tpcxxxkri

June 19, 2024

[66]:
```
# This Python 3 environment comes with many helpful analytics libraries␣
↪installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/
↪docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list␣
↪all files under the input directory

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that␣
↪gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved␣
↪outside of the current session
```

```
/kaggle/input/mental-health-dataset/KB.json
```

[67]:
```
import json
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, confusion_matrix,␣
↪accuracy_score
```

```
from sklearn.model_selection import GridSearchCV, cross_val_score
import nltk
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from wordcloud import WordCloud
import tensorflow as tf
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Embedding, LSTM, Dense, SpatialDropout1D
from tensorflow.keras.utils import to_categorical
```

[68]:
```
df = pd.read_json(path_or_buf='/kaggle/input/mental-health-dataset/KB.json')
```

[69]:
```
df.head()
```

[69]:
```
                                             intents
0  {'tag': 'greeting', 'patterns': ['Hi', 'Hey', …
1  {'tag': 'morning', 'patterns': ['Good morning'…
2  {'tag': 'afternoon', 'patterns': ['Good aftern…
3  {'tag': 'evening', 'patterns': ['Good evening'…
4  {'tag': 'night', 'patterns': ['Good night', 'N…
```

[70]:
```
df.tail()
```

[70]:
```
                                              intents
75  {'tag': 'fact-28', 'patterns': ['What do I do …
76  {'tag': 'fact-29', 'patterns': ['How do I know…
77  {'tag': 'fact-30', 'patterns': ['How can I mai…
78  {'tag': 'fact-31', 'patterns': ['What's the di…
79  {'tag': 'fact-32', 'patterns': ['What's the di…
```

[71]:
```
tags = []
patterns = []
responses = []

for intent in df['intents']:
    for pattern in intent['patterns']:
        tags.append(intent['tag'])
        patterns.append(pattern)
        if 'responses' in intent:
            responses.append(intent['responses'][0])
        else:
            responses.append(None)

df = pd.DataFrame({'tag': tags, 'pattern': patterns, 'response': responses})
df.head()
```

```
[71]:         tag          pattern                                  response
      0  greeting               Hi  Hello there. Tell me how are you feeling today?
      1  greeting              Hey  Hello there. Tell me how are you feeling today?
      2  greeting  Is anyone there?  Hello there. Tell me how are you feeling today?
      3  greeting         Hi there  Hello there. Tell me how are you feeling today?
      4  greeting            Hello  Hello there. Tell me how are you feeling today?
```

```
[72]: df.tail()
```

```
[72]:          tag                                            pattern  \
      6250  fact-29                       How do I know if I'm unwell?
      6251  fact-30  How can I maintain social connections? What if…
      6252  fact-31  What's the difference between anxiety and stress?
      6253  fact-32  What's the difference between sadness and depr…
      6254  fact-32          difference between sadness and depression

                                                  response
      6250  If your beliefs , thoughts , feelings or behav…
      6251  A lot of people are alone right now, but we do…
      6252  Stress and anxiety are often used interchangea…
      6253  Sadness is a normal reaction to a loss, disapp…
      6254  Sadness is a normal reaction to a loss, disapp…
```

```
[73]: df.columns
```

```
[73]: Index(['tag', 'pattern', 'response'], dtype='object')
```

```
[74]: df.shape
```

```
[74]: (6255, 3)
```

```
[75]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6255 entries, 0 to 6254
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   tag       6255 non-null   object
 1   pattern   6255 non-null   object
 2   response  5609 non-null   object
dtypes: object(3)
memory usage: 146.7+ KB
```

```
[76]: df.isnull().sum()
```

```
[76]: tag           0
      pattern       0
      response    646
      dtype: int64
```

```
[77]: df.describe()
```

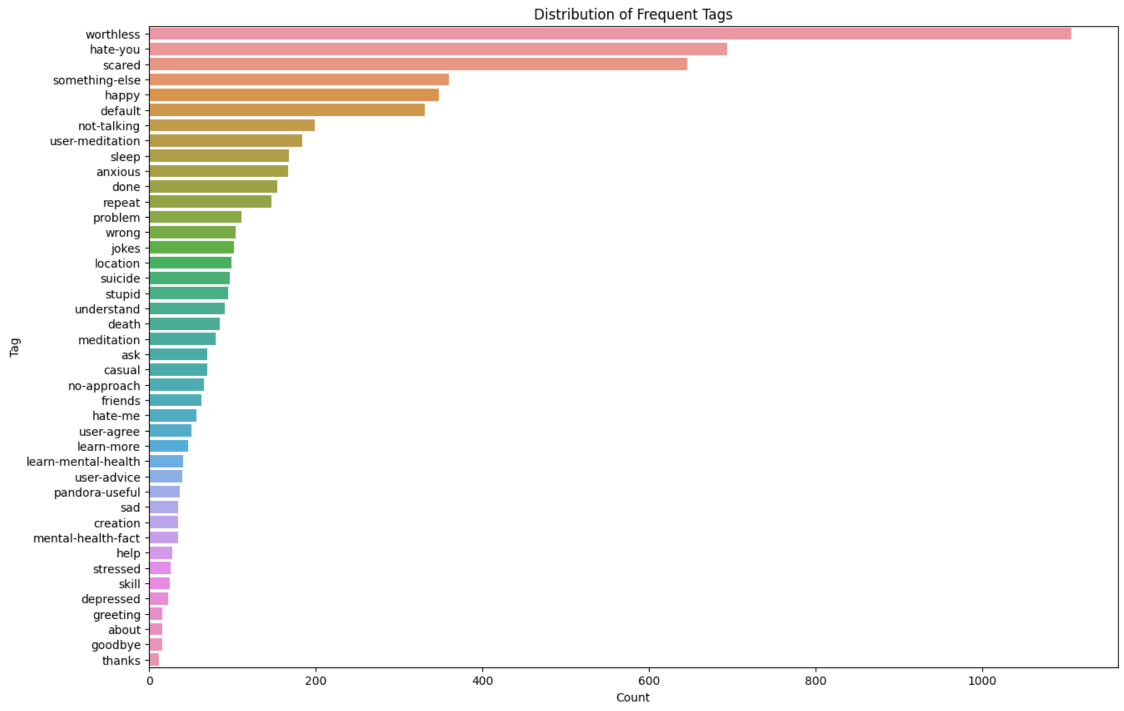
```
[77]:              tag                                        pattern  \
      count       6255                                           6255
      unique        80                                           3163
      top     worthless  I'm not good enough for anyone to care about me.
      freq        1107                                             69

                                         response
      count                                  5609
      unique                                   79
      top     I hear you. It's tough feeling this way.
      freq                                   1107
```

```
[78]: df['tag'].value_counts()
```

```
[78]: tag
      worthless         1107
      hate-you           694
      scared             646
      something-else     360
      happy              348
                        …
      fact-11              1
      fact-10              1
      fact-9               1
      fact-8               1
      fact-12              1
      Name: count, Length: 80, dtype: int64
```

```
[79]: min_count = 10
      tag_counts = df['tag'].value_counts()
      filtered_tags = tag_counts[tag_counts >= min_count].index
```

```
[80]: plt.figure(figsize=(15, 10))
      sns.countplot(y=df[df['tag'].isin(filtered_tags)]['tag'],␣
       ↪order=tag_counts[filtered_tags].index)
      plt.title('Distribution of Frequent Tags')
      plt.xlabel('Count')
      plt.ylabel('Tag')
      plt.show()
```



[84]:
```
nltk.download('stopwords')
nltk.download('wordnet')

!unzip /usr/share/nltk_data/corpora/wordnet.zip -d /usr/share/nltk_data/corpora/
```

```
[nltk_data] Downloading package stopwords to /usr/share/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to /usr/share/nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
Archive:  /usr/share/nltk_data/corpora/wordnet.zip
   creating: /usr/share/nltk_data/corpora/wordnet/
  inflating: /usr/share/nltk_data/corpora/wordnet/lexnames
  inflating: /usr/share/nltk_data/corpora/wordnet/data.verb
  inflating: /usr/share/nltk_data/corpora/wordnet/index.adv
  inflating: /usr/share/nltk_data/corpora/wordnet/adv.exc
  inflating: /usr/share/nltk_data/corpora/wordnet/index.verb
  inflating: /usr/share/nltk_data/corpora/wordnet/cntlist.rev
  inflating: /usr/share/nltk_data/corpora/wordnet/data.adj
  inflating: /usr/share/nltk_data/corpora/wordnet/index.adj
  inflating: /usr/share/nltk_data/corpora/wordnet/LICENSE
  inflating: /usr/share/nltk_data/corpora/wordnet/citation.bib
  inflating: /usr/share/nltk_data/corpora/wordnet/noun.exc
  inflating: /usr/share/nltk_data/corpora/wordnet/verb.exc
  inflating: /usr/share/nltk_data/corpora/wordnet/README
  inflating: /usr/share/nltk_data/corpora/wordnet/index.sense
  inflating: /usr/share/nltk_data/corpora/wordnet/data.noun
  inflating: /usr/share/nltk_data/corpora/wordnet/data.adv
  inflating: /usr/share/nltk_data/corpora/wordnet/index.noun
  inflating: /usr/share/nltk_data/corpora/wordnet/adj.exc
```

[85]:
```
lemmatizer = WordNetLemmatizer()
stop_words = set(stopwords.words('english'))

def preprocess_text(text):
    text = text.lower()
    text = ''.join([char for char in text if char.isalpha() or char == ' '])
    text = ' '.join([lemmatizer.lemmatize(word) for word in text.split() if␣
 ↪word not in stop_words])
    return text

df['pattern_cleaned'] = df['pattern'].apply(preprocess_text)
df['response_cleaned'] = df['response'].apply(lambda x: preprocess_text(x) if x␣
 ↪else "")

df.head()
```

[85]:
```
        tag           pattern  \
0  greeting                Hi
1  greeting               Hey
2  greeting  Is anyone there?
3  greeting          Hi there
4  greeting             Hello

                                        response pattern_cleaned  \
0  Hello there. Tell me how are you feeling today?              hi
1  Hello there. Tell me how are you feeling today?             hey
2  Hello there. Tell me how are you feeling today?          anyone
3  Hello there. Tell me how are you feeling today?              hi
4  Hello there. Tell me how are you feeling today?           hello

          response_cleaned
0  hello tell feeling today
1  hello tell feeling today
2  hello tell feeling today
3  hello tell feeling today
4  hello tell feeling today
```

[86]:
```
vectorizer = TfidfVectorizer(max_features=5000)
X = vectorizer.fit_transform(df['pattern_cleaned']).toarray()
y = df['tag']

from sklearn.preprocessing import LabelEncoder
```

```
label_encoder = LabelEncoder()
y = label_encoder.fit_transform(y)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

print(X_train.shape, X_test.shape)
print(y_train.shape, y_test.shape)
```

```
(5004, 1750) (1251, 1750)
(5004,) (1251,)
```

[87]:
```
nb_model = MultinomialNB()
nb_model.fit(X_train, y_train)
nb_pred = nb_model.predict(X_test)
```

[88]:
```
svm_model = SVC(kernel='linear')
svm_model.fit(X_train, y_train)
svm_pred = svm_model.predict(X_test)
```

[89]:
```
rf_model = RandomForestClassifier()
rf_model.fit(X_train, y_train)
rf_pred = rf_model.predict(X_test)
```

[90]:
```
param_grid = {'C': [0.1, 1, 10], 'kernel': ['linear', 'rbf']}
grid_search = GridSearchCV(SVC(), param_grid, refit=True, verbose=2)
grid_search.fit(X_train, y_train)
svm_best = grid_search.best_estimator_
```

```
Fitting 5 folds for each of 6 candidates, totalling 30 fits

/opt/conda/lib/python3.10/site-packages/sklearn/model_selection/_split.py:700:
UserWarning: The least populated class in y has only 1 members, which is less
than n_splits=5.
  warnings.warn(

[CV] END …C=0.1, kernel=linear; total time=  18.4s
[CV] END …C=0.1, kernel=linear; total time=  17.7s
[CV] END …C=0.1, kernel=linear; total time=  18.0s
[CV] END …C=0.1, kernel=linear; total time=  17.4s
[CV] END …C=0.1, kernel=linear; total time=  17.8s
[CV] END …C=0.1, kernel=rbf; total time=  24.2s
[CV] END …C=0.1, kernel=rbf; total time=  23.9s
[CV] END …C=0.1, kernel=rbf; total time=  23.4s
[CV] END …C=0.1, kernel=rbf; total time=  23.5s
[CV] END …C=0.1, kernel=rbf; total time=  23.7s
[CV] END …C=1, kernel=linear; total time=  14.6s
[CV] END …C=1, kernel=linear; total time=  14.6s
```

```
[CV] END …C=1, kernel=linear; total time=  14.7s
[CV] END …C=1, kernel=linear; total time=  13.9s
[CV] END …C=1, kernel=linear; total time=  14.6s
[CV] END …C=1, kernel=rbf; total time=  20.6s
[CV] END …C=1, kernel=rbf; total time=  19.9s
[CV] END …C=1, kernel=rbf; total time=  20.5s
[CV] END …C=1, kernel=rbf; total time=  19.9s
[CV] END …C=1, kernel=rbf; total time=  20.1s
[CV] END …C=10, kernel=linear; total time=  14.4s
[CV] END …C=10, kernel=linear; total time=  14.1s
[CV] END …C=10, kernel=linear; total time=  14.3s
[CV] END …C=10, kernel=linear; total time=  13.9s
[CV] END …C=10, kernel=linear; total time=  14.4s
[CV] END …C=10, kernel=rbf; total time=  20.6s
[CV] END …C=10, kernel=rbf; total time=  19.6s
[CV] END …C=10, kernel=rbf; total time=  20.4s
[CV] END …C=10, kernel=rbf; total time=  19.1s
[CV] END …C=10, kernel=rbf; total time=  20.7s
```

[91]:
```
nb_cv_scores = cross_val_score(nb_model, X, y, cv=5)
svm_cv_scores = cross_val_score(svm_best, X, y, cv=5)
rf_cv_scores = cross_val_score(rf_model, X, y, cv=5)
```

```
/opt/conda/lib/python3.10/site-packages/sklearn/model_selection/_split.py:700:
UserWarning: The least populated class in y has only 1 members, which is less
than n_splits=5.
  warnings.warn(
/opt/conda/lib/python3.10/site-packages/sklearn/model_selection/_split.py:700:
UserWarning: The least populated class in y has only 1 members, which is less
than n_splits=5.
  warnings.warn(
/opt/conda/lib/python3.10/site-packages/sklearn/model_selection/_split.py:700:
UserWarning: The least populated class in y has only 1 members, which is less
than n_splits=5.
  warnings.warn(
```

[92]:
```
def evaluate_model(model, X_test, y_test, y_pred):
    unique_labels = np.unique(np.concatenate((y_test, y_pred)))
    target_names = label_encoder.inverse_transform(unique_labels)
    print("Accuracy:", accuracy_score(y_test, y_pred))
    print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
    print("Classification Report:\n", classification_report(y_test, y_pred,␣
 ↪target_names=target_names, zero_division=0))
```

[93]:
```
print("Naive Bayes Model")
evaluate_model(nb_model, X_test, y_test, nb_pred)
```

```
Naive Bayes Model
```

```
Accuracy: 0.7426059152677857
Confusion Matrix:
 [[  0   0   0 …   0   2   0]
 [  0   0   0 …   0   1   0]
 [  0   0  17 …   0   1   0]
 …
 [  0   0   0 …  34   0   0]
 [  0   0   0 …   0 230   0]
 [  0   0   0 …   0   2  15]]
Classification Report:
                      precision    recall  f1-score   support

               about       0.00      0.00      0.00         4
           afternoon       0.00      0.00      0.00         1
             anxious       1.00      0.53      0.69        32
                 ask       1.00      0.53      0.70        15
              casual       0.00      0.00      0.00        14
            creation       0.00      0.00      0.00         6
               death       1.00      0.87      0.93        15
             default       0.80      0.79      0.79        56
           depressed       0.00      0.00      0.00         7
                done       0.92      0.71      0.80        34
             evening       0.00      0.00      0.00         1
              fact-1       0.00      0.00      0.00         1
             fact-16       0.00      0.00      0.00         1
             fact-18       0.00      0.00      0.00         1
             fact-21       0.00      0.00      0.00         1
             fact-24       0.00      0.00      0.00         1
             fact-26       0.00      0.00      0.00         1
             fact-27       0.00      0.00      0.00         1
             fact-28       0.00      0.00      0.00         1
             fact-31       0.00      0.00      0.00         1
              fact-5       0.00      0.00      0.00         2
             friends       0.00      0.00      0.00        10
             goodbye       0.00      0.00      0.00         5
            greeting       0.00      0.00      0.00         3
               happy       0.74      0.95      0.83        65
             hate-me       0.00      0.00      0.00        15
            hate-you       0.78      0.98      0.87       139
                help       0.00      0.00      0.00         7
               jokes       0.84      0.76      0.80        21
 learn-mental-health       0.50      0.25      0.33         8
          learn-more       0.00      0.00      0.00         7
            location       1.00      0.80      0.89        20
          meditation       0.92      0.79      0.85        14
  mental-health-fact       0.60      1.00      0.75         3
             morning       0.00      0.00      0.00         2
                name       0.00      0.00      0.00         2
```

```
   neutral-response       0.00      0.00      0.00         2
              night       0.00      0.00      0.00         2
        no-approach       0.00      0.00      0.00        15
        no-response       0.00      0.00      0.00         1
        not-talking       0.59      0.65      0.62        31
     pandora-useful       1.00      0.50      0.67         4
            problem       0.80      0.21      0.33        19
             repeat       0.84      0.55      0.67        29
                sad       0.00      0.00      0.00         6
             scared       0.72      0.98      0.83       128
              skill       0.00      0.00      0.00         8
              sleep       0.90      0.70      0.79        40
     something-else       0.86      1.00      0.92        80
           stressed       0.00      0.00      0.00         7
             stupid       1.00      0.50      0.67        16
            suicide       1.00      0.10      0.17        21
             thanks       0.00      0.00      0.00         1
         understand       1.00      0.43      0.60        21
        user-advice       0.00      0.00      0.00         8
         user-agree       1.00      0.40      0.57        10
    user-meditation       0.94      0.97      0.96        35
          worthless       0.60      0.99      0.75       232
              wrong       0.94      0.83      0.88        18

           accuracy                           0.74      1251
          macro avg       0.38      0.30      0.32      1251
       weighted avg       0.69      0.74      0.69      1251
```

[94]:
```
print("Cross-validation scores:", nb_cv_scores)
```

```
Cross-validation scores: [0.61470823 0.7226219  0.78497202 0.80015987
0.80415667]
```

[95]:
```
print("Mean CV score:", np.mean(nb_cv_scores))
```

```
Mean CV score: 0.7453237410071942
```

[96]:
```
print("\nRandom Forest Model")
evaluate_model(rf_model, X_test, y_test, rf_pred)
```

```

Random Forest Model
Accuracy: 0.86810551558753
Confusion Matrix:
 [[  0   0   0 …   0   0   0]
 [  0   0   0 …   0   0   0]
 [  0   0  32 …   0   0   0]
 …
 [  0   0   0 …  34   0   0]
 [  0   0   0 …   0 226   0]
 [  0   0   0 …   0   1  17]]
Classification Report:
                      precision    recall  f1-score   support

               about       0.00      0.00      0.00         4
           afternoon       0.00      0.00      0.00         1
             anxious       0.97      1.00      0.98        32
                 ask       0.94      1.00      0.97        15
              casual       0.20      0.79      0.32        14
            creation       0.33      0.17      0.22         6
               death       1.00      1.00      1.00        15
             default       0.96      0.84      0.90        56
           depressed       1.00      0.14      0.25         7
                done       0.96      0.74      0.83        34
             evening       0.00      0.00      0.00         1
              fact-1       0.00      0.00      0.00         1
             fact-14       0.00      0.00      0.00         0
             fact-16       0.00      0.00      0.00         1
             fact-18       0.00      0.00      0.00         1
             fact-21       0.00      0.00      0.00         1
             fact-24       0.00      0.00      0.00         1
             fact-26       1.00      1.00      1.00         1
             fact-27       0.00      0.00      0.00         1
             fact-28       0.00      0.00      0.00         1
              fact-3       0.00      0.00      0.00         0
             fact-31       0.00      0.00      0.00         1
              fact-5       0.00      0.00      0.00         2
             friends       1.00      1.00      1.00        10
             goodbye       0.50      0.20      0.29         5
            greeting       0.00      0.00      0.00         3
               happy       0.86      0.92      0.89        65
             hate-me       0.83      0.67      0.74        15
            hate-you       0.96      0.96      0.96       139
                help       0.50      0.29      0.36         7
               jokes       1.00      1.00      1.00        21
  learn-mental-health       0.70      0.88      0.78         8
          learn-more       0.55      0.86      0.67         7
            location       0.85      0.85      0.85        20
          meditation       0.87      0.93      0.90        14
  mental-health-fact       0.75      1.00      0.86         3
             morning       1.00      1.00      1.00         2
                name       0.00      0.00      0.00         2
    neutral-response       0.00      0.00      0.00         2
               night       0.67      1.00      0.80         2
         no-approach       0.33      0.33      0.33        15
```

```
     no-response       0.00      0.00      0.00         1
     not-talking       0.72      0.74      0.73        31
  pandora-useful       0.67      1.00      0.80         4
         problem       1.00      1.00      1.00        19
          repeat       0.89      0.86      0.88        29
             sad       0.17      0.17      0.17         6
          scared       0.97      0.98      0.97       128
           skill       0.00      0.00      0.00         8
           sleep       0.92      0.88      0.90        40
  something-else       1.00      0.99      0.99        80
        stressed       1.00      0.14      0.25         7
          stupid       0.88      0.88      0.88        16
         suicide       0.74      0.67      0.70        21
          thanks       0.00      0.00      0.00         1
      understand       0.88      0.71      0.79        21
     user-advice       1.00      0.38      0.55         8
      user-agree       0.91      1.00      0.95        10
 user-meditation       0.97      0.97      0.97        35
       worthless       0.92      0.97      0.95       232
           wrong       0.81      0.94      0.87        18

        accuracy                           0.87      1251
       macro avg       0.54      0.52      0.51      1251
    weighted avg       0.87      0.87      0.86      1251
```

[97]:
```
print("Cross-validation scores:", rf_cv_scores)
print("Mean CV score:", np.mean(rf_cv_scores))
```

```
Cross-validation scores: [0.6922462  0.88489209 0.92645883 0.93445244
0.92885691]
Mean CV score: 0.8733812949640288
```

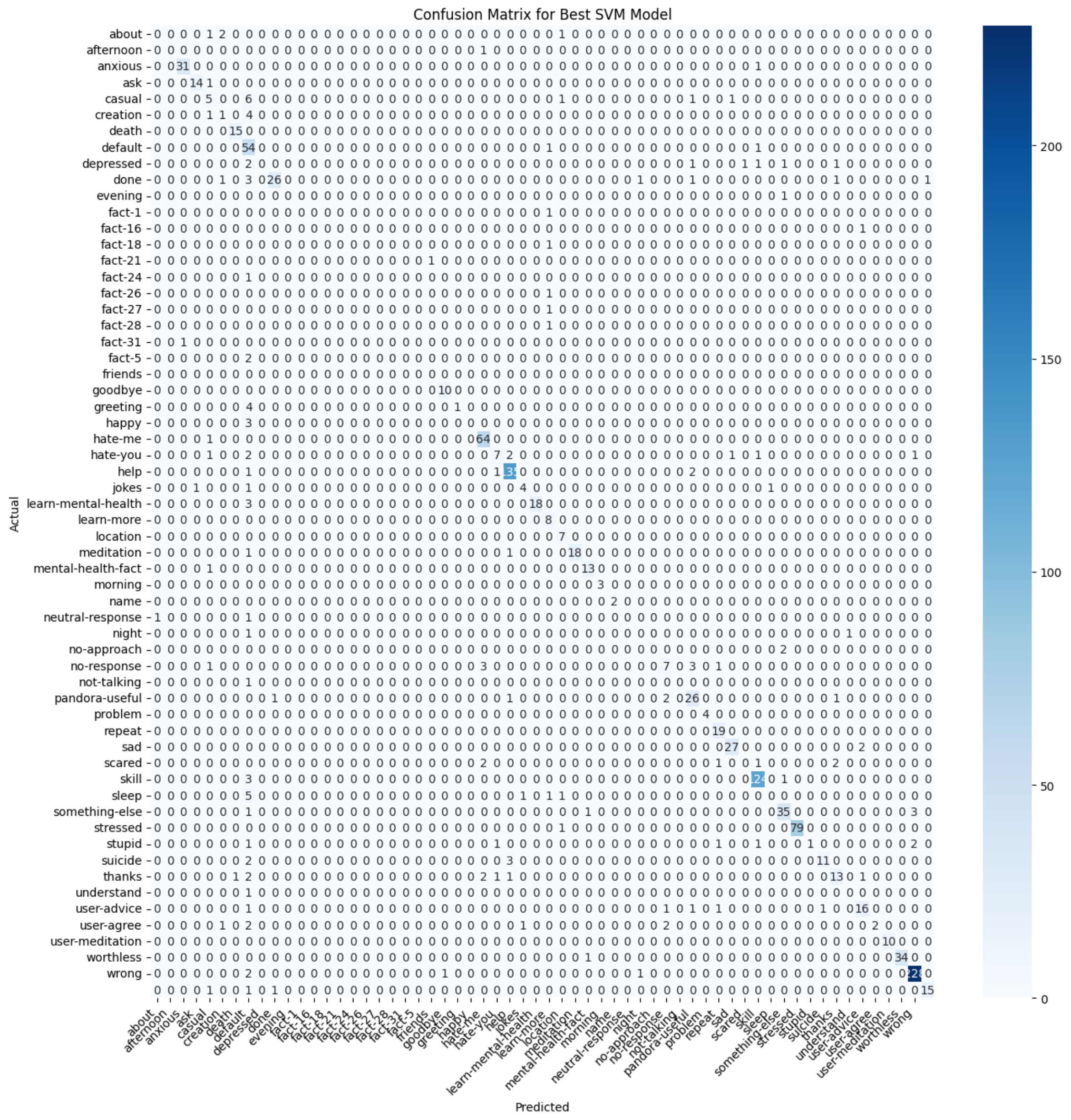
[98]:
```
print("\nBest SVM Model (Grid Search)")
svm_best_pred = svm_best.predict(X_test)
evaluate_model(svm_best, X_test, y_test, svm_best_pred)
```

```

Best SVM Model (Grid Search)
Accuracy: 0.8689048760991207
Confusion Matrix:
 [[  0   0   0 …   0   0   0]
 [  0   0   0 …   0   0   0]
 [  0   0  31 …   0   0   0]
 …
 [  0   0   0 …  34   0   0]
 [  0   0   0 …   0 228   0]
 [  0   0   0 …   0   0  15]]
```

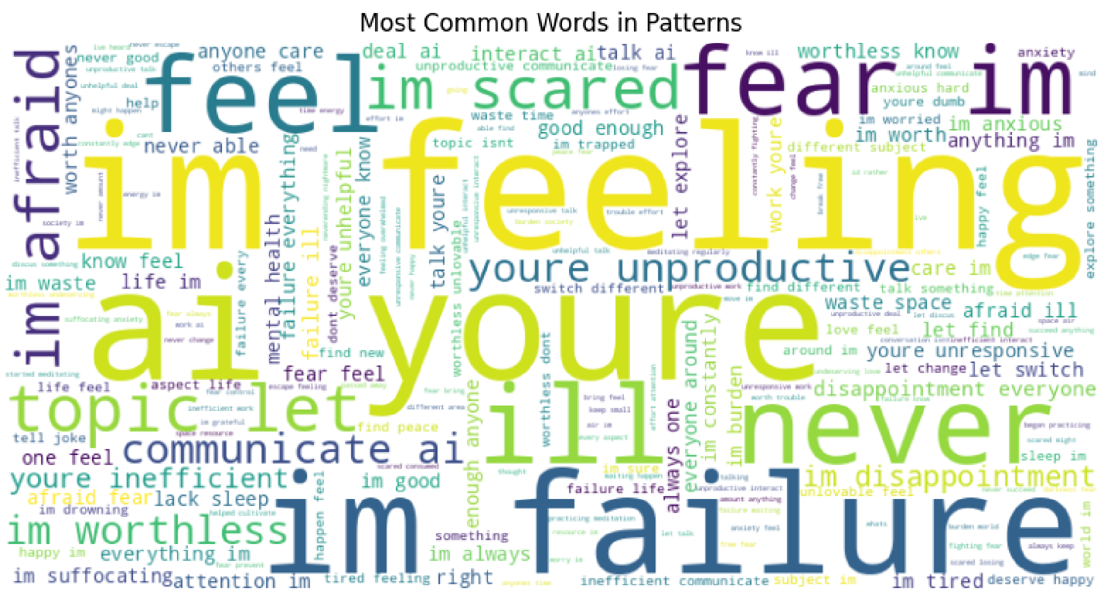
```
Classification Report:
                      precision    recall  f1-score   support

               about       0.00      0.00      0.00         4
           afternoon       0.00      0.00      0.00         1
             anxious       0.97      0.97      0.97        32
                 ask       0.93      0.93      0.93        15
              casual       0.38      0.36      0.37        14
            creation       0.20      0.17      0.18         6
               death       0.94      1.00      0.97        15
             default       0.49      0.96      0.65        56
           depressed       0.00      0.00      0.00         7
                done       0.93      0.76      0.84        34
             evening       0.00      0.00      0.00         1
              fact-1       0.00      0.00      0.00         1
             fact-16       0.00      0.00      0.00         1
             fact-18       0.00      0.00      0.00         1
             fact-21       0.00      0.00      0.00         1
             fact-24       0.00      0.00      0.00         1
             fact-26       0.00      0.00      0.00         1
             fact-27       0.00      0.00      0.00         1
             fact-28       0.00      0.00      0.00         1
             fact-31       0.00      0.00      0.00         1
              fact-5       0.00      0.00      0.00         2
              fact-7       0.00      0.00      0.00         0
             friends       0.91      1.00      0.95        10
             goodbye       1.00      0.20      0.33         5
            greeting       0.00      0.00      0.00         3
               happy       0.89      0.98      0.93        65
             hate-me       0.70      0.47      0.56        15
            hate-you       0.94      0.97      0.96       139
                help       0.67      0.57      0.62         7
               jokes       1.00      0.86      0.92        21
  learn-mental-health       0.53      1.00      0.70         8
          learn-more       0.64      1.00      0.78         7
            location       1.00      0.90      0.95        20
          meditation       0.87      0.93      0.90        14
  mental-health-fact       1.00      1.00      1.00         3
             morning       1.00      1.00      1.00         2
                name       0.00      0.00      0.00         2
    neutral-response       0.00      0.00      0.00         2
               night       0.00      0.00      0.00         2
         no-approach       0.58      0.47      0.52        15
         no-response       0.00      0.00      0.00         1
         not-talking       0.74      0.84      0.79        31
       pandora-useful       1.00      1.00      1.00         4
             problem       0.83      1.00      0.90        19
              repeat       0.93      0.93      0.93        29
```

```
               sad       0.00      0.00      0.00         6
           scared       0.95      0.97      0.96       128
            skill       0.00      0.00      0.00         8
            sleep       0.88      0.88      0.88        40
   something-else       1.00      0.99      0.99        80
         stressed       1.00      0.14      0.25         7
           stupid       0.92      0.69      0.79        16
          suicide       0.72      0.62      0.67        21
           thanks       0.00      0.00      0.00         1
       understand       0.80      0.76      0.78        21
      user-advice       1.00      0.25      0.40         8
       user-agree       1.00      1.00      1.00        10
  user-meditation       1.00      0.97      0.99        35
        worthless       0.97      0.98      0.98       232
            wrong       0.94      0.83      0.88        18

         accuracy                           0.87      1251
        macro avg       0.52      0.49      0.49      1251
     weighted avg       0.86      0.87      0.85      1251
```

[101]:
```
conf_matrix = confusion_matrix(y_test, svm_best_pred)
plt.figure(figsize=(15, 15))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues',␣
 ↪xticklabels=label_encoder.inverse_transform(np.unique(y_test)),␣
 ↪yticklabels=label_encoder.inverse_transform(np.unique(y_test)))
plt.title('Confusion Matrix for Best SVM Model')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.xticks(rotation=45, ha='right')
plt.yticks(rotation=0)
plt.show()
```



```
[102]: all_patterns = ' '.join(df['pattern_cleaned'])
       wordcloud = WordCloud(width=800, height=400, background_color='white').
        ↪generate(all_patterns)

       plt.figure(figsize=(10, 6))
       plt.imshow(wordcloud, interpolation='bilinear')
       plt.axis('off')
       plt.title('Most Common Words in Patterns')
       plt.show()
```



[103]:
```
MAX_NB_WORDS = 5000
MAX_SEQUENCE_LENGTH = 250
EMBEDDING_DIM = 100

tokenizer = Tokenizer(num_words=MAX_NB_WORDS)
tokenizer.fit_on_texts(df['pattern_cleaned'].values)
word_index = tokenizer.word_index
X_lstm = tokenizer.texts_to_sequences(df['pattern_cleaned'].values)
X_lstm = pad_sequences(X_lstm, maxlen=MAX_SEQUENCE_LENGTH)
y_lstm = pd.get_dummies(df['tag']).values

X_train_lstm, X_test_lstm, y_train_lstm, y_test_lstm = train_test_split(X_lstm,␣
  ↪y_lstm, test_size=0.2, random_state=42)
```

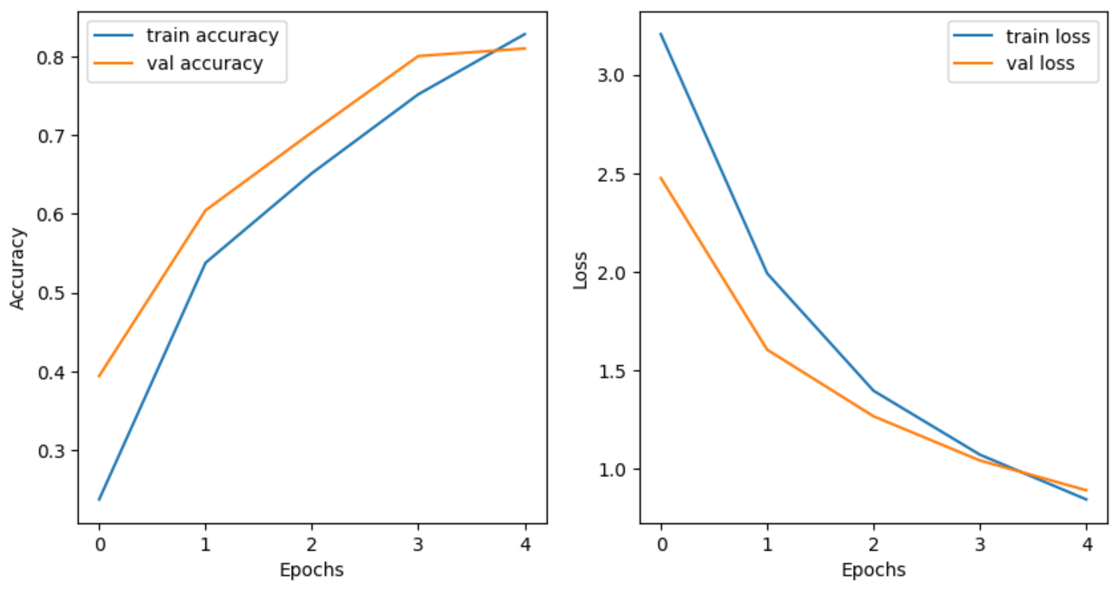
[104]:
```
model_lstm = Sequential()
model_lstm.add(Embedding(MAX_NB_WORDS, EMBEDDING_DIM,␣
  ↪input_length=MAX_SEQUENCE_LENGTH))
model_lstm.add(SpatialDropout1D(0.2))
model_lstm.add(LSTM(100, dropout=0.2, recurrent_dropout=0.2))
model_lstm.add(Dense(len(y_lstm[0]), activation='softmax'))
model_lstm.compile(loss='categorical_crossentropy', optimizer='adam',␣
  ↪metrics=['accuracy'])

history = model_lstm.fit(X_train_lstm, y_train_lstm, epochs=5, batch_size=64,␣
  ↪validation_data=(X_test_lstm, y_test_lstm), verbose=2)
```

```
Epoch 1/5
```

```
/opt/conda/lib/python3.10/site-packages/keras/src/layers/core/embedding.py:90:
UserWarning: Argument `input_length` is deprecated. Just remove it.
  warnings.warn(
```

```
79/79 - 26s - 327ms/step - accuracy: 0.2374 - loss: 3.2060 - val_accuracy:
0.3941 - val_loss: 2.4749
Epoch 2/5
79/79 - 22s - 280ms/step - accuracy: 0.5378 - loss: 1.9902 - val_accuracy:
0.6043 - val_loss: 1.6025
Epoch 3/5
79/79 - 23s - 287ms/step - accuracy: 0.6515 - loss: 1.3937 - val_accuracy:
0.7034 - val_loss: 1.2640
Epoch 4/5
79/79 - 40s - 510ms/step - accuracy: 0.7516 - loss: 1.0688 - val_accuracy:
0.8002 - val_loss: 1.0394
Epoch 5/5
79/79 - 22s - 280ms/step - accuracy: 0.8279 - loss: 0.8415 - val_accuracy:
0.8098 - val_loss: 0.8879
```

[105]:
```
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.plot(history.history['accuracy'], label='train accuracy')
plt.plot(history.history['val_accuracy'], label='val accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.subplot(1, 2, 2)
plt.plot(history.history['loss'], label='train loss')
plt.plot(history.history['val_loss'], label='val loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```



[106]:
```
y_test_lstm_pred = model_lstm.predict(X_test_lstm)
y_test_lstm_pred_class = np.argmax(y_test_lstm_pred, axis=1)
y_test_lstm_class = np.argmax(y_test_lstm, axis=1)

print("LSTM Model")
evaluate_model(model_lstm, X_test_lstm, y_test_lstm_class,␣
 ↪y_test_lstm_pred_class)
```

```
40/40              3s 63ms/step
LSTM Model
Accuracy: 0.8097521982414069
Confusion Matrix:
 [[  0   0   0 …   0   0   0]
 [  0   0   0 …   0   0   0]
 [  0   0  31 …   0   0   0]
 …
 [  0   0   0 …  34   0   0]
 [  0   0   0 …   0 228   0]
 [  0   0   0 …   0   1  12]]
Classification Report:
                        precision    recall  f1-score   support

              about       0.00      0.00      0.00         4
          afternoon       0.00      0.00      0.00         1
            anxious       0.94      0.97      0.95        32
                ask       0.64      0.93      0.76        15
             casual       0.00      0.00      0.00        14
           creation       0.00      0.00      0.00         6
```

death	1.00	0.93	0.97	15
default	0.47	0.95	0.63	56
depressed	0.00	0.00	0.00	7
done	0.52	0.79	0.63	34
evening	0.00	0.00	0.00	1
fact-1	0.00	0.00	0.00	1
fact-16	0.00	0.00	0.00	1
fact-18	0.00	0.00	0.00	1
fact-21	0.00	0.00	0.00	1
fact-24	0.00	0.00	0.00	1
fact-26	0.00	0.00	0.00	1
fact-27	0.00	0.00	0.00	1
fact-28	0.00	0.00	0.00	1
fact-31	0.00	0.00	0.00	1
fact-5	0.00	0.00	0.00	2
friends	1.00	1.00	1.00	10
goodbye	0.00	0.00	0.00	5
greeting	0.00	0.00	0.00	3
happy	0.81	0.97	0.88	65
hate-me	0.00	0.00	0.00	15
hate-you	0.94	0.96	0.95	139
help	0.00	0.00	0.00	7
jokes	0.94	0.76	0.84	21
learn-mental-health	1.00	0.50	0.67	8
learn-more	0.00	0.00	0.00	7
location	1.00	0.75	0.86	20
meditation	0.92	0.86	0.89	14
mental-health-fact	0.27	1.00	0.43	3
morning	0.00	0.00	0.00	2
name	0.00	0.00	0.00	2
neutral-response	0.00	0.00	0.00	2
night	0.00	0.00	0.00	2
no-approach	0.00	0.00	0.00	15
no-response	0.00	0.00	0.00	1
not-talking	0.54	0.68	0.60	31
pandora-useful	1.00	1.00	1.00	4
problem	0.86	1.00	0.93	19
repeat	0.44	0.72	0.55	29
sad	0.00	0.00	0.00	6
scared	0.98	0.98	0.98	128
skill	0.00	0.00	0.00	8
sleep	0.82	0.90	0.86	40
something-else	0.99	0.99	0.99	80
stressed	0.00	0.00	0.00	7
stupid	0.65	0.69	0.67	16
suicide	0.31	0.52	0.39	21
thanks	0.00	0.00	0.00	1
understand	0.77	0.48	0.59	21

```
     user-advice       0.00      0.00      0.00         8
      user-agree       0.70      0.70      0.70        10
 user-meditation       1.00      0.97      0.99        35
       worthless       0.94      0.98      0.96       232
           wrong       1.00      0.67      0.80        18

        accuracy                           0.81      1251
       macro avg       0.36      0.38      0.36      1251
    weighted avg       0.76      0.81      0.78      1251
```