IMPORTING LIBRARIES

In [8]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

IMPORTING DATASET

In [9]:
```
train_df=pd.read_csv("/content/Poem_classification - train_data.csv")
train_df
```

Out[9]:

	Genre	Poem
0	Music	NaN
1	Music	In the thick brushthey spend the...
2	Music	Storms are generous. ...
3	Music	—After Ana Mendieta Did you carry around the ...
4	Music	for Aja Sherrard at 20The portent may itself ...
...	...	...
836	Environment	Why make so much of fragmentary blue In here a...
837	Environment	Woman, I wish I didn't know your name. What co...
838	Environment	Yonder to the kiosk, beside the creek, Paddle ...
839	Environment	You come to fetch me from my work to-night Whe...
840	Environment	You see them through water and glass, (both li...

841 rows × 2 columns

In [10]:
```
test_df=pd.read_csv("/content/Poem_classification - test_data.csv")
test_df
```

Out[10]:

	Genre	Poem
0	Music	A woman walks by the bench I'm sitting onwith ...
1	Music	Because I am a boy, the untouchability of beau...
2	Music	Because today we did not leave this world,We n...
3	Music	Big Bend has been here, been here. Shouldn't i...
4	Music	I put shells there, along the lip of the road....
...	...	...
145	Environment	To pick a tulip from the garden, the red one. ...
146	Environment	We are as clouds that veil the midnight moon; ...
147	Environment	When pulled, the spider web took another form....
148	Environment	Whose woods these are I think I know. His hous...
149	Environment	you can make the maples blazejust by stopping ...

150 rows × 2 columns

In [11]:
```
df=pd.concat([train_df,test_df],axis=0,ignore_index=True)
df
```

Out[11]:

	Genre	Poem
0	Music	NaN
1	Music	In the thick brushthey spend the...
2	Music	Storms are generous. ...
3	Music	—After Ana Mendieta Did you carry around the ...
4	Music	for Aja Sherrard at 20The portent may itself ...
...	...	...
986	Environment	To pick a tulip from the garden, the red one. ...
987	Environment	We are as clouds that veil the midnight moon; ...
988	Environment	When pulled, the spider web took another form....
989	Environment	Whose woods these are I think I know. His hous...
990	Environment	you can make the maples blazejust by stopping ...

991 rows × 2 columns

DATA EXPLORATION

In [12]:
```
df.shape
```

Out[12]:
```
(991, 2)
```

In [13]:
```
df.head()
```

Out[13]:

	Genre	Poem
0	Music	NaN
1	Music	In the thick brushthey spend the...
2	Music	Storms are generous. ...
3	Music	—After Ana Mendieta Did you carry around the ...
4	Music	for Aja Sherrard at 20The portent may itself ...

In [14]:
```
df.tail()
```

Out[14]:

	Genre	Poem
986	Environment	To pick a tulip from the garden, the red one. ...
987	Environment	We are as clouds that veil the midnight moon; ...
988	Environment	When pulled, the spider web took another form....
989	Environment	Whose woods these are I think I know. His hous...
990	Environment	you can make the maples blazejust by stopping ...

In [15]:
```
df.columns
```

Out[15]:
```
Index(['Genre', 'Poem'], dtype='object')
```

In [16]:
```
df.dtypes
```

Out[16]:
```
Genre    object
Poem     object
dtype: object
```

DATA WRANGLING

In [17]:
```
# MISSING VALUES
df.isna().sum()
```

Out[17]:
```
Genre    0
Poem     4
dtype: int64
```

In [18]:
```
# REMOVE THE MISSING VALUES
df.dropna(axis=0,inplace=True)
df
```

Out[18]:

	Genre	Poem
1	Music	In the thick brushthey spend the...
2	Music	Storms are generous. ...
3	Music	—After Ana Mendieta Did you carry around the ...
4	Music	for Aja Sherrard at 20The portent may itself ...
5	Music	for Bob Marley, Bavaria, November 1980 Here i...
...	...	...
986	Environment	To pick a tulip from the garden, the red one. ...
987	Environment	We are as clouds that veil the midnight moon; ...
988	Environment	When pulled, the spider web took another form....
989	Environment	Whose woods these are I think I know. His hous...
990	Environment	you can make the maples blazejust by stopping ...

987 rows × 2 columns

In [19]:
```
# CHECK FOR DUPLICATES
df.duplicated().sum()
```

Out[19]:
```
3
```

In [20]:
```
# DROP DUPLICATES
df.drop_duplicates(inplace=True)
df
```

Out[20]:

	Genre	Poem
1	Music	In the thick brushthey spend the...
2	Music	Storms are generous. ...
3	Music	—After Ana Mendieta Did you carry around the ...
4	Music	for Aja Sherrard at 20The portent may itself ...
5	Music	for Bob Marley, Bavaria, November 1980 Here i...
...	...	...
986	Environment	To pick a tulip from the garden, the red one. ...
987	Environment	We are as clouds that veil the midnight moon; ...
988	Environment	When pulled, the spider web took another form....
989	Environment	Whose woods these are I think I know. His hous...
990	Environment	you can make the maples blazejust by stopping ...

984 rows × 2 columns

In [21]:
```
# RESET THE INDEX VALUES
df.reset_index(drop=True,inplace=True)
df
```

Out[21]:

	Genre	Poem
0	Music	In the thick brushthey spend the...
1	Music	Storms are generous. ...
2	Music	—After Ana Mendieta Did you carry around the ...
3	Music	for Aja Sherrard at 20The portent may itself ...
4	Music	for Bob Marley, Bavaria, November 1980 Here i...
...	...	...
979	Environment	To pick a tulip from the garden, the red one. ...
980	Environment	We are as clouds that veil the midnight moon; ...
981	Environment	When pulled, the spider web took another form....
982	Environment	Whose woods these are I think I know. His hous...
983	Environment	you can make the maples blazejust by stopping ...

984 rows × 2 columns

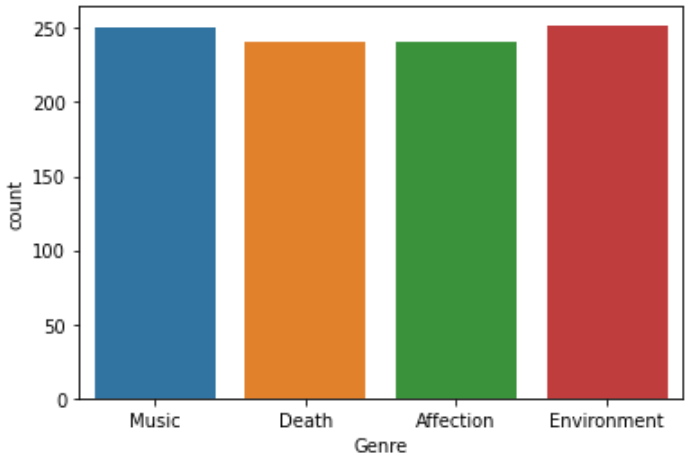
DATA ANALYSIS

In [22]:
```
# OBSERVING OUTPUT LABEL
df['Genre'].value_counts()
```

Out[22]:
```
Environment    252
Music          250
Death          241
Affection      241
Name: Genre, dtype: int64
```

In [23]:
```
sns.countplot(x='Genre',data=df)     #
```

Out[23]:
```
<Axes: xlabel='Genre', ylabel='count'>
```



DOWNLOADING PACKAGES FOR NLP

In [24]:
```
import nltk
nltk.download('stopwords')   #to get all stop words
nltk.download('wordnet')     #for lemmatization
nltk.download('punkt')       #for tokenization
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
```

Out[24]:
```
True
```

NLP PREPROCESSING

In [25]:
```
# ASSIGNMENT THE TEXT COLUMN TO AN OBJECT
poem=df.Poem
poem
```

Out[25]:
```
0                    In the thick brushthey spend the...
1          Storms are generous.                      ...
2        —After Ana Mendieta Did you carry around the ...
3        for Aja Sherrard at 20The portent may itself ...
4        for Bob Marley, Bavaria, November 1980 Here i...
                              ...
979     To pick a tulip from the garden, the red one. ...
980     We are as clouds that veil the midnight moon; ...
981     When pulled, the spider web took another form....
982     Whose woods these are I think I know. His hous...
983     you can make the maples blazejust by stopping ...
Name: Poem, Length: 984, dtype: object
```

In [26]:
```
# TOKENIZATION
from nltk import TweetTokenizer
tk=TweetTokenizer()
poem=poem.apply(lambda x:tk.tokenize(x)).apply(lambda x:" ".join(x))
poem
```

Out[26]:
```
0      In the thick brushthey spend the hottest part ...
1      Storms are generous . Something so easy to sur...
2      — After Ana Mendieta Did you carry around the ...
3      for Aja Sherrard at 20The portent may itself b...
4      for Bob Marley , Bavaria , November 1980 Here ...
                             ...
979    To pick a tulip from the garden , the red one ...
980    We are as clouds that veil the midnight moon ;...
981    When pulled , the spider web took another form...
982    Whose woods these are I think I know . His hou...
983    you can make the maples blazejust by stopping ...
Name: Poem, Length: 984, dtype: object
```

In [27]:
```
# REMOVING SPECIAL CHARACTERS FROM THE TOKENS
import re
poem=poem.str.replace('[^a-zA-Z0-9]+',' ')
poem
```

Out[27]:
```
0      In the thick brushthey spend the hottest part ...
1      Storms are generous Something so easy to surre...
2       After Ana Mendieta Did you carry around the m...
3      for Aja Sherrard at 20The portent may itself b...
4      for Bob Marley Bavaria November 1980 Here is t...
                             ...
979    To pick a tulip from the garden the red one To...
980    We are as clouds that veil the midnight moon H...
981    When pulled the spider web took another form T...
982    Whose woods these are I think I know His house...
983    you can make the maples blazejust by stopping ...
Name: Poem, Length: 984, dtype: object
```

In [28]:
```
# TOKENIZE WORDS WITH LENGTH MORE THAN 3 (a,in etc removed)
from nltk import word_tokenize
poem=poem.apply(lambda x:' '.join(w for w in word_tokenize(x) if len(w)>=3))
poem
```

Out[28]:
```
0      the thick brushthey spend the hottest part the...
1      Storms are generous Something easy surrender s...
2      After Ana Mendieta Did you carry around the ma...
3      for Aja Sherrard 20The portent may itself memo...
4      for Bob Marley Bavaria November 1980 Here the ...
                             ...
979    pick tulip from the garden the red one put the...
980    are clouds that veil the midnight moon How res...
981    When pulled the spider web took another form T...
982    Whose woods these are think know His house the...
983    you can make the maples blazejust stopping loo...
Name: Poem, Length: 984, dtype: object
```

In [29]:
```
# LEMMETIZATION USING SNOWBALL STEMMER AND CONVERTING WORDS TO LOWER CASE
from nltk import SnowballStemmer
snow=SnowballStemmer('english')
poem=poem.apply(lambda x:[snow.stem(i.lower()) for i in tk.tokenize(x)]).apply(lamb
poem
```

Out[29]:
```
0      the thick brushthey spend the hottest part the...
1      storm are generous someth easi surrend sit the...
2      after ana mendieta did you carri around the ma...
3      for aja sherrard 20the portent may itself memo...
4      for bob marley bavaria novemb 1980 here the br...
                             ...
979    pick tulip from the garden the red one put the...
980    are cloud that veil the midnight moon how rest...
981    when pull the spider web took anoth form the b...
982    whose wood these are think know his hous the v...
983    you can make the mapl blazejust stop look you ...
Name: Poem, Length: 984, dtype: object
```

In [30]:
```
# REMOVING STOPWORDS
from nltk.corpus import stopwords
stop=stopwords.words('english')
poem=poem.apply(lambda x:[i for i in tk.tokenize(x) if i not in stop]).apply(lambda
poem
```

Out[30]:
```
0      thick brushthey spend hottest part day soak ho...
1      storm generous someth easi surrend sit window ...
2      ana mendieta carri around matin star hold fore...
3      aja sherrard 20the portent may memori wallac s...
4      bob marley bavaria novemb 1980 brilliant morn ...
                             ...
979    pick tulip garden red one put desk small blue ...
980    cloud veil midnight moon restless speed gleam ...
981    pull spider web took anoth form bull eye relax...
982              whose wood think know hous villag though
983    make mapl blazejust stop look set clock barkso...
Name: Poem, Length: 984, dtype: object
```

In [31]:
```
# VECTORIZATION BY TFIDF
from sklearn.feature_extraction.text import TfidfVectorizer
vec=TfidfVectorizer()
train_data=vec.fit_transform(poem)
train_data
```

Out[31]:
```
<984x7107 sparse matrix of type '<class 'numpy.float64'>'
        with 24103 stored elements in Compressed Sparse Row format>
```

In [32]:
```
print(train_data)
```

```
  (0, 4220)     0.30146785245762203
  (0, 539)      0.30146785245762203
  (0, 2938)     0.30146785245762203
  (0, 4827)     0.28448961932519834
  (0, 6784)     0.15975167083525493
  (0, 3975)     0.19570681681046495
  (0, 6417)     0.2554651380781227
  (0, 2971)     0.30146785245762203
  (0, 5577)     0.2630995752575813
  (0, 1557)     0.13765785431631364
  (0, 4370)     0.21439440871639504
  (0, 2986)     0.28448961932519834
  (0, 5679)     0.2630995752575813
  (0, 834)      0.30146785245762203
  (0, 6184)     0.22644065683104703
  (1, 716)      0.35210110842881304
  (1, 2503)     0.27209369845069353
  (1, 5796)     0.28557634665273696
  (1, 6920)     0.24869303114218172
  (1, 5461)     0.27980021531629556
  (1, 5995)     0.3921048134178728
  (1, 1894)     0.32261975421270095
  (1, 5611)     0.27711539882459263
  (1, 2529)     0.3921048134178728
  (1, 5846)     0.3032008826248073
  :     :
  (982, 3352)   0.3046024553468519
  (983, 617)    0.2386634288829473
  (983, 469)    0.2386634288829473
  (983, 5360)   0.2386634288829473
  (983, 3191)   0.2386634288829473
  (983, 2643)   0.2386634288829473
  (983, 2526)   0.2386634288829473
  (983, 448)    0.2386634288829473
  (983, 634)    0.2386634288829473
  (983, 5783)   0.21568558179409517
  (983, 3446)   0.1888032240055286
  (983, 3699)   0.192707734705243
  (983, 4319)   0.19713430384862338
  (983, 5615)   0.192707734705243
  (983, 1189)   0.19713430384862338
  (983, 1360)   0.192707734705243
  (983, 5835)   0.1792665558109597
  (983, 5281)   0.1792665558109597
  (983, 4540)   0.20828836725616787
  (983, 6361)   0.1792665558109597
  (983, 541)    0.16233267307846355
  (983, 2113)   0.13400878269650782
  (983, 3670)   0.24066665404942378
  (983, 661)    0.12761402114022935
  (983, 3584)   0.12128053506543703
```

In [33]:
```
x=train_data
```

In [34]:
```
# ASSIGN VALUES TO THE OUTPUT LABEL USINGING MAP FUNCTION
df['Genre']=df['Genre'].map({'Environment':1,'Music':2,'Death':3,'Affection':4})
```

In [35]:
```
y=df['Genre'].values
y
```

Out[35]:

```
array([2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1])
```

TRAIN-TEST SPLIT

In [36]:

```
# TRAIN TEST SPLIT
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.30,random_state=42)
```

MODEL CREATION AND PERFROMACE EVALUATION

In [37]:

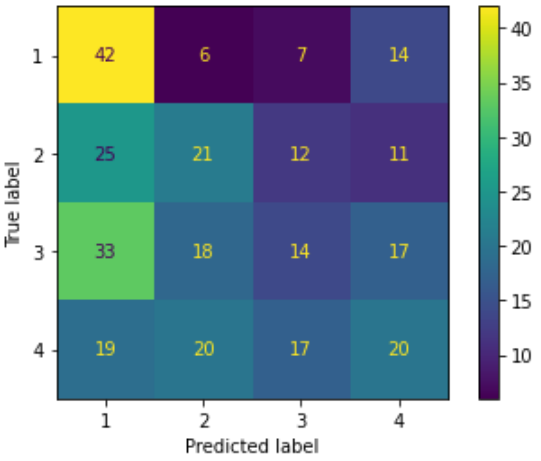
```
# CLASSIFICATION MODEL
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
```

In [38]:

```
from sklearn.metrics import confusion_matrix,accuracy_score,classification_report,C
```

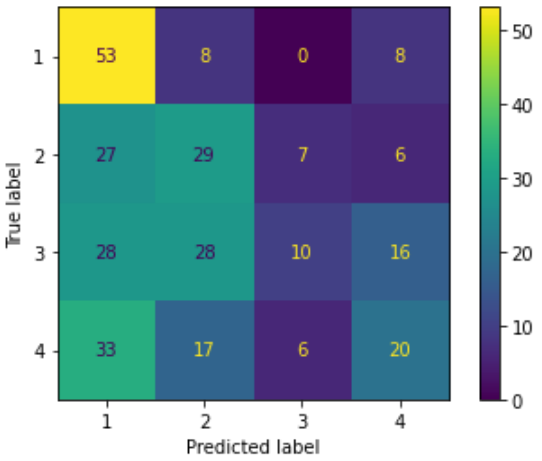
In [39]:
```
print("KNN CLASSIFIER")
model_knn=KNeighborsClassifier()
model_knn.fit(x_train,y_train)
y_knn=model_knn.predict(x_test)
print("CONFUSION MATRIX:\n",confusion_matrix(y_test,y_knn))
print(ConfusionMatrixDisplay.from_predictions(y_test,y_knn))
print("ACCURACY SCORE:",accuracy_score(y_test,y_knn))
print("CLASSIFICATION REPORT:\n",classification_report(y_test,y_knn))
```

```
KNN CLASSIFIER
CONFUSION MATRIX:
 [[42  6  7 14]
 [25 21 12 11]
 [33 18 14 17]
 [19 20 17 20]]
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7fbdfda
7f880>
ACCURACY SCORE: 0.3277027027027027
CLASSIFICATION REPORT:
               precision    recall  f1-score   support

           1       0.35      0.61      0.45        69
           2       0.32      0.30      0.31        69
           3       0.28      0.17      0.21        82
           4       0.32      0.26      0.29        76

    accuracy                           0.33       296
   macro avg       0.32      0.34      0.32       296
weighted avg       0.32      0.33      0.31       296
```



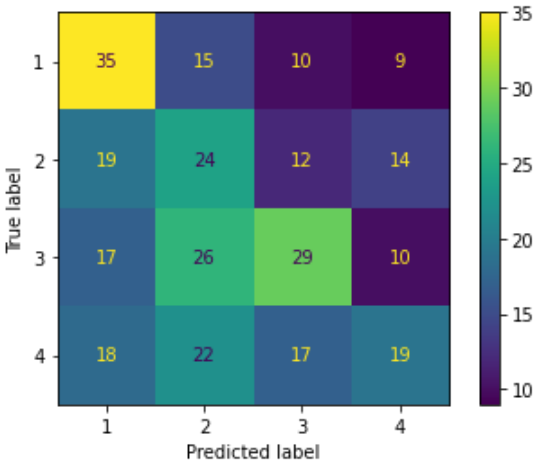
In [40]:
```
print("NAIVE-BAYES")
model_nb=MultinomialNB()
model_nb.fit(x_train,y_train)
y_nb=model_nb.predict(x_test)
print("CONFUSION MATRIX:\n",confusion_matrix(y_test,y_nb))
print(ConfusionMatrixDisplay.from_predictions(y_test,y_nb))
print("ACCURACY SCORE:",accuracy_score(y_test,y_nb))
print("CLASSIFICATION REPORT:\n",classification_report(y_test,y_nb))
```

```
NAIVE-BAYES
CONFUSION MATRIX:
 [[53  8  0  8]
 [27 29  7  6]
 [28 28 10 16]
 [33 17  6 20]]
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7fbdf74
c6370>
ACCURACY SCORE: 0.3783783783783784
CLASSIFICATION REPORT:
              precision    recall  f1-score   support

           1       0.38      0.77      0.50        69
           2       0.35      0.42      0.38        69
           3       0.43      0.12      0.19        82
           4       0.40      0.26      0.32        76

    accuracy                           0.38       296
   macro avg       0.39      0.39      0.35       296
weighted avg       0.39      0.38      0.34       296
```



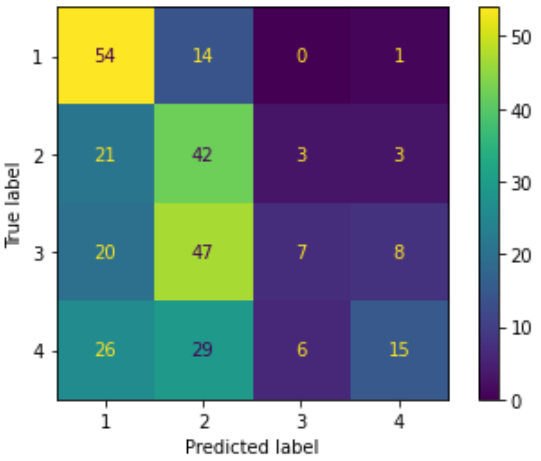
In [41]:
```
print("DECISION TREE")
model_dt=DecisionTreeClassifier()
model_dt.fit(x_train,y_train)
y_dt=model_dt.predict(x_test)
print("CONFUSION MATRIX:\n",confusion_matrix(y_test,y_dt))
print(ConfusionMatrixDisplay.from_predictions(y_test,y_dt))
print("ACCURACY SCORE:",accuracy_score(y_test,y_dt))
print("CLASSIFICATION REPORT:\n",classification_report(y_test,y_dt))
```

```
DECISION TREE
CONFUSION MATRIX:
 [[35 15 10  9]
 [19 24 12 14]
 [17 26 29 10]
 [18 22 17 19]]
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7fbdf74
19b80>
ACCURACY SCORE: 0.3614864864864865
CLASSIFICATION REPORT:
              precision    recall  f1-score   support

           1       0.39      0.51      0.44        69
           2       0.28      0.35      0.31        69
           3       0.43      0.35      0.39        82
           4       0.37      0.25      0.30        76

    accuracy                           0.36       296
   macro avg       0.37      0.36      0.36       296
weighted avg       0.37      0.36      0.36       296
```



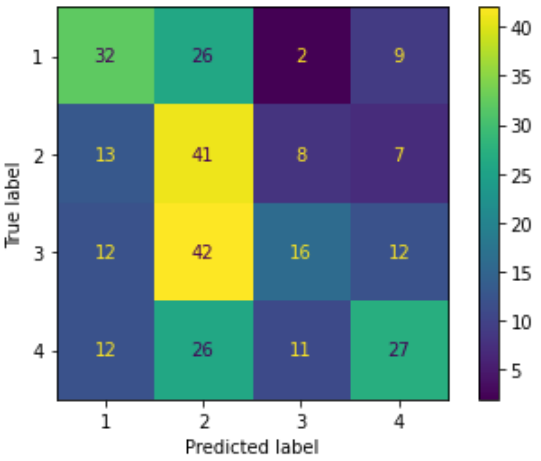
In [42]:
```
print("SUPPORT VECTOR")
model_svm=SVC()
model_svm.fit(x_train,y_train)
y_svm=model_svm.predict(x_test)
print("CONFUSION MATRIX:\n",confusion_matrix(y_test,y_svm))
print(ConfusionMatrixDisplay.from_predictions(y_test,y_svm))
print("ACCURACY SCORE:",accuracy_score(y_test,y_svm))
print("CLASSIFICATION REPORT:\n",classification_report(y_test,y_svm))
```

```
SUPPORT VECTOR
CONFUSION MATRIX:
 [[54 14  0  1]
 [21 42  3  3]
 [20 47  7  8]
 [26 29  6 15]]
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7fbdf74
0bf10>
ACCURACY SCORE: 0.39864864864864863
CLASSIFICATION REPORT:
              precision    recall  f1-score   support

           1       0.45      0.78      0.57        69
           2       0.32      0.61      0.42        69
           3       0.44      0.09      0.14        82
           4       0.56      0.20      0.29        76

    accuracy                           0.40       296
   macro avg       0.44      0.42      0.36       296
weighted avg       0.44      0.40      0.34       296
```



In [43]:
```
print("RANDOM FOREST")
model_rf=RandomForestClassifier()
model_rf.fit(x_train,y_train)
y_rf=model_rf.predict(x_test)
print("CONFUSION MATRIX:\n",confusion_matrix(y_test,y_rf))
print(ConfusionMatrixDisplay.from_predictions(y_test,y_rf))
print("ACCURACY SCORE:",accuracy_score(y_test,y_rf))
print("CLASSIFICATION REPORT:\n",classification_report(y_test,y_rf))
```

```
RANDOM FOREST
CONFUSION MATRIX:
 [[32 26  2  9]
 [13 41  8  7]
 [12 42 16 12]
 [12 26 11 27]]
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x7fbdf74
a3b20>
ACCURACY SCORE: 0.3918918918918919
CLASSIFICATION REPORT:
              precision    recall  f1-score   support

           1       0.46      0.46      0.46        69
           2       0.30      0.59      0.40        69
           3       0.43      0.20      0.27        82
           4       0.49      0.36      0.41        76

    accuracy                           0.39       296
   macro avg       0.42      0.40      0.39       296
weighted avg       0.42      0.39      0.38       296
```



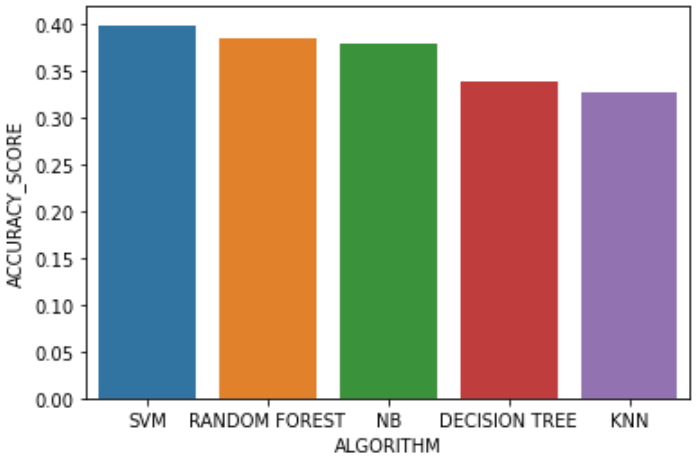
In [44]:
```
# COMPARING THE ACCURACY SCORES OF ALL THE CLASSIFIERS
lst=[model_knn,model_nb,model_svm,model_dt,model_rf]
model=['KNN','NB','SVM','DECISION TREE','RANDOM FOREST']
lst_acc=[]
for i in lst:
  i.fit(x_train,y_train)
  y_pred=i.predict(x_test)
  lst_acc.append(accuracy_score(y_test,y_pred))

acc_df=pd.DataFrame({'ALGORITHM':model,'ACCURACY_SCORE':lst_acc})
acc_df.sort_values(by='ACCURACY_SCORE',ascending=False,inplace=True)
acc_df
```

Out[44]:

	ALGORITHM	ACCURACY_SCORE
2	SVM	0.398649
4	RANDOM FOREST	0.385135
1	NB	0.378378
3	DECISION TREE	0.337838
0	KNN	0.327703

In [45]:
```
sns.barplot(x='ALGORITHM',y='ACCURACY_SCORE',data=acc_df)
```

Out[45]:
```
<Axes: xlabel='ALGORITHM', ylabel='ACCURACY_SCORE'>
```



CONCLUSION: SVM AND RANDOM FOREST GIVES HIGHEST ACCURACY

In [46]:
```
# PERFORMING HYPERPARAMATER TUNING ON SVM TO IMPROVE ACCURACY
from sklearn.model_selection import GridSearchCV
cls1=SVC()
```

In [52]:
```
params={'C':[0.1,1,10,100,1000],'gamma':[1,0.1,0.01,0.001,0.001],'kernel':['rfb','l
clf=GridSearchCV(cls1,params,cv=10,scoring='accuracy')
clf.fit(x_train,y_train)
```

Out[52]:

▸ **GridSearchCV**

▸ **estimator: SVC**

▸ SVC

In [53]:
```
print(clf.best_params_)
```

```
{'C': 1, 'gamma': 1, 'kernel': 'linear'}
```

In [54]:
```
print(clf.best_estimator_)
```

```
SVC(C=1, gamma=1, kernel='linear')
```

In [55]:
```
svm_best=SVC(C=1,gamma=1,kernel='linear')
svm_best.fit(x_train,y_train)
y_best=svm_best.predict(x_test)
```

In [56]:
```
new_accuracy=accuracy_score(y_test,y_best)
print(new_accuracy)
```

```
0.42905405405405406
```

CONCLUSION: THE ACCURACY OF THE MODEL IS IMPROVED BY USING HYPER-PARAMETER TUNING