Tabular_Classification

August 31, 2025

0.1 1. Imports

[3]:
```
import torch # Torch main framework
import torch.nn as nn # Used for getting the NN Layers
from torch.optim import Adam # Adam Optimizer
from torch.utils.data import Dataset, DataLoader # Dataset class and DataLoader␣
 ↪for creatning the objects
from torchsummary import summary # Visualize the model layers and number of␣
 ↪parameters
from sklearn.model_selection import train_test_split # Split the dataset␣
 ↪(train, validation, test)
from sklearn.metrics import accuracy_score # Calculate the testing Accuracy
import matplotlib.pyplot as plt # Plotting the training progress at the end
import pandas as pd # Data reading and preprocessing
import numpy as np # Mathematical operations

device = 'cuda' if torch.cuda.is_available() else 'cpu'
print (device) # detect the GPU if any, if not use CPU.
```

```
cpu
```

0.2 2. Dataset

[5]:
```
import kagglehub

# Download latest version
path = kagglehub.dataset_download("mssmartypants/rice-type-classification")

print("Path to dataset files:", path)
```

```
Downloading from
https://www.kaggle.com/api/v1/datasets/download/mssmartypants/rice-type-
classification?dataset_version_number=2…

100%|
  | 888k/888k [00:53<00:00, 17.0kB/s]

Extracting files…
Path to dataset files:
```

```
C:\Users\ADMIN\.cache\kagglehub\datasets\mssmartypants\rice-type-
classification\versions\2
```

[10]:
```python
data_df = pd.read_csv("riceClassification.csv")
```

[12]:
```python
data_df.head()
```

[12]:
```
   id  Area  MajorAxisLength  MinorAxisLength  Eccentricity  ConvexArea  \
0   1  4537        92.229316        64.012769      0.719916        4677
1   2  2872        74.691881        51.400454      0.725553        3015
2   3  3048        76.293164        52.043491      0.731211        3132
3   4  3073        77.033628        51.928487      0.738639        3157
4   5  3693        85.124785        56.374021      0.749282        3802

   EquivDiameter    Extent  Perimeter  Roundness  AspectRation  Class
0      76.004525  0.657536    273.085   0.764510      1.440796      1
1      60.471018  0.713009    208.317   0.831658      1.453137      1
2      62.296341  0.759153    210.012   0.868434      1.465950      1
3      62.551300  0.783529    210.657   0.870203      1.483456      1
4      68.571668  0.769375    230.332   0.874743      1.510000      1
```

[14]:
```python
data_df.isnull().sum()
```

[14]:
```
id                 0
Area               0
MajorAxisLength    0
MinorAxisLength    0
Eccentricity       0
ConvexArea         0
EquivDiameter      0
Extent             0
Perimeter          0
Roundness          0
AspectRation       0
Class              0
dtype: int64
```

[16]:
```python
data_df.drop(["id"],axis=1,inplace=True)
```

[18]:
```python
data_df.head()
```

[18]:
```
   Area  MajorAxisLength  MinorAxisLength  Eccentricity  ConvexArea  \
0  4537        92.229316        64.012769      0.719916        4677
1  2872        74.691881        51.400454      0.725553        3015
2  3048        76.293164        52.043491      0.731211        3132
3  3073        77.033628        51.928487      0.738639        3157
```

```
4  3693         85.124785         56.374021       0.749282         3802

   EquivDiameter    Extent  Perimeter  Roundness  AspectRation  Class
0      76.004525  0.657536    273.085   0.764510      1.440796      1
1      60.471018  0.713009    208.317   0.831658      1.453137      1
2      62.296341  0.759153    210.012   0.868434      1.465950      1
3      62.551300  0.783529    210.657   0.870203      1.483456      1
4      68.571668  0.769375    230.332   0.874743      1.510000      1
```

[20]:
```
data_df["Class"].unique()
```

[20]:
```
array([1, 0], dtype=int64)
```

[22]:
```
data_df.shape
```

[22]:
```
(18185, 11)
```

0.3 3 .Data Preprocessing

[25]:
```
original_df = data_df.copy()
original_df.head()
```

[25]:
```
   Area  MajorAxisLength  MinorAxisLength  Eccentricity  ConvexArea  \
0  4537        92.229316        64.012769      0.719916        4677
1  2872        74.691881        51.400454      0.725553        3015
2  3048        76.293164        52.043491      0.731211        3132
3  3073        77.033628        51.928487      0.738639        3157
4  3693        85.124785        56.374021      0.749282        3802

   EquivDiameter    Extent  Perimeter  Roundness  AspectRation  Class
0      76.004525  0.657536    273.085   0.764510      1.440796      1
1      60.471018  0.713009    208.317   0.831658      1.453137      1
2      62.296341  0.759153    210.012   0.868434      1.465950      1
3      62.551300  0.783529    210.657   0.870203      1.483456      1
4      68.571668  0.769375    230.332   0.874743      1.510000      1
```

[27]:
```
for column in data_df:
  data_df[column] = data_df[column]/data_df[column].abs().max()
data_df.head()
```

[27]:
```
       Area  MajorAxisLength  MinorAxisLength  Eccentricity  ConvexArea  \
0  0.444368         0.503404         0.775435      0.744658    0.424873
1  0.281293         0.407681         0.622653      0.750489    0.273892
2  0.298531         0.416421         0.630442      0.756341    0.284520
3  0.300979         0.420463         0.629049      0.764024    0.286791
4  0.361704         0.464626         0.682901      0.775033    0.345385
```

```
   EquivDiameter    Extent  Perimeter  Roundness  AspectRation  Class
0       0.666610  0.741661   0.537029   0.844997      0.368316    1.0
1       0.530370  0.804230   0.409661   0.919215      0.371471    1.0
2       0.546380  0.856278   0.412994   0.959862      0.374747    1.0
3       0.548616  0.883772   0.414262   0.961818      0.379222    1.0
4       0.601418  0.867808   0.452954   0.966836      0.386007    1.0
```

0.4 4 .Data Splitting

[31]:
```python
x = np.array(data_df.iloc[:, :-1])
y = np.array(data_df.iloc[:, -1])

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3)
x_test,x_val,y_test,y_val = train_test_split(x_test,y_test,test_size=0.5)
```

[33]:
```python
print("training set is",x_train.shape[0],"row which is ", round(x_train.
 ↪shape[0]/data_df.shape[0],4)*100,"%")   #4 means i need the 4 values after␣
 ↪decimal
print("validation set is",x_val.shape[0],"row which is ", round(x_val.shape[0]/
 ↪data_df.shape[0],4)*100,"%")
print("testing set is",x_test.shape[0],"row which is ", round(x_test.shape[0]/
 ↪data_df.shape[0],4)*100,"%")
```

```
training set is 12729 row which is  70.0 %
validation set is 2728 row which is  15.0 %
testing set is 2728 row which is  15.0 %
```

0.5 5 .Dataset Object

[36]:
```python
class dataset(Dataset):
  def __init__(self, x,y):
    self.x = torch.tensor(x,dtype=torch.float32).to(device)
    self.y = torch.tensor(y,dtype=torch.float32).to(device)

  def __len__(self):
    return len(self.x)

  def __getitem__(self,index):
    return self.x[index],self.y[index]
training_data = dataset(x_train,y_train)
testing_data = dataset(x_test,y_test)
validation_data = dataset(x_val,y_val)
```

0.6 6 . Training Hyper Parameters

[39]:
```
BATCH_SIZE = 32
EPOCHS = 10
HIDDEN_NEURONS = 10
LR = 1e-3
```

0.7 7. Data Loaders

[42]:
```
train_dataloader = DataLoader(training_data, batch_size=BATCH_SIZE, shuffle=␣
 ↪True)
validation_dataloader = DataLoader(validation_data, batch_size=BATCH_SIZE,␣
 ↪shuffle= True)
testing_dataloader = DataLoader(testing_data, batch_size=BATCH_SIZE, shuffle=␣
 ↪True)
```

0.8 8. Model Class

[46]:
```
class MyModel(nn.Module):
  def __init__(self):
    super(MyModel, self).__init__()

    self.input_layer = nn.Linear(x.shape[1],HIDDEN_NEURONS)
    self.linear = nn.Linear(HIDDEN_NEURONS,1)
    self.sigmoid = nn.Sigmoid()

  def forward(self,x):
    x=self.input_layer(x)
    x=self.linear(x)
    x=self.sigmoid(x)
    return x
```

0.9 9. Model Creation

[50]:
```
model = MyModel().to(device)
summary(model, (x.shape[1],))
```

```
----------------------------------------------------------------
        Layer (type)               Output Shape         Param #
================================================================
            Linear-1                  [-1, 10]             110
            Linear-2                   [-1, 1]              11
           Sigmoid-3                   [-1, 1]               0
================================================================
Total params: 121
Trainable params: 121
Non-trainable params: 0
----------------------------------------------------------------
```

```
Input size (MB): 0.00
Forward/backward pass size (MB): 0.00
Params size (MB): 0.00
Estimated Total Size (MB): 0.00
----------------------------------------------------------------
```

0.10 10. Loss and Optimizer

[53]:
```python
criterion = nn.BCELoss()
optimizer = Adam(model.parameters(),lr=LR)
```

0.11 11. Training

[56]:
```python
total_loss_train_plot = []
total_loss_validation_plot = []
total_acc_train_plot = []
total_acc_validation_plot = []

for epoch in range(EPOCHS):
    total_acc_train = 0
    total_loss_train = 0
    total_acc_val = 0
    total_loss_val = 0

    ## Training and Validation
    for data in train_dataloader:
      inputs,labels = data
      prediction = model(inputs).squeeze(1)

      batch_loss = criterion(prediction,labels)
      total_loss_train += batch_loss.item()
      acc = ((prediction).round() == labels).sum().item()
      total_acc_train += acc



      batch_loss.backward()
      optimizer.step()
      optimizer.zero_grad()

    ## Validation
    with torch.no_grad():
        for data in validation_dataloader:
            inputs, labels = data

            prediction = model(inputs).squeeze(1)
```

```
            batch_loss = criterion(prediction, labels)

            total_loss_val += batch_loss.item()

            acc = ((prediction).round() == labels).sum().item()

            total_acc_val += acc


    total_loss_train_plot.append(round(total_loss_train/1000, 4))
    total_loss_validation_plot.append(round(total_loss_val/1000, 4))
    total_acc_train_plot.append(round(total_acc_train/(training_data.
↪__len__())*100, 4))
    total_acc_validation_plot.append(round(total_acc_val/(validation_data.
↪__len__())*100, 4))

    print(f'''Epoch no. {epoch + 1} Train Loss: {total_loss_train/1000:.4f}␣
↪Train Accuracy: {(total_acc_train/(training_data.__len__())*100):.4f}␣
↪Validation Loss: {total_loss_val/1000:.4f} Validation Accuracy:␣
↪{(total_acc_val/(validation_data.__len__())*100):.4f}''')
    print("="*50)
```

```
Epoch no. 1 Train Loss: 0.2380 Train Accuracy: 79.7942 Validation Loss: 0.0372
Validation Accuracy: 97.1774
==================================================
Epoch no. 2 Train Loss: 0.1097 Train Accuracy: 97.8003 Validation Loss: 0.0151
Validation Accuracy: 98.2038
==================================================
Epoch no. 3 Train Loss: 0.0514 Train Accuracy: 98.2324 Validation Loss: 0.0088
Validation Accuracy: 98.5337
==================================================
Epoch no. 4 Train Loss: 0.0337 Train Accuracy: 98.4052 Validation Loss: 0.0066
Validation Accuracy: 98.6437
==================================================
Epoch no. 5 Train Loss: 0.0264 Train Accuracy: 98.4916 Validation Loss: 0.0054
Validation Accuracy: 98.6070
==================================================
Epoch no. 6 Train Loss: 0.0226 Train Accuracy: 98.5702 Validation Loss: 0.0049
Validation Accuracy: 98.6804
==================================================
Epoch no. 7 Train Loss: 0.0203 Train Accuracy: 98.5859 Validation Loss: 0.0044
Validation Accuracy: 98.7170
==================================================
Epoch no. 8 Train Loss: 0.0191 Train Accuracy: 98.5309 Validation Loss: 0.0042
Validation Accuracy: 98.6804
==================================================
Epoch no. 9 Train Loss: 0.0182 Train Accuracy: 98.5623 Validation Loss: 0.0040
```

```
Validation Accuracy: 98.6804
==================================================
Epoch no. 10 Train Loss: 0.0175 Train Accuracy: 98.5859 Validation Loss: 0.0040
Validation Accuracy: 98.6437
==================================================
```

0.12 12. Testing

[59]:
```
with torch.no_grad():
  total_loss_test = 0
  total_acc_test = 0
  for data in testing_dataloader:
    inputs, labels = data

    prediction = model(inputs).squeeze(1)

    batch_loss_test = criterion((prediction), labels)
    total_loss_test += batch_loss_test.item()
    acc = ((prediction).round() == labels).sum().item()
    total_acc_test += acc

print(f"Accuracy Score is: {round((total_acc_test/x_test.shape[0])*100, 2)}%")
```

```
Accuracy Score is: 98.61%
```

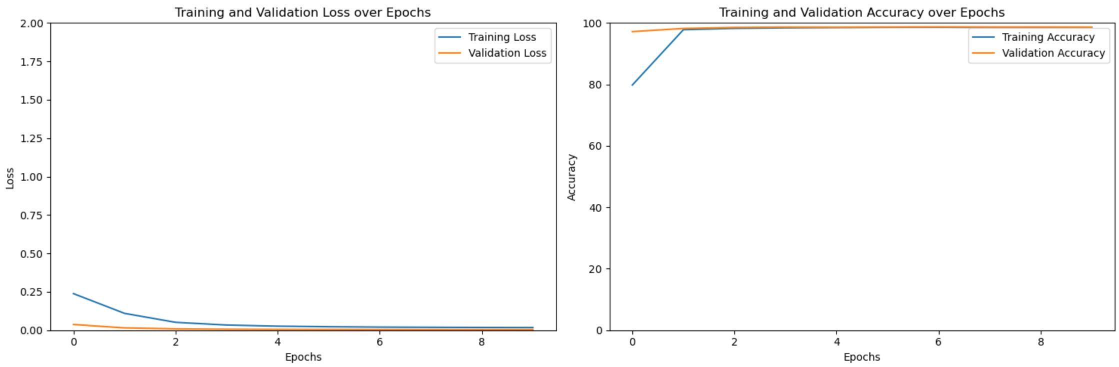
[61]:
```
fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(15, 5))

axs[0].plot(total_loss_train_plot, label='Training Loss')
axs[0].plot(total_loss_validation_plot, label='Validation Loss')
axs[0].set_title('Training and Validation Loss over Epochs')
axs[0].set_xlabel('Epochs')
axs[0].set_ylabel('Loss')
axs[0].set_ylim([0, 2])
axs[0].legend()

axs[1].plot(total_acc_train_plot, label='Training Accuracy')
axs[1].plot(total_acc_validation_plot, label='Validation Accuracy')
axs[1].set_title('Training and Validation Accuracy over Epochs')
axs[1].set_xlabel('Epochs')
axs[1].set_ylabel('Accuracy')
axs[1].set_ylim([0, 100])
axs[1].legend()

plt.tight_layout()

plt.show()
```



0.13 13. Inference

[64]:
```
area = float(input("Area: "))/original_df['Area'].abs().max()
MajorAxisLength = float(input("Major Axis Length: "))/
↪original_df['MajorAxisLength'].abs().max()
MinorAxisLength = float(input("Minor Axis Length: "))/
↪original_df['MinorAxisLength'].abs().max()
Eccentricity = float(input("Eccentricity: "))/original_df['Eccentricity'].abs().
↪max()
ConvexArea = float(input("Convex Area: "))/original_df['ConvexArea'].abs().max()
EquivDiameter = float(input("EquivDiameter: "))/original_df['EquivDiameter'].
↪abs().max()
Extent = float(input("Extent: "))/original_df['Extent'].abs().max()
Perimeter = float(input("Perimeter: "))/original_df['Perimeter'].abs().max()
Roundness = float(input("Roundness: "))/original_df['Roundness'].abs().max()
AspectRation = float(input("AspectRation: "))/original_df['AspectRation'].abs().
↪max()

my_inputs = [area, MajorAxisLength, MinorAxisLength, Eccentricity, ConvexArea,␣
↪EquivDiameter, Extent, Perimeter, Roundness, AspectRation]

print("="*20)
model_inputs = torch.Tensor(my_inputs).to(device)
prediction = (model(model_inputs))
print(prediction)
print("Class is: ", round(prediction.item()))
```

```
Area:  6431.279
Major Axis Length:  145.6
Minor Axis Length:  65.3
Eccentricity:  0.91
Convex Area:  6.56
EquivDiameter:  90.33
Extent:  0.85
```

```
Perimeter:  329.55
Roundness:  0.74
AspectRation:  2.55

====================
tensor([0.9993], grad_fn=<SigmoidBackward0>)
Class is:  1
```

```
[ ]:
```