train.En.csv')
train_data.info()
train_data.head()
train_data.describe()
counts =train_data['sarcastic'].value_counts()
```

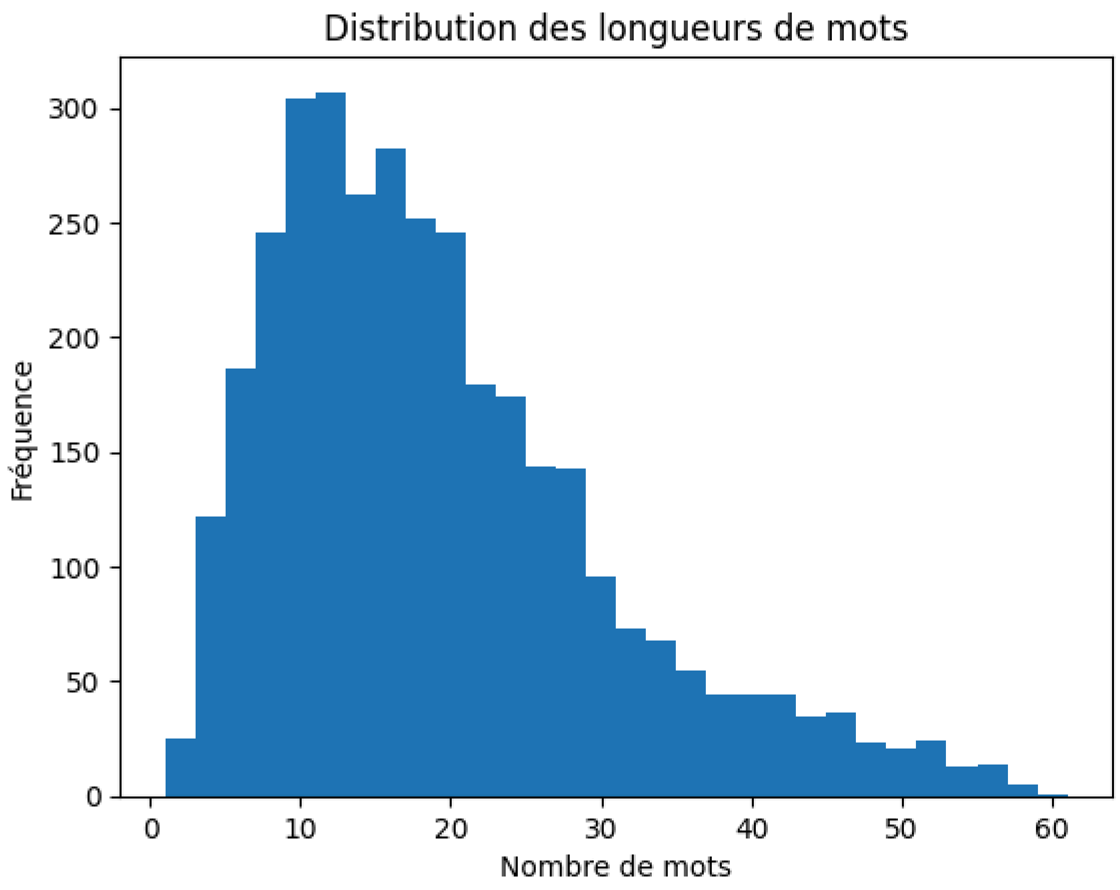
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3468 entries, 0 to 3467
Data columns (total 10 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Unnamed: 0           3468 non-null   int64  
 1   tweet                3467 non-null   object 
 2   sarcastic            3468 non-null   int64  
 3   rephrase             867 non-null    object 
 4   sarcasm              867 non-null    float64
 5   irony                867 non-null    float64
 6   satire               867 non-null    float64
 7   understatement       867 non-null    float64
 8   overstatement        867 non-null    float64
 9   rhetorical_question  867 non-null    float64
dtypes: float64(6), int64(2), object(2)
memory usage: 271.1+ KB
```

1. Mesure de la longueur des textes

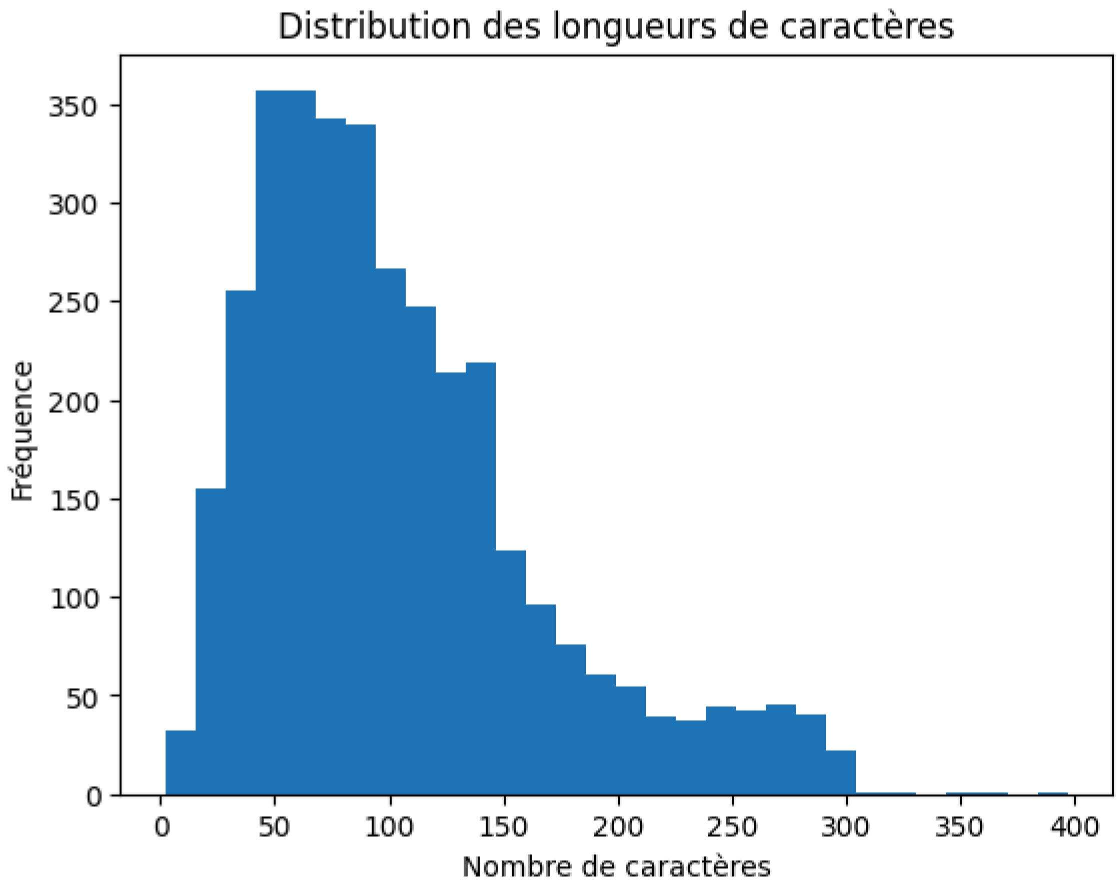
In [42]:
```
train_data['word_count'] = train_data['tweet'].apply(lambda x: len(str(x).spli
t()))
train_data['char_count'] = train_data['tweet'].apply(lambda x: len(str(x)))
```

1. Visualisation des données

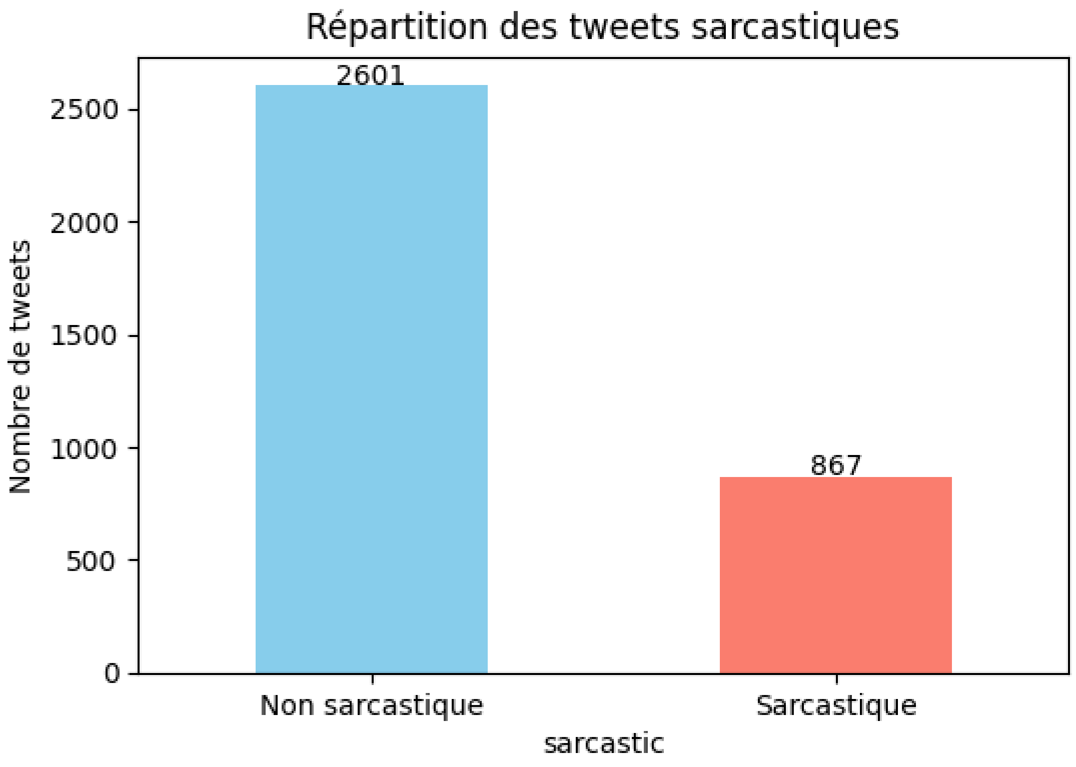
In [43]:
```
plt.hist(train_data['word_count'], bins=30)
plt.title('Distribution des longueurs de mots')
plt.xlabel('Nombre de mots')
plt.ylabel('Fréquence')
plt.show()
```



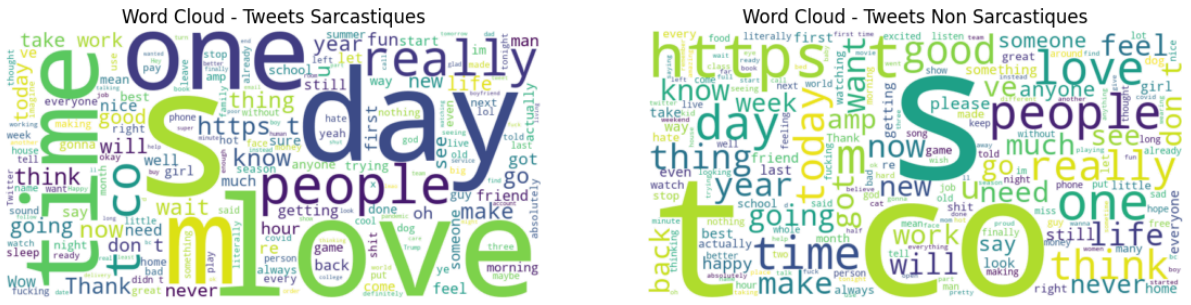
In [44]:
```
plt.hist(train_data['char_count'], bins=30)
plt.title('Distribution des longueurs de caractères')
plt.xlabel('Nombre de caractères')
plt.ylabel('Fréquence')
plt.show()
```



In [45]:
```
plt.figure(figsize=(6,4))
counts.plot(kind='bar', color=['skyblue','salmon'])
plt.xticks([0,1], ['Non sarcastique', 'Sarcastique'], rotation=0)
plt.title("Répartition des tweets sarcastiques")
plt.ylabel("Nombre de tweets")
for i, v in enumerate(counts.values):
    plt.text(i, v + 5, str(v), ha='center')
plt.show()
```



In [46]:
```
tweets_sarcastic = ' '.join(train_data[train_data['sarcastic'] == 1]['tweet'].
astype(str))
tweets_non_sarcastic = ' '.join(train_data[train_data['sarcastic'] == 0]['twee
t'].astype(str))
stopwords=set(STOPWORDS)
wordcloud_sarcastic = WordCloud(width=800, height=400, background_color='whit
e', stopwords=stopwords).generate(tweets_sarcastic)
wordcloud_non_sarcastic = WordCloud(width=800, height=400, background_color='w
hite', stopwords=stopwords).generate(tweets_non_sarcastic)
plt.figure(figsize=(14, 6))
plt.subplot(1, 2, 1)
plt.imshow(wordcloud_sarcastic, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud - Tweets Sarcastiques')
plt.subplot(1, 2, 2)
plt.imshow(wordcloud_non_sarcastic, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud - Tweets Non Sarcastiques')
plt.show()
```



2-Prétraitement du texte

In [47]:
```
train_data=train_data[["tweet","sarcastic"]]
train_data.head()
```

Out[47]:

	tweet	sarcastic
0	The only thing I got from college is a caffein...	1
1	I love it when professors draw a big question ...	1
2	Remember the hundred emails from companies whe...	1
3	Today my pop-pop told me I was not “forced” to...	1
4	@VolphanCarol @littlewhitty @mysticalmanatee I...	1

1. Nettoyage et transformation du texte

In [48]:
```
def clean_text(text):
    if not isinstance(text, str):
        return ""
    text = text.lower()
    text = re.sub(r"http\S+|www\S+", "", text)
    text = re.sub(r"@\w+", "", text)
    text = re.sub(r"#", "", text)
    text = re.sub(r"[^a-zA-Z\s]", "", text)
    text = re.sub(r"\s+", " ", text).strip()
    words = [word for word in text.split() if word not in stopwords]
    text = " ".join(words)

    return text
```

In [49]:
```
train_data['text_cleaned'] = train_data['tweet'].apply(clean_text)
train_data.head()
```

Out[49]:

	tweet	sarcastic	text_cleaned
0	The only thing I got from college is a caffein...	1	thing got college caffeine addiction
1	I love it when professors draw a big question ...	1	love professors draw big question mark next an...
2	Remember the hundred emails from companies whe...	1	remember hundred emails companies covid starte...
3	Today my pop-pop told me I was not “forced” to...	1	today poppop told forced go college okay sure ...
4	@VolphanCarol @littlewhitty @mysticalmanatee I...	1	reported cancun cruz worrying heartbeats const...

1. Sélection des colonnes pertinentes

In [50]:
```
train_data=train_data[['text_cleaned','sarcastic']]
train_data.head()
```

Out[50]:

	text_cleaned	sarcastic
0	thing got college caffeine addiction	1
1	love professors draw big question mark next an...	1
2	remember hundred emails companies covid starte...	1
3	today poppop told forced go college okay sure ...	1
4	reported cancun cruz worrying heartbeats const...	1

1. Séparation des features et du label

In [51]:
```
X = train_data['text_cleaned'].astype(str)
y = train_data['sarcastic']
```

1. Division des données

```
In [52]: X_train, X_test, y_train, y_test = train_test_split(
             X, y, test_size=0.2, random_state=42, stratify=y
         )
```

3-Vectorisation (transformation en nombres)

1. Vectorisation TF-IDF

```
In [53]: tfidf = TfidfVectorizer(max_features=5000, ngram_range=(1,2))
         X_train_tfidf = tfidf.fit_transform(X_train)
         X_test_tfidf = tfidf.transform(X_test)
```

1. Encodage des textes avec SBERT

```
In [54]: X_test_list = X_test.astype(str).tolist()
         X_train_list = X_train.astype(str).tolist()

         model_sbert = SentenceTransformer('all-MiniLM-L6-v2')
         X_train_emb = model_sbert.encode(X_train_list, batch_size=32, show_progress_ba
         r=True)
         X_test_emb = model_sbert.encode(X_test_list, batch_size=32, show_progress_bar=
         True)
```

```
Batches: 100%|██████████| 87/87 [00:05<00:00, 15.97it/s]
Batches: 100%|██████████| 22/22 [00:01<00:00, 14.65it/s]
```

4-Application d'algorithmes de Machine Learning

1. Fonction d'entraînement ,d'évaluation des modèles

```
In [55]: def train_evaluate(model, X_train, y_train, X_test, y_test, name="Model"):
             print(f"\n===== {name} =====")
             model.fit(X_train, y_train)
             y_pred = model.predict(X_test)
             print(classification_report(y_test, y_pred, digits=3))

             cm = confusion_matrix(y_test, y_pred)
             sns.heatmap(cm, annot=True, fmt="d", cmap="Blues")
             plt.title(f"{name} - Confusion Matrix")
             plt.xlabel("Prédictions")
             plt.ylabel("Vérités terrain")
             plt.show()
             return y_pred
```

1. Entraînement et évaluation de tous les modèles

Il s'agit de:

1)Entraîner le modèle

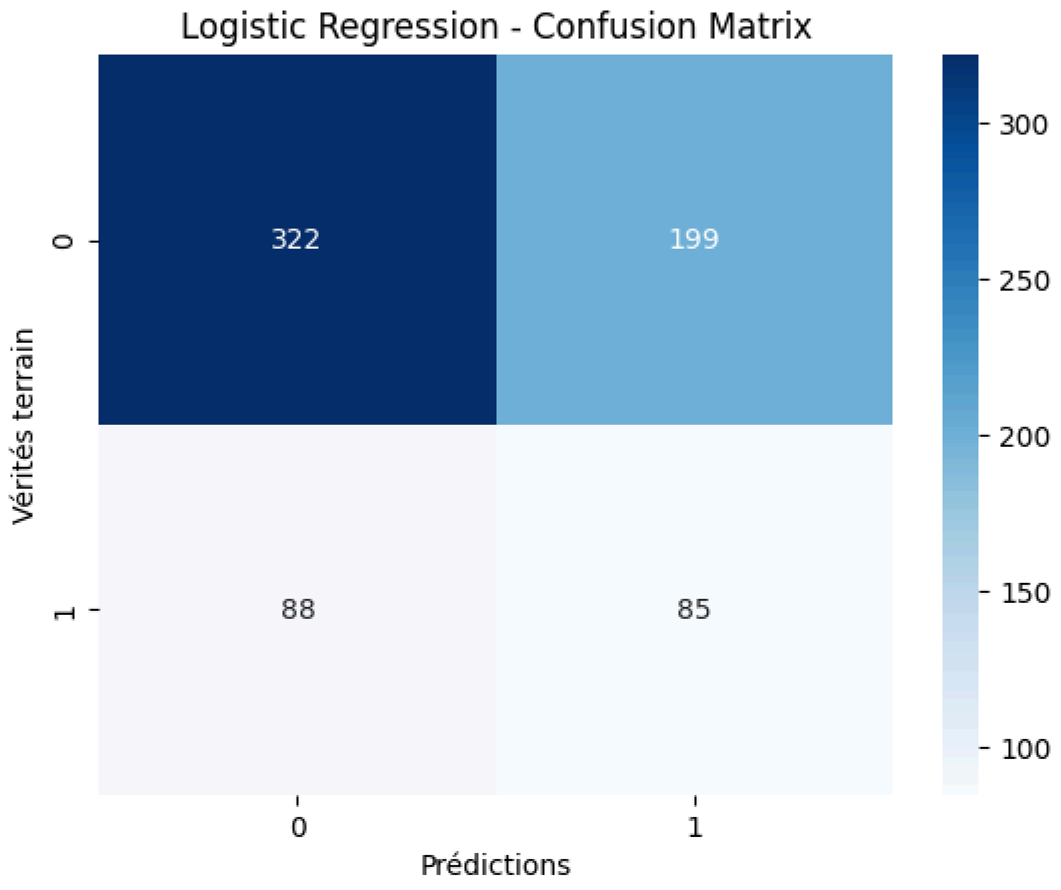
2)Évaluer les performances : accuracy, precision, recall,F1-score

3)Afficher la matrice de confusion

(a) Modèle Logistic Regression

In [56]:
```
logreg = LogisticRegression(max_iter=1000, class_weight='balanced')
f1_logreg = train_evaluate(logreg, X_train_emb, y_train, X_test_emb, y_test,
"Logistic Regression")
```

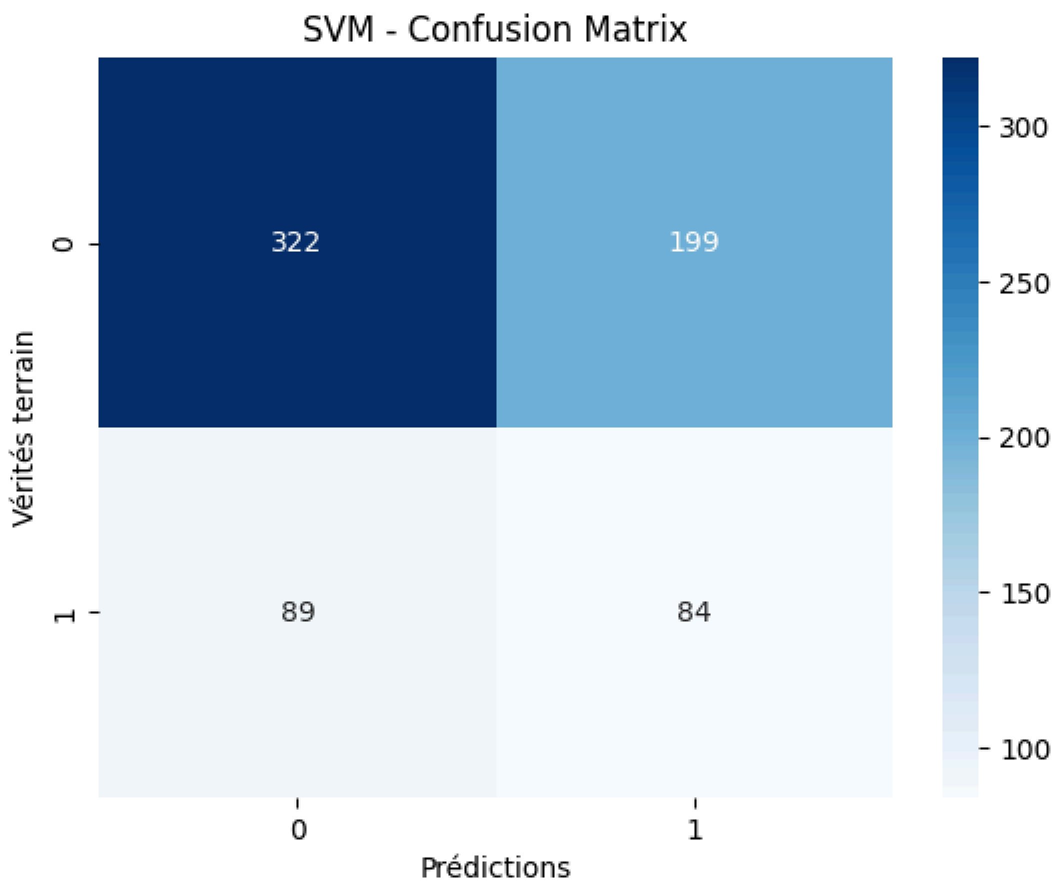
```
===== Logistic Regression =====
              precision    recall  f1-score   support

           0      0.785     0.618     0.692       521
           1      0.299     0.491     0.372       173

    accuracy                          0.586       694
   macro avg      0.542     0.555     0.532       694
weighted avg      0.664     0.586     0.612       694
```



(b) Modèle SVM (Support Vector Classifier)

In [57]:
```
svm = LinearSVC( class_weight='balanced',  random_state=42)
f1_svm = train_evaluate(svm, X_train_emb, y_train, X_test_emb, y_test, "SVM")
```

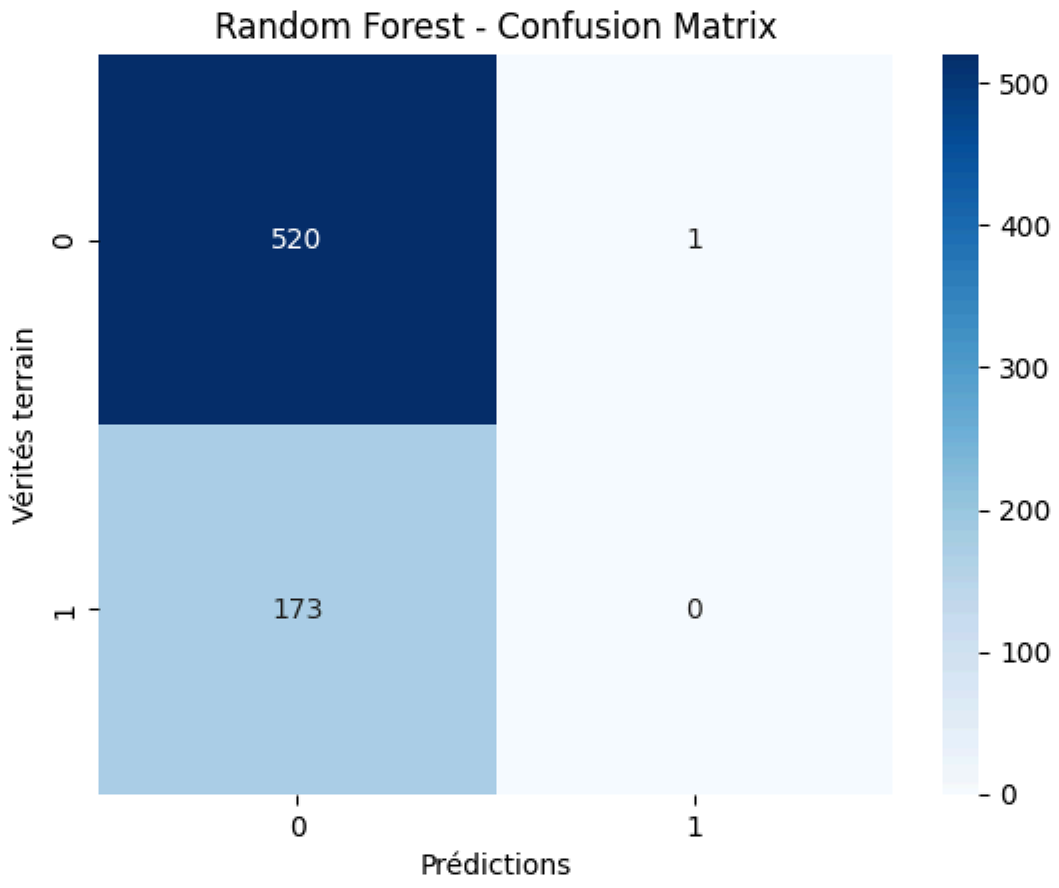
```
===== SVM =====
              precision    recall  f1-score   support

           0      0.783     0.618     0.691       521
           1      0.297     0.486     0.368       173

    accuracy                          0.585       694
   macro avg      0.540     0.552     0.530       694
weighted avg      0.662     0.585     0.611       694
```



(c) Modèle Random Forest

In [75]:
```
rf = RandomForestClassifier( class_weight='balanced', random_state=42)
f1_rf = train_evaluate(rf, X_train_emb, y_train, X_test_emb, y_test, "Random F
orest")
```

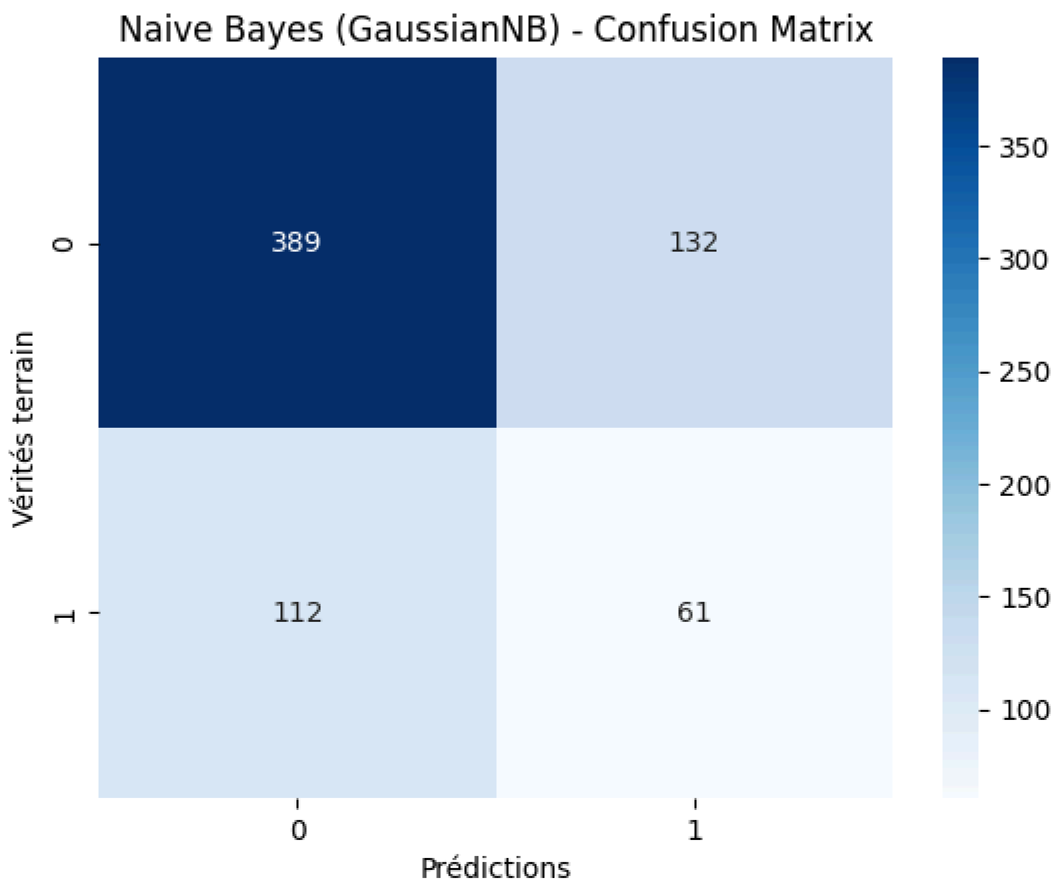
```
===== Random Forest =====
              precision    recall  f1-score   support

           0      0.750     0.998     0.857       521
           1      0.000     0.000     0.000       173

    accuracy                          0.749       694
   macro avg      0.375     0.499     0.428       694
weighted avg      0.563     0.749     0.643       694
```



(d) Modèle Naive Bayes (GaussianNB)

```
In [59]: gnb = GaussianNB()
         f1_gnb = train_evaluate(gnb, X_train_emb, y_train, X_test_emb, y_test, "Naive
         Bayes (GaussianNB)")
```

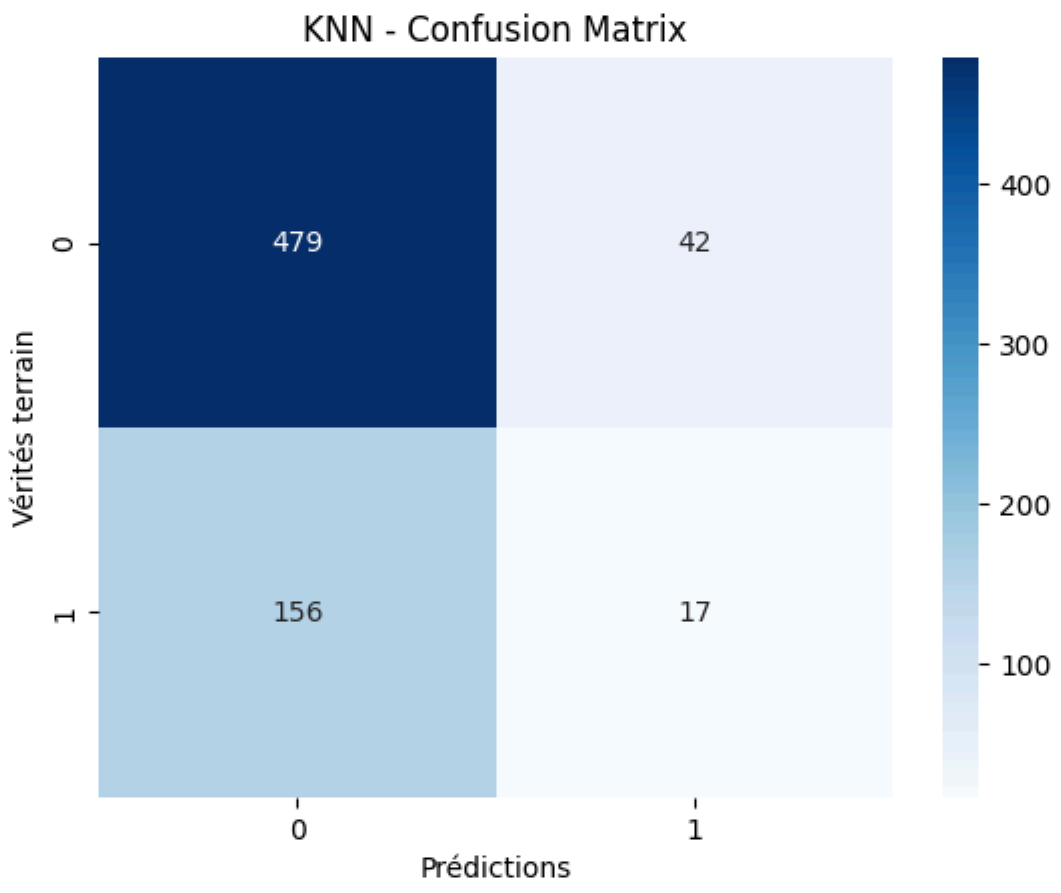
```
===== Naive Bayes (GaussianNB) =====
              precision    recall  f1-score   support

           0      0.776     0.747     0.761       521
           1      0.316     0.353     0.333       173

    accuracy                          0.648       694
   macro avg      0.546     0.550     0.547       694
weighted avg      0.662     0.648     0.655       694
```



(e) Modèle K-Nearest Neighbors (KNN)

```
In [60]: knn = KNeighborsClassifier(n_neighbors=5)
         f1_knn = train_evaluate(knn, X_train_emb, y_train, X_test_emb, y_test, "KNN")
```

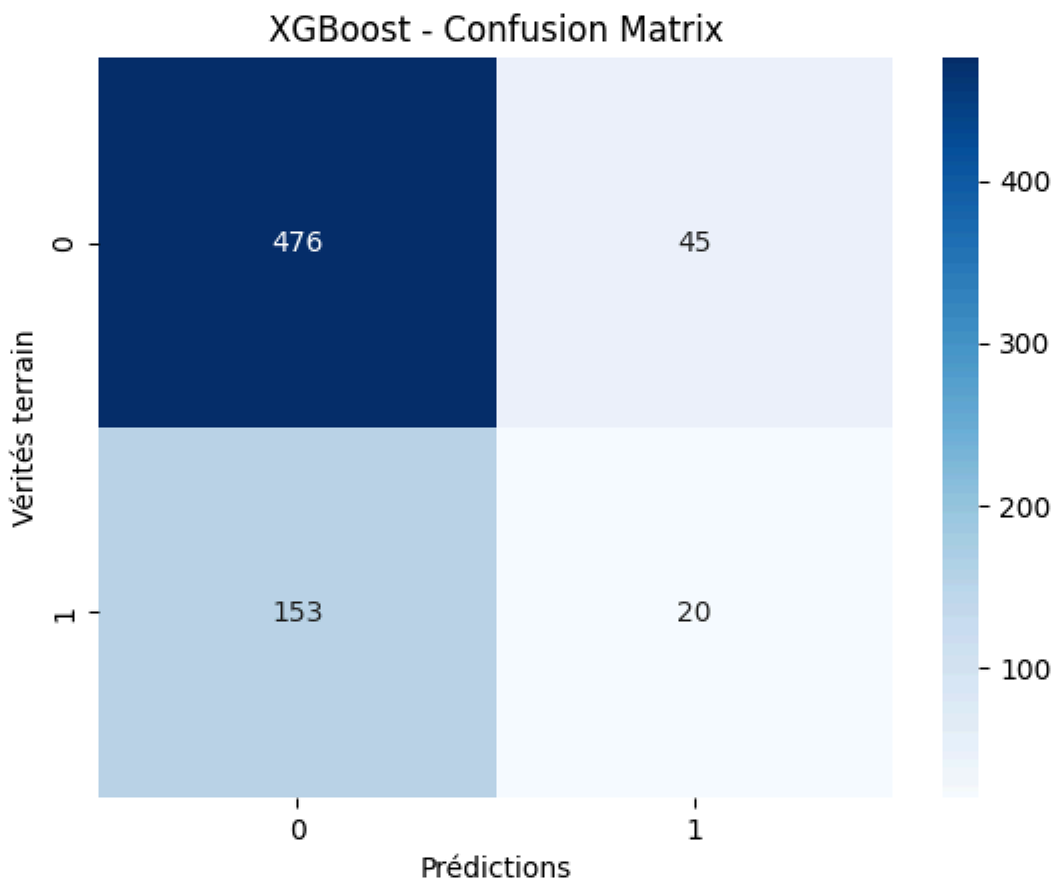
```
===== KNN =====
              precision    recall  f1-score   support

           0      0.754     0.919     0.829       521
           1      0.288     0.098     0.147       173

    accuracy                          0.715       694
   macro avg      0.521     0.509     0.488       694
weighted avg      0.638     0.715     0.659       694
```



(f) Modèle XGBoost

In [61]:
```
neg = sum([1 for label in y_train if label==0])
pos = sum([1 for label in y_train if label==1])
scale_pos_weight = neg / pos

xgb = xgb.XGBClassifier(
    n_estimators=200,
    learning_rate=0.1,
    max_depth=5,
    scale_pos_weight=scale_pos_weight,
    use_label_encoder=False,
    eval_metric='logloss',
    random_state=42
)
f1_xgb = train_evaluate(xgb, X_train_emb, y_train, X_test_emb, y_test, "XGBoos
t")
```

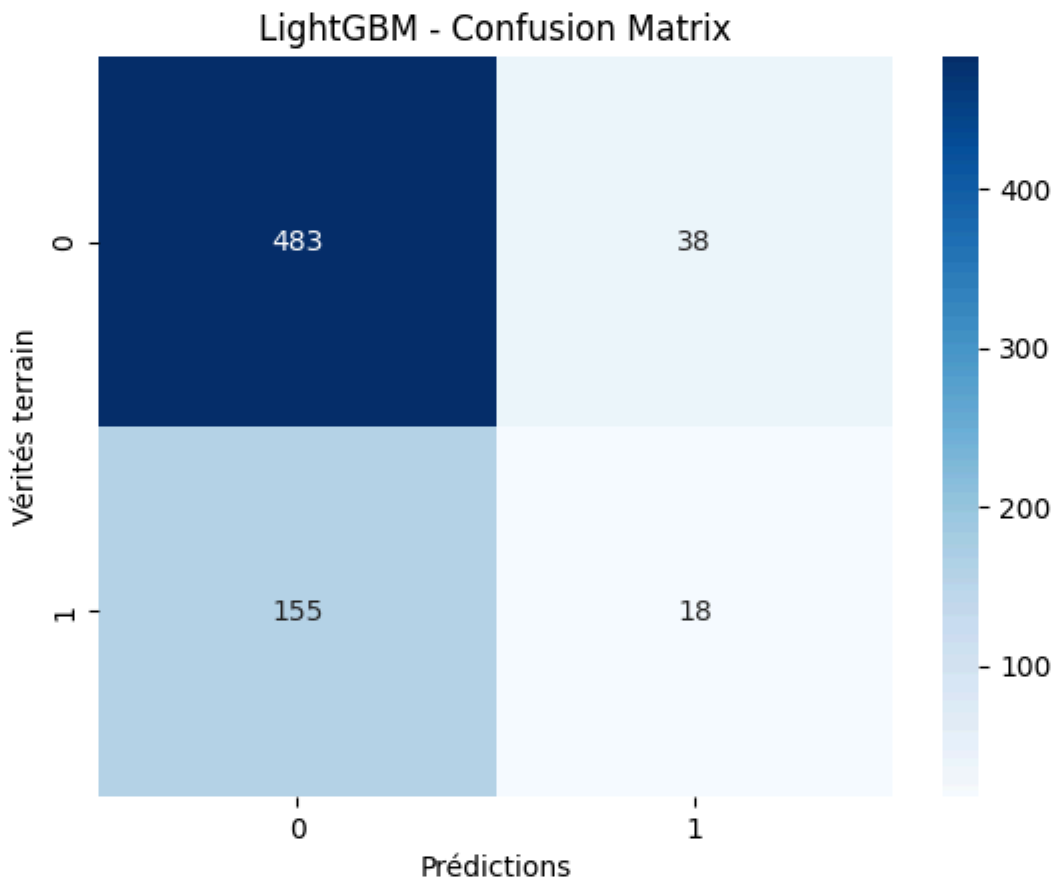
```
===== XGBoost =====

c:\Users\brahi\AppData\Local\Programs\Python\Python313\Lib\site-packages\xgbo
ost\training.py:199: UserWarning: [21:12:27] WARNING: C:\actions-runner\_work
\xgboost\xgboost\src\learner.cc:790:
Parameters: { "use_label_encoder" } are not used.

  bst.update(dtrain, iteration=i, fobj=obj)
              precision    recall  f1-score   support

           0      0.757     0.914     0.828       521
           1      0.308     0.116     0.168       173

    accuracy                          0.715       694
   macro avg      0.532     0.515     0.498       694
weighted avg      0.645     0.715     0.663       694
```



(g) Modèle LightGBM

In [79]:
```
import lightgbm as lgb

lgb_model = lgb.LGBMClassifier(
    objective='binary',
    class_weight='balanced',
    n_estimators=100,
    force_col_wise=True
)
f1_lgb = train_evaluate(lgb_model, X_train_emb, y_train, X_test_emb, y_test,
"LightGBM")
```

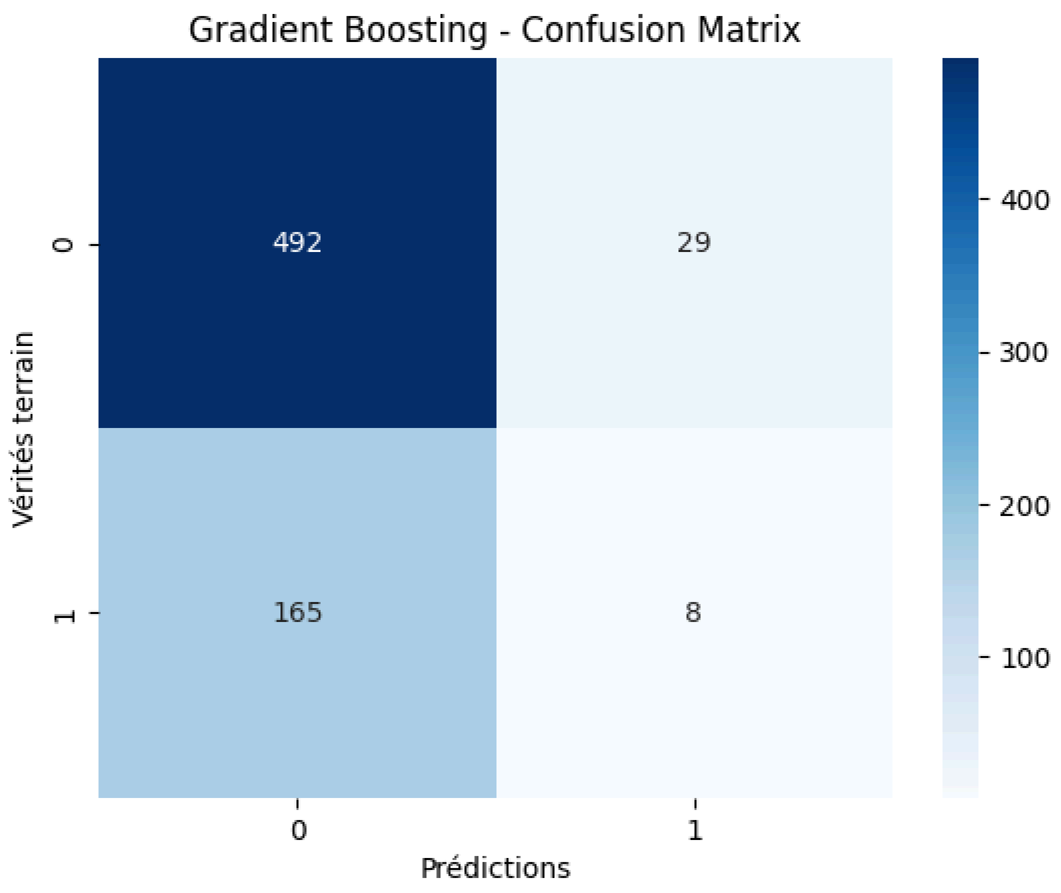
```
===== LightGBM =====
[LightGBM] [Info] Number of positive: 694, number of negative: 2080
[LightGBM] [Info] Total Bins 97920
[LightGBM] [Info] Number of data points in the train set: 2774, number of use
d features: 384
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.500000 -> initscore=0.00000
0
[LightGBM] [Info] Start training from score 0.000000
              precision    recall  f1-score   support

           0      0.757     0.927     0.833       521
           1      0.321     0.104     0.157       173

    accuracy                          0.722       694
   macro avg      0.539     0.516     0.495       694
weighted avg      0.648     0.722     0.665       694


c:\Users\brahi\AppData\Local\Programs\Python\Python313\Lib\site-packages\skle
arn\utils\validation.py:2749: UserWarning: X does not have valid feature name
s, but LGBMClassifier was fitted with feature names
  warnings.warn(
```



(h) Modèle GradientBoost

```
In [63]: from sklearn.ensemble import GradientBoostingClassifier

         gb = GradientBoostingClassifier(n_estimators=200, learning_rate=0.1, max_depth
         =3, random_state=42)
         f1_gb = train_evaluate(gb, X_train_emb, y_train, X_test_emb, y_test, "Gradient
         Boosting")
```

```
===== Gradient Boosting =====
              precision    recall  f1-score   support

           0      0.749     0.944     0.835       521
           1      0.216     0.046     0.076       173

    accuracy                          0.720       694
   macro avg      0.483     0.495     0.456       694
weighted avg      0.616     0.720     0.646       694
```



5-Comparaison et sélection du meilleur modèle

1. Modèles utilisés et F1-score associés

In [64]:
```
model_preds= {"Logistic Regression": f1_logreg,
              "SVM": f1_svm,
              "Random Forest": f1_rf,
              "Naive Bayes": f1_gnb,
              "KNN": f1_knn,
              "XGBoost": f1_xgb,
              "LightGBM": f1_lgb,
              "Gradient Boosting": f1_gb
            }
models={"Logistic Regression": logreg,
            "SVM": svm,
        "Random Forest": rf,
        "Naive Bayes": gnb,
        "KNN": knn,
        "XGBoost": xgb,
        "LightGBM": lgb_model,
        "Gradient Boosting": gb
        }
```

1. Définition de la classe minoritaire

In [65]:
```
from collections import Counter

counter = Counter(y_train)
minority_class = min(counter, key=counter.get)
print("Classe minoritaire =", minority_class)
```

```
Classe minoritaire = 1
```

1. Calcul des métriques pour la classe minoritaire

In [66]:
```
results = []

for name in model_preds.keys():
    y_pred = model_preds[name]
    model = models[name]

    # F1 score par classe (array)
    f1_per_class = f1_score(y_test, y_pred, average=None)
    f1_minority  = f1_per_class[minority_class]

    # Precision & Recall pour la classe minoritaire
    precision_per_class = precision_score(y_test, y_pred, average=None)
    recall_per_class    = recall_score(y_test, y_pred, average=None)

    precision_minority = precision_per_class[minority_class]
    recall_minority    = recall_per_class[minority_class]

    # AUC si possible
    if hasattr(model, "predict_proba"):
        y_proba = model.predict_proba(X_test_emb)[:, 1]
        auc = roc_auc_score(y_test, y_proba)
    elif hasattr(model, "decision_function"):
        y_score = model.decision_function(X_test_emb)
        auc = roc_auc_score(y_test, y_score)
    else:
        auc = None

    results.append({
        "Model": name,
        "Precision_minority": precision_minority,
        "Recall_minority": recall_minority,
        "F1_minority": f1_minority,
        "AUC": auc
    })
```

```
c:\Users\brahi\AppData\Local\Programs\Python\Python313\Lib\site-packages\skle
arn\metrics\_classification.py:1731: UndefinedMetricWarning: Precision is ill
-defined and being set to 0.0 in labels with no predicted samples. Use `zero_
division` parameter to control this behavior.
  _warn_prf(average, modifier, f"{metric.capitalize()} is", result.shape[0])
c:\Users\brahi\AppData\Local\Programs\Python\Python313\Lib\site-packages\skle
arn\utils\validation.py:2749: UserWarning: X does not have valid feature name
s, but LGBMClassifier was fitted with feature names
  warnings.warn(
```

1. Présenter les résultats dans un tableau comparatif

In [67]:
```
df_results = pd.DataFrame(results)
df_results = df_results.sort_values(by="F1_minority", ascending=False)
df_results.reset_index(drop=True, inplace=True)
df_results
```

Out[67]:

	Model	Precision_minority	Recall_minority	F1_minority	AUC
0	Logistic Regression	0.299296	0.491329	0.371991	0.567628
1	SVM	0.296820	0.485549	0.368421	0.554447
2	Naive Bayes	0.316062	0.352601	0.333333	0.560061
3	XGBoost	0.307692	0.115607	0.168067	0.514517
4	KNN	0.288136	0.098266	0.146552	0.538382
5	LightGBM	0.368421	0.080925	0.132701	0.526910
6	Gradient Boosting	0.216216	0.046243	0.076190	0.529362
7	Random Forest	0.000000	0.000000	0.000000	0.584070

1. Sélection du meilleur modèle selon le F1 de la classe minoritaire

In [68]:
```
best_model = df_results.loc[0, "Model"]
print(f"Best model based on F1 score for minority class: {best_model}")
```

```
Best model based on F1 score for minority class: Logistic Regression
```

6-Test final et sauvegarde

1. Chargement et aperçu du fichier de test

In [69]:
```
test_data = pd.read_csv('task_A_En_test.csv')
test_data.head()
```

Out[69]:

	tweet	sarcastic
0	Size on the the Toulouse team, That pack is mo...	0
1	Pinball!	0
2	So the Scottish Government want people to get ...	1
3	villainous pro tip : change the device name on...	0
4	I would date any of these men 🥺	0

1. Prétraitement des textes du fichier de test

In [70]:
```python
test_data['text_cleaned'] = test_data['tweet'].apply(clean_text)
test_data.head()
```

Out[70]:

	tweet	sarcastic	text_cleaned
0	Size on the the Toulouse team, That pack is mo...	0	size toulouse team pack monstrous cant see wel...
1	Pinball!	0	pinball
2	So the Scottish Government want people to get ...	1	scottish government want people booster shots ...
3	villainous pro tip : change the device name on...	0	villainous pro tip change device name bluetoot...
4	I would date any of these men 🥺	0	date men

1. Encodage des textes du test avec SBERT

In [71]:
```python
X_test_final_list = test_data['text_cleaned'].astype(str).tolist()
X_test_final_emb = model_sbert.encode(X_test_final_list, batch_size=32, show_p
rogress_bar=True)
```

```
Batches: 100%|██████████| 44/44 [00:02<00:00, 17.44it/s]
```

1. Prédictions sur le fichier de test avec le meilleur modèle

In [72]:
```python
best_model_instance = models[best_model]
y_test_final_pred = best_model_instance.predict(X_test_final_emb)
test_data['sarcastic_pred'] = y_test_final_pred
test_data.head()
```

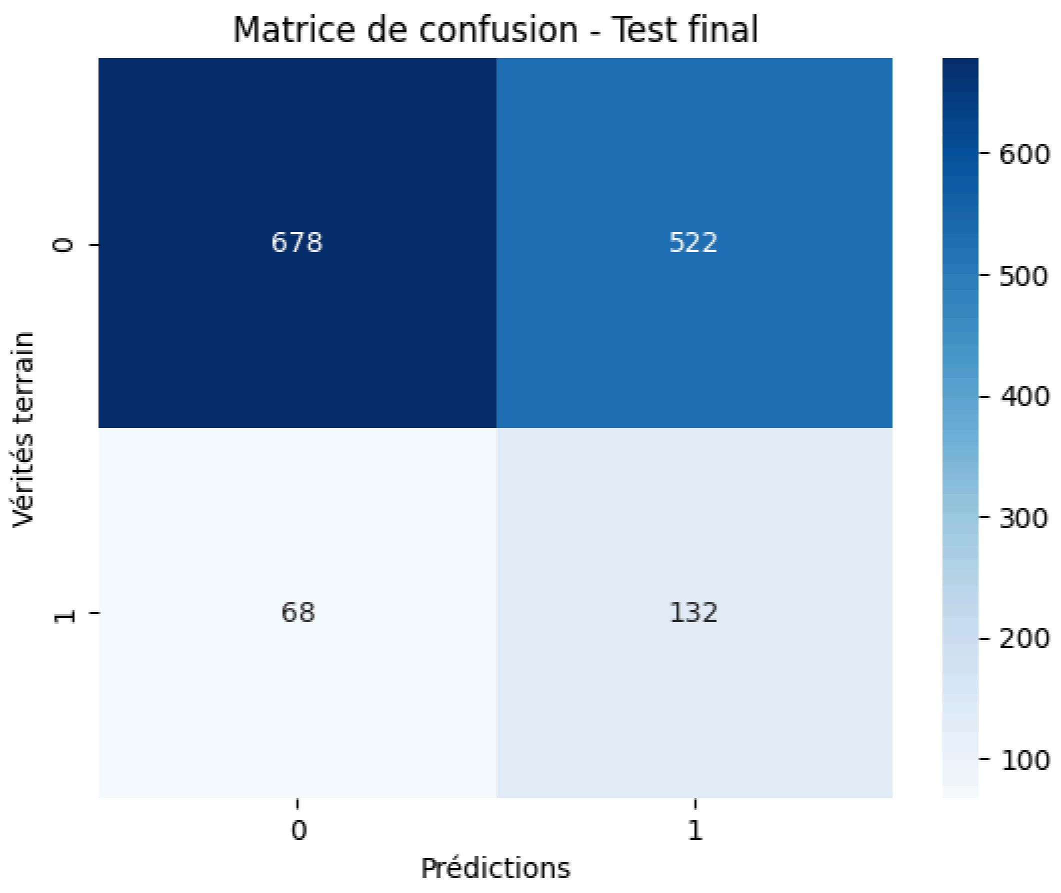
Out[72]:

	tweet	sarcastic	text_cleaned	sarcastic_pred
0	Size on the the Toulouse team, That pack is mo...	0	size toulouse team pack monstrous cant see wel...	1
1	Pinball!	0	pinball	0
2	So the Scottish Government want people to get ...	1	scottish government want people booster shots ...	0
3	villainous pro tip : change the device name on...	0	villainous pro tip change device name bluetoot...	1
4	I would date any of these men 🥺	0	date men	1

1. Évaluation des prédictions sur le fichier de test

```
In [73]: if 'sarcastic' in test_data.columns:
             y_true = test_data['sarcastic']
             y_pred = test_data['sarcastic_pred']
             print("\nClassification Report on Test Data:")
             print(classification_report(y_true, y_pred, digits=3))
             try:
                 y_prob = best_model_instance.predict_proba(X_test_final_emb)[:, 1]
                 auc = roc_auc_score(y_true, y_prob)
                 print(f"AUC : {auc:.3f}")
             except:
                 print("AUC non disponible (le modèle ne supporte pas predict_proba).")
             cm = confusion_matrix(y_true, y_pred)
             sns.heatmap(cm, annot=True, fmt="d", cmap="Blues")
             plt.title("Matrice de confusion - Test final")
             plt.xlabel("Prédictions")
             plt.ylabel("Vérités terrain")
             plt.show()
         else:
             print("⚠️ La colonne 'sarcastic' n'existe pas dans le fichier test.")
```

```
Classification Report on Test Data:
              precision    recall  f1-score   support

           0      0.909     0.565     0.697      1200
           1      0.202     0.660     0.309       200

    accuracy                          0.579      1400
   macro avg      0.555     0.613     0.503      1400
weighted avg      0.808     0.579     0.641      1400

AUC : 0.648
```



1. Sauvegarde du modèle et des prédictions finales avec les labels

In [74]:
```
joblib.dump(best_model_instance, "best_model_sbert.pkl")

test_data[["text_cleaned","sarcastic_pred","sarcastic"]].to_csv("final_predict
ions.csv", index=False)

print("✔ Modèle sauvegardé : best_model_sbert.pkl")
print("✔ Prédictions sauvegardées : final_predictions.csv")
```

```
✔ Modèle sauvegardé : best_model_sbert.pkl
✔ Prédictions sauvegardées : final_predictions.csv
```