LabAssignment2_Optimization

June 11, 2023

1 Lab Assignment 2

1.1 Breast Cancer Prediction

1. Predict Breast Cancer using Feed forward neural network of configuration Nx128x64x32x16x1 and evaluated performance of momemntum, Adagrad, RMSprop, and Adam optimizers in terms of accuracy and F1-score.

[2]:
```
import pandas as pd
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, f1_score
import tensorflow as tf
from tensorflow.keras import models, layers
```

[3]:
```
df = pd.read_csv("data/BreastCancerData.csv")
```

[4]:
```
df.head()
```

[4]:

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	\
0	842302	M	17.99	10.38	122.80	1001.0	
1	842517	M	20.57	17.77	132.90	1326.0	
2	84300903	M	19.69	21.25	130.00	1203.0	
3	84348301	M	11.42	20.38	77.58	386.1	
4	84358402	M	20.29	14.34	135.10	1297.0	

	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	\
0	0.11840	0.27760	0.3001	0.14710	
1	0.08474	0.07864	0.0869	0.07017	
2	0.10960	0.15990	0.1974	0.12790	
3	0.14250	0.28390	0.2414	0.10520	
4	0.10030	0.13280	0.1980	0.10430	

	…	texture_worst	perimeter_worst	area_worst	smoothness_worst	\
0	…	17.33	184.60	2019.0	0.1622	
1	…	23.41	158.80	1956.0	0.1238	
2	…	25.53	152.50	1709.0	0.1444	
3	…	26.50	98.87	567.7	0.2098	

```
4  …          16.67           152.20      1575.0           0.1374

   compactness_worst  concavity_worst  concave points_worst  symmetry_worst  \
0             0.6656           0.7119                0.2654          0.4601
1             0.1866           0.2416                0.1860          0.2750
2             0.4245           0.4504                0.2430          0.3613
3             0.8663           0.6869                0.2575          0.6638
4             0.2050           0.4000                0.1625          0.2364

   fractal_dimension_worst  Unnamed: 32
0                  0.11890          NaN
1                  0.08902          NaN
2                  0.08758          NaN
3                  0.17300          NaN
4                  0.07678          NaN

[5 rows x 33 columns]
```

[5]:
```
df.shape
```

[5]:
```
(569, 33)
```

[6]:
```
df.isna().sum()
```

[6]:
```
id                         0
diagnosis                  0
radius_mean                0
texture_mean               0
perimeter_mean             0
area_mean                  0
smoothness_mean            0
compactness_mean           0
concavity_mean             0
concave points_mean        0
symmetry_mean              0
fractal_dimension_mean     0
radius_se                  0
texture_se                 0
perimeter_se               0
area_se                    0
smoothness_se              0
compactness_se             0
concavity_se               0
concave points_se          0
symmetry_se                0
fractal_dimension_se       0
radius_worst               0
```

```
texture_worst               0
perimeter_worst             0
area_worst                  0
smoothness_worst            0
compactness_worst           0
concavity_worst             0
concave points_worst        0
symmetry_worst              0
fractal_dimension_worst     0
Unnamed: 32               569
dtype: int64
```

[7]:
```
df=df.drop(columns=['Unnamed: 32','id'])
```

[8]:
```
df.head()
```

[8]:

	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	\
0	M	17.99	10.38	122.80	1001.0	
1	M	20.57	17.77	132.90	1326.0	
2	M	19.69	21.25	130.00	1203.0	
3	M	11.42	20.38	77.58	386.1	
4	M	20.29	14.34	135.10	1297.0	

	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	\
0	0.11840	0.27760	0.3001	0.14710	
1	0.08474	0.07864	0.0869	0.07017	
2	0.10960	0.15990	0.1974	0.12790	
3	0.14250	0.28390	0.2414	0.10520	
4	0.10030	0.13280	0.1980	0.10430	

	symmetry_mean	…	radius_worst	texture_worst	perimeter_worst	\
0	0.2419	…	25.38	17.33	184.60	
1	0.1812	…	24.99	23.41	158.80	
2	0.2069	…	23.57	25.53	152.50	
3	0.2597	…	14.91	26.50	98.87	
4	0.1809	…	22.54	16.67	152.20	

	area_worst	smoothness_worst	compactness_worst	concavity_worst	\
0	2019.0	0.1622	0.6656	0.7119	
1	1956.0	0.1238	0.1866	0.2416	
2	1709.0	0.1444	0.4245	0.4504	
3	567.7	0.2098	0.8663	0.6869	
4	1575.0	0.1374	0.2050	0.4000	

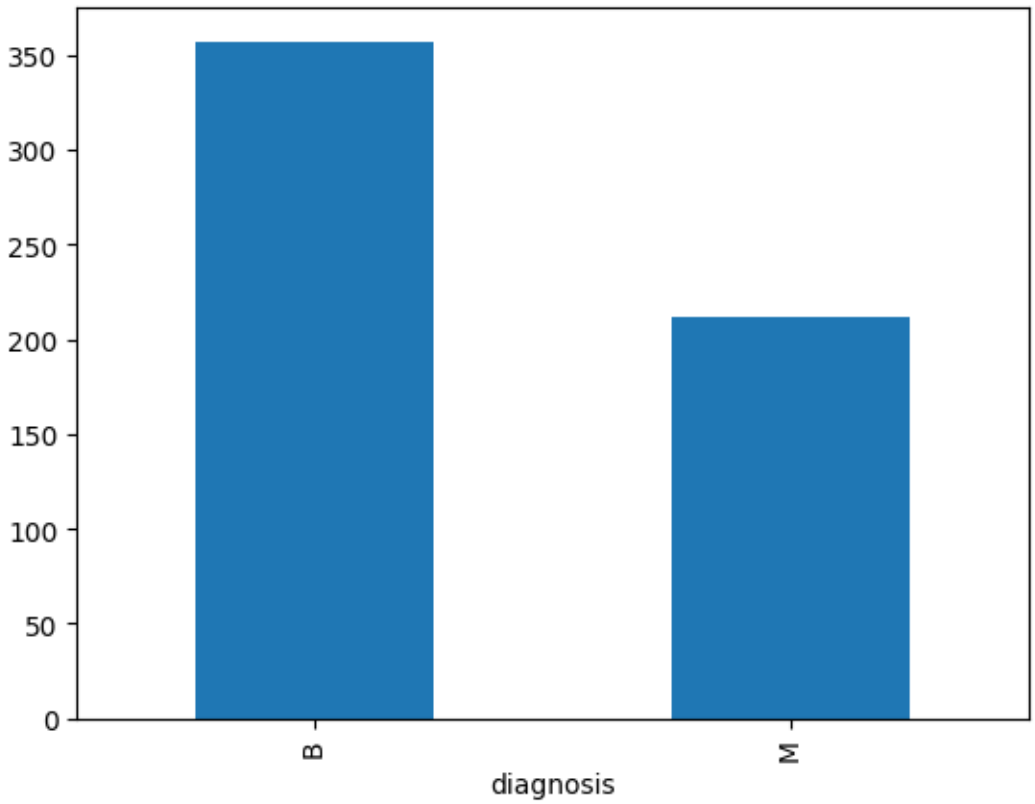
	concave points_worst	symmetry_worst	fractal_dimension_worst
0	0.2654	0.4601	0.11890
1	0.1860	0.2750	0.08902

```
2                0.2430           0.3613                0.08758
3                0.2575           0.6638                0.17300
4                0.1625           0.2364                0.07678

[5 rows x 31 columns]
```

[9]:
```
df['diagnosis'].value_counts().plot(kind='bar')
```

[9]:
```
<Axes: xlabel='diagnosis'>
```



[10]:
```
encoder = LabelEncoder()
```

[11]:
```
encoded_diagnosis = encoder.fit_transform(df['diagnosis'])
```

[12]:
```
df['encoded_diagnosis']=encoded_diagnosis
```

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

[13]:
```
  diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
0         M        17.99         10.38          122.80     1001.0
1         M        20.57         17.77          132.90     1326.0
```

```
2         M        19.69         21.25          130.00     1203.0
3         M        11.42         20.38           77.58      386.1
4         M        20.29         14.34          135.10     1297.0

   smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
0          0.11840           0.27760          0.3001              0.14710
1          0.08474           0.07864          0.0869              0.07017
2          0.10960           0.15990          0.1974              0.12790
3          0.14250           0.28390          0.2414              0.10520
4          0.10030           0.13280          0.1980              0.10430

   symmetry_mean  …  texture_worst  perimeter_worst  area_worst  \
0         0.2419  …          17.33           184.60      2019.0
1         0.1812  …          23.41           158.80      1956.0
2         0.2069  …          25.53           152.50      1709.0
3         0.2597  …          26.50            98.87       567.7
4         0.1809  …          16.67           152.20      1575.0

   smoothness_worst  compactness_worst  concavity_worst  concave points_worst  \
0            0.1622             0.6656           0.7119                0.2654
1            0.1238             0.1866           0.2416                0.1860
2            0.1444             0.4245           0.4504                0.2430
3            0.2098             0.8663           0.6869                0.2575
4            0.1374             0.2050           0.4000                0.1625

   symmetry_worst  fractal_dimension_worst  encoded_diagnosis
0          0.4601                  0.11890                  1
1          0.2750                  0.08902                  1
2          0.3613                  0.08758                  1
3          0.6638                  0.17300                  1
4          0.2364                  0.07678                  1

[5 rows x 32 columns]
```

[14]:
```
df=df.drop(columns=['diagnosis'])
```

[15]:
```
X=df.drop(columns=['encoded_diagnosis'])
y=df[['encoded_diagnosis']]
```

[16]:
```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[17]:
```
def create_model():
    model = models.Sequential()
    model.add(layers.Dense(128, activation='relu', input_shape=(30,)))
    model.add(layers.Dense(64, activation='relu'))
```

```
    model.add(layers.Dense(32, activation='relu'))
    model.add(layers.Dense(16, activation='relu'))
    model.add(layers.Dense(1, activation='sigmoid'))
    return model
```

[18]:
```
optimizers = ['sgd', 'adagrad', 'rmsprop', 'adam']
results = []

for optimizer in optimizers:
    model = create_model()
    model.compile(optimizer=optimizer, loss='binary_crossentropy',␣
 ↪metrics=['accuracy'])
    model.fit(X_train, y_train, epochs=10, batch_size=32, verbose=0)

    # Predict on the test set
    y_pred = model.predict(X_test)
    y_pred_class = (y_pred > 0.5).astype(int)
    # Calculate accuracy and F1-score
    accuracy = accuracy_score(y_test, y_pred_class)
    f1 = f1_score(y_test, y_pred_class)

    results.append({'Optimizer': optimizer, 'Accuracy': accuracy, 'F1-score':␣
 ↪f1})
```

```
4/4 [==============================] - 0s 6ms/step
4/4 [==============================] - 0s 5ms/step
4/4 [==============================] - 0s 5ms/step
4/4 [==============================] - 0s 5ms/step
```

[19]:
```
results_df = pd.DataFrame(results)
results_df
```

[19]:

	Optimizer	Accuracy	F1-score
0	sgd	0.622807	0.000000
1	adagrad	0.929825	0.900000
2	rmsprop	0.947368	0.926829
3	adam	0.912281	0.893617

From the result above we can see that the `rmsprop` optimizer performed best on the basis of F1-score and Accuracy

1.2 News Category Classification

2. Predict class label to predict news category using Feed forward neural network of configuration Nx256x128x64x32x16xo and evaluatd performance of momemntum, Adagrad, RMSprop, and Adam optimizers in terms of accuracy and F1-score.

There are four distinct sections where each story may fall in to. The Sections are labelled as follows

: * Politics: 0 * Technology: 1 * Entertainment: 2 * Business: 3

[20]:
```
import pandas as pd
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, f1_score
import tensorflow as tf
from tensorflow.keras import models, layers
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
import numpy as np
```

[21]:
```
df=pd.read_csv("data/NewsData.csv",encoding='latin')
```

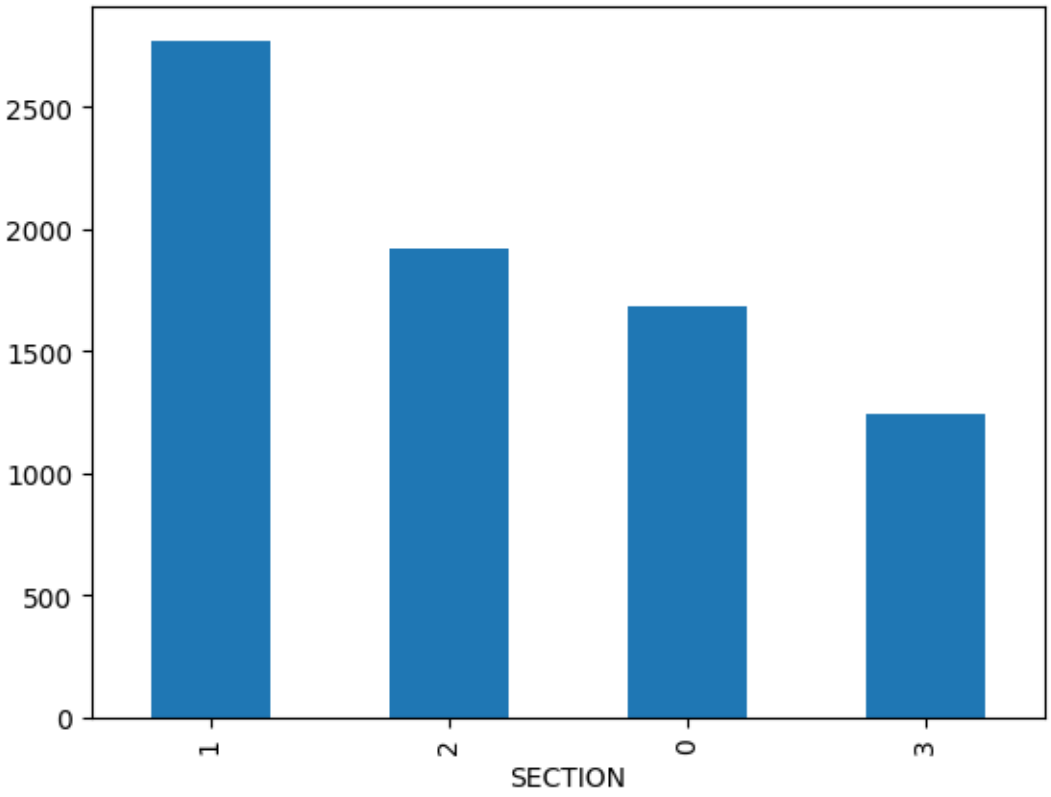
[22]:
```
df.head()
```

[22]:

	STORY	SECTION
0	But the most painful was the huge reversal in …	3
1	How formidable is the opposition alliance amon…	0
2	Most Asian currencies were trading lower today…	3
3	If you want to answer any question, click on …	1
4	In global markets, gold prices edged up today …	3

[23]:
```
df['SECTION'].value_counts().plot(kind='bar')
```

[23]:
```
<Axes: xlabel='SECTION'>
```



[24]:
```
X=df['STORY'].values
y=df['SECTION'].values
```

[25]:
```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[26]:
```
labels = tf.keras.utils.to_categorical(y_train, num_classes=4)
```

[27]:
```
# Tokenize the text data
tokenizer = Tokenizer()
tokenizer.fit_on_texts(X_train)
word_index = tokenizer.word_index
sequences = tokenizer.texts_to_sequences(X_train)
```

[28]:
```
# Pad sequences to a fixed length
max_sequence_length = 10  # maximum length of a sequence
padded_sequences = pad_sequences(sequences, maxlen=max_sequence_length)
```

[29]:
```
def create_model():
    model = tf.keras.models.Sequential([
```

```
    tf.keras.layers.Embedding(len(word_index) + 1, 256,␣
↪input_length=max_sequence_length),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(128, activation='relu'),
    tf.keras.layers.Dense(64, activation='relu'),
    tf.keras.layers.Dense(32, activation='relu'),
    tf.keras.layers.Dense(16, activation='relu'),
    tf.keras.layers.Dense(4, activation='softmax')
    ])
    return model
```

[31]:
```
optimizers = ['sgd', 'adagrad', 'rmsprop', 'adam']
results = []

for optimizer in optimizers:
    model = create_model()
    model.compile(optimizer=optimizer, loss='categorical_crossentropy',␣
↪metrics=['accuracy'])
    model.fit(padded_sequences, labels, epochs=10, batch_size=32, verbose=0)

    test_sequences = tokenizer.texts_to_sequences(X_test)
    test_padded_sequences = pad_sequences(test_sequences,␣
↪maxlen=max_sequence_length)
    # Predict on the test set
    y_pred = model.predict(test_padded_sequences)
    y_pred_class=[]
    for item in y_pred:
        temp = np.argmax(item)
        y_pred_class.append(temp)
    # Calculate accuracy and F1-score
    accuracy = accuracy_score(y_test, y_pred_class)
    f1 = f1_score(y_test, y_pred_class,average='macro')

    results.append({'Optimizer': optimizer, 'Accuracy': accuracy, 'F1-score':␣
↪f1})
```

```
48/48 [==============================] - 1s 6ms/step
48/48 [==============================] - 1s 7ms/step
48/48 [==============================] - 1s 9ms/step
48/48 [==============================] - 1s 14ms/step
```

[32]:
```
results_df = pd.DataFrame(results)
results_df
```

[32]:

	Optimizer	Accuracy	F1-score
0	sgd	0.359764	0.135899
1	adagrad	0.359764	0.132289

```
2   rmsprop  0.699869  0.681804
3      adam  0.748362  0.735969
```

For News Classification `adam` performed better.