In [44]:
```
import pandas as pd
import numpy as np
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, TensorDataset
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, TensorDataset
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt
import seaborn as sns
```

In [24]:
```
import pandas as pd
df=pd.read_csv("apneaset.csv")
df
```

Out[24]:

	Patinet_ID	EEG_Signal_Amplitude	EEG_Delta_band	EEG_Theta_band	EEG_Alpha_band	EEG_Beta_band	Hair_Phenotype	heart_
0	180203	56	2.4786	5.5748	11.7319	23.9909	Curly_hair	Medium_Pulse
1	152268	97	3.2531	6.4658	13.1411	28.3962	Curly_hair	High_Pulse
2	157399	83	3.6325	6.0053	13.6766	26.0487	Wavy_hair	High_Pulse
3	131849	58	2.9477	5.5462	10.3739	22.0865	Straight_hair	Medium_Pulse
4	164593	22	1.9366	4.3574	8.9079	18.7077	Curly_hair	Low_Pulse
...	...	...	...	...	...	...	...	
670	134065	95	3.0788	6.7874	14.5136	26.9154	No_hair	High_Pulse
671	182597	23	1.2767	4.9695	8.8617	18.6980	No_hair	Low_Pulse
672	156972	36	2.3799	5.3240	11.5026	23.6280	Wavy_hair	Medium_Pulse
673	172428	59	2.6147	5.3841	11.1521	20.8031	Straight_hair	Medium_Pulse
674	158058	100	3.4924	6.7524	12.9776	26.8441	No_hair	High_Pulse

675 rows × 14 columns

In [25]:
```
df["apnea_Severity"] = df["apnea_Severity"].map(
    {'High_Severity': 2, 'Medium_Severity': 1, 'Low_Severity': 0})
df["heart_rate"] = df["heart_rate"].map(
    {'High_PulseRate': 2, 'Medium_PulseRate': 1, 'Low_PulseRate': 0})
df["skin_conductance"] = df["skin_conductance"].map(
    {'High_Conductance': 2, 'Normal_Conductance': 1, 'Low_Conductance': 0})
df["skin_temperature"] = df["skin_temperature"].map(
    {'Low_Temperature': 2, 'Normal_Temperature': 1, 'Fever': 0})
df["cortisol_level"] = df["cortisol_level"].map(
    {'Above_AverageCL': 2, 'AverageCL': 1, 'Below_AverageCL': 0})
df["Systolic_BP"] = df["Systolic_BP"].map(
    {'Range1_LowSystolic': 2, 'Range2_LowSystolic': 1, 'Range3_LowSystolic': 0})
df["Diastolic_BP"] = df["Diastolic_BP"].map(
    {'VerylowDiSystolic': 2, 'NormalDiSystolic': 1, 'LowDiSystolic': 0})
```

In [26]:
```
df
```

Out[26]:

	Patinet_ID	EEG_Signal_Amplitude	EEG_Delta_band	EEG_Theta_band	EEG_Alpha_band	EEG_Beta_band	Hair_Phenotype	heart_rate	sl
0	180203	56	2.4786	5.5748	11.7319	23.9909	Curly_hair	1	
1	152268	97	3.2531	6.4658	13.1411	28.3962	Curly_hair	2	
2	157399	83	3.6325	6.0053	13.6766	26.0487	Wavy_hair	2	
3	131849	58	2.9477	5.5462	10.3739	22.0865	Straight_hair	1	
4	164593	22	1.9366	4.3574	8.9079	18.7077	Curly_hair	0	
...	...	...	...	...	...	...	...	...	...
670	134065	95	3.0788	6.7874	14.5136	26.9154	No_hair	2	
671	182597	23	1.2767	4.9695	8.8617	18.6980	No_hair	0	
672	156972	36	2.3799	5.3240	11.5026	23.6280	Wavy_hair	1	
673	172428	59	2.6147	5.3841	11.1521	20.8031	Straight_hair	1	
674	158058	100	3.4924	6.7524	12.9776	26.8441	No_hair	2	

675 rows × 14 columns

In [27]:
```
# Select only the specified columns in the DataFrame
df = df[["EEG_Signal_Amplitude", "EEG_Delta_band", "EEG_Theta_band", "EEG_Alpha_band", "EEG_Beta_band",
         "skin_conductance", "skin_temperature", "cortisol_level", "Systolic_BP", "Diastolic_BP", "apne
```

In [28]:
```
df
```

Out[28]:

	EEG_Signal_Amplitude	EEG_Delta_band	EEG_Theta_band	EEG_Alpha_band	EEG_Beta_band	heart_rate	skin_conductance	skin_tempe
0	56	2.4786	5.5748	11.7319	23.9909	1	1	
1	97	3.2531	6.4658	13.1411	28.3962	2	0	
2	83	3.6325	6.0053	13.6766	26.0487	2	0	
3	58	2.9477	5.5462	10.3739	22.0865	1	1	
4	22	1.9366	4.3574	8.9079	18.7077	0	2	
...	...	...	...	...	...	...	...	...
670	95	3.0788	6.7874	14.5136	26.9154	2	0	
671	23	1.2767	4.9695	8.8617	18.6980	0	2	
672	36	2.3799	5.3240	11.5026	23.6280	1	1	
673	59	2.6147	5.3841	11.1521	20.8031	1	1	
674	100	3.4924	6.7524	12.9776	26.8441	2	0	

675 rows × 12 columns

In [29]:
```
# Imported Library's
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, TensorDataset
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score
import warnings
warnings.filterwarnings("ignore")
```

In [30]:
```
# Handle missing values if any
df.dropna(inplace=True)
df
```

Out[30]:

	EEG_Signal_Amplitude	EEG_Delta_band	EEG_Theta_band	EEG_Alpha_band	EEG_Beta_band	heart_rate	skin_conductance	skin_tempe
0	56	2.4786	5.5748	11.7319	23.9909	1	1	
1	97	3.2531	6.4658	13.1411	28.3962	2	0	
2	83	3.6325	6.0053	13.6766	26.0487	2	0	
3	58	2.9477	5.5462	10.3739	22.0865	1	1	
4	22	1.9366	4.3574	8.9079	18.7077	0	2	
...	...	...	...	...	...	...	...	
670	95	3.0788	6.7874	14.5136	26.9154	2	0	
671	23	1.2767	4.9695	8.8617	18.6980	0	2	
672	36	2.3799	5.3240	11.5026	23.6280	1	1	
673	59	2.6147	5.3841	11.1521	20.8031	1	1	
674	100	3.4924	6.7524	12.9776	26.8441	2	0	

675 rows × 12 columns

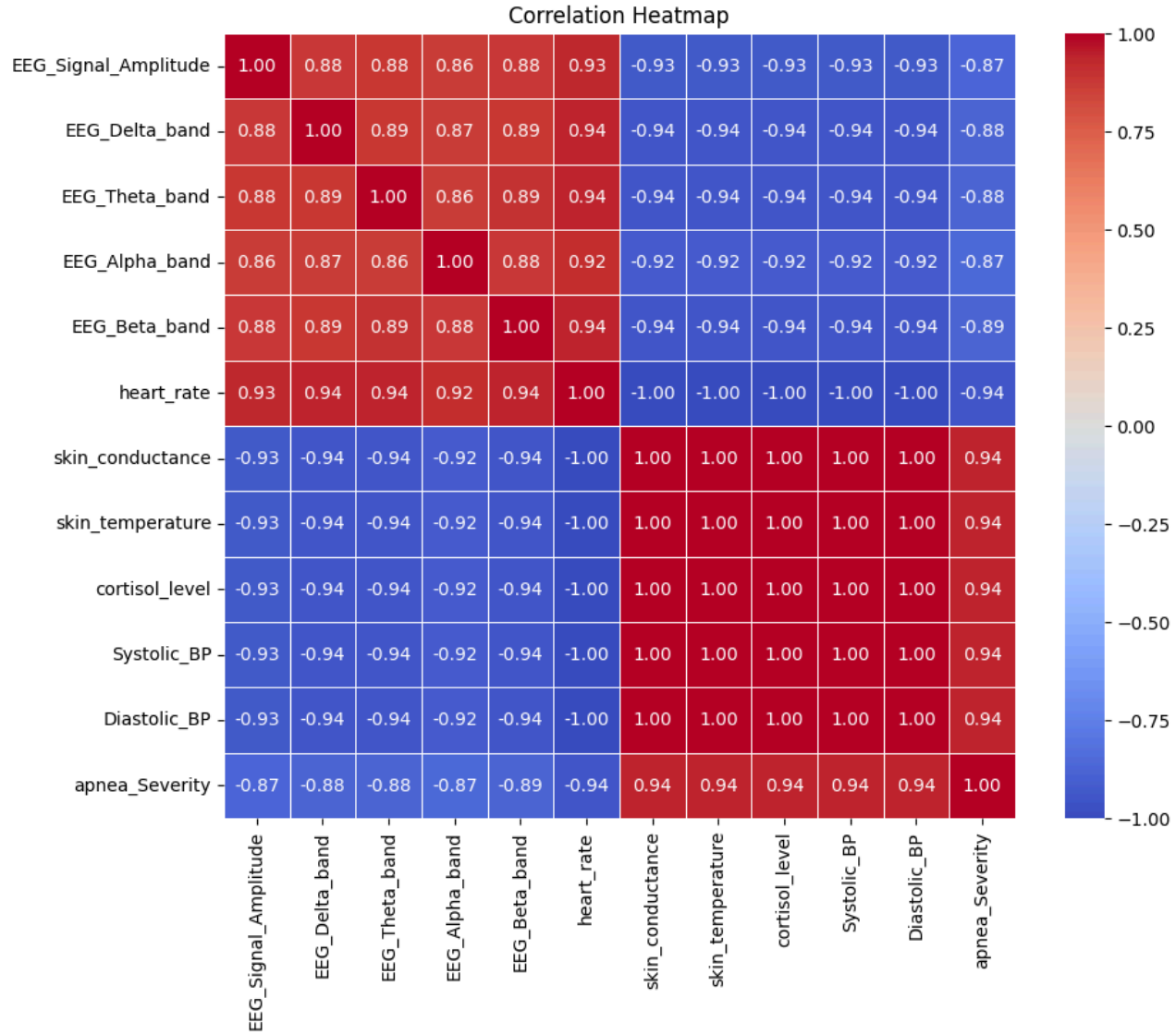
In [31]:
```
correlation_matrix = df.corr()
print(correlation_matrix)
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f", linewidths=.5)
plt.title("Correlation Heatmap")
plt.show()
```

```
                      EEG_Signal_Amplitude  EEG_Delta_band  EEG_Theta_band  \
EEG_Signal_Amplitude              1.000000        0.882041        0.883475
EEG_Delta_band                    0.882041        1.000000        0.890056
EEG_Theta_band                    0.883475        0.890056        1.000000
EEG_Alpha_band                    0.862325        0.867287        0.860805
EEG_Beta_band                     0.876931        0.889012        0.893707
heart_rate                        0.931941        0.942607        0.944144
skin_conductance                 -0.931941       -0.942607       -0.944144
skin_temperature                 -0.931941       -0.942607       -0.944144
cortisol_level                   -0.931941       -0.942607       -0.944144
Systolic_BP                      -0.931941       -0.942607       -0.944144
Diastolic_BP                     -0.931941       -0.942607       -0.944144
apnea_Severity                   -0.868084       -0.884335       -0.878918

                      EEG_Alpha_band  EEG_Beta_band  heart_rate  \
EEG_Signal_Amplitude        0.862325       0.876931    0.931941
EEG_Delta_band              0.867287       0.889012    0.942607
EEG_Theta_band              0.860805       0.893707    0.944144
EEG_Alpha_band              1.000000       0.878412    0.920644
EEG_Beta_band               0.878412       1.000000    0.941563
heart_rate                  0.920644       0.941563    1.000000
skin_conductance           -0.920644      -0.941563   -1.000000
skin_temperature           -0.920644      -0.941563   -1.000000
cortisol_level             -0.920644      -0.941563   -1.000000
Systolic_BP                -0.920644      -0.941563   -1.000000
Diastolic_BP               -0.920644      -0.941563   -1.000000
apnea_Severity             -0.865113      -0.885964   -0.937604

                      skin_conductance  skin_temperature  cortisol_level  \
EEG_Signal_Amplitude         -0.931941         -0.931941       -0.931941
EEG_Delta_band               -0.942607         -0.942607       -0.942607
EEG_Theta_band               -0.944144         -0.944144       -0.944144
EEG_Alpha_band               -0.920644         -0.920644       -0.920644
EEG_Beta_band                -0.941563         -0.941563       -0.941563
heart_rate                   -1.000000         -1.000000       -1.000000
skin_conductance              1.000000          1.000000        1.000000
skin_temperature              1.000000          1.000000        1.000000
cortisol_level                1.000000          1.000000        1.000000
Systolic_BP                   1.000000          1.000000        1.000000
Diastolic_BP                  1.000000          1.000000        1.000000
apnea_Severity                0.937604          0.937604        0.937604

                      Systolic_BP  Diastolic_BP  apnea_Severity
EEG_Signal_Amplitude    -0.931941     -0.931941       -0.868084
EEG_Delta_band          -0.942607     -0.942607       -0.884335
EEG_Theta_band          -0.944144     -0.944144       -0.878918
EEG_Alpha_band          -0.920644     -0.920644       -0.865113
EEG_Beta_band           -0.941563     -0.941563       -0.885964
heart_rate              -1.000000     -1.000000       -0.937604
skin_conductance         1.000000      1.000000        0.937604
skin_temperature         1.000000      1.000000        0.937604
cortisol_level           1.000000      1.000000        0.937604
Systolic_BP              1.000000      1.000000        0.937604
Diastolic_BP             1.000000      1.000000        0.937604
apnea_Severity           0.937604      0.937604        1.000000
```



In [32]:
```
# Split the dataset into features and target
X = df.drop(columns=['apnea_Severity']).values
y = df['apnea_Severity'].values
```

In [33]:
```
# Perform feature scaling
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

In [34]:
```
# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)
```

In [35]:
```
# Convert data to PyTorch tensors
X_train_tensor = torch.tensor(X_train, dtype=torch.float32)
X_test_tensor = torch.tensor(X_test, dtype=torch.float32)
y_train_tensor = torch.tensor(y_train, dtype=torch.long)
y_test_tensor = torch.tensor(y_test, dtype=torch.long)
```

In [36]:
```
# Defineing the neural network model
class Classifier(nn.Module):
    def __init__(self, input_size, output_size):
        super(Classifier, self).__init__()
        self.fc1 = nn.Linear(input_size, 128)
        self.fc2 = nn.Linear(128, 64)
        self.fc3 = nn.Linear(64, output_size)
        self.dropout = nn.Dropout(0.5)  # Adding dropout for regularization

    def forward(self, x):
        x = torch.relu(self.fc1(x))
        x = self.dropout(x)
        x = torch.relu(self.fc2(x))
        x = self.dropout(x)
        x = self.fc3(x)
        return x
```

In [37]:
```
# Instantiate the model
input_size = X_train.shape[1]
output_size = len(df['apnea_Severity'].unique())
model = Classifier(input_size, output_size)
```

In [38]:
```
# Define the loss function and optimizer, and adjust the learning rate
criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.parameters(), lr=0.001)  # Adjusted learning rate
```

In [39]:
```
# Training loop
num_epochs = 100
for epoch in range(num_epochs):
    optimizer.zero_grad()
    outputs = model(X_train_tensor)
    loss = criterion(outputs, y_train_tensor)
    loss.backward()
    optimizer.step()
    if (epoch+1) % 10 == 0:
        print(f'Epoch [{epoch+1}/{num_epochs}], Loss: {loss.item():.4f}')
```

```
Epoch [10/100], Loss: 0.8643
Epoch [20/100], Loss: 0.6109
Epoch [30/100], Loss: 0.4788
Epoch [40/100], Loss: 0.4000
Epoch [50/100], Loss: 0.3173
Epoch [60/100], Loss: 0.3046
Epoch [70/100], Loss: 0.2790
Epoch [80/100], Loss: 0.2583
Epoch [90/100], Loss: 0.2497
Epoch [100/100], Loss: 0.2532
```

In [40]:
```
 # Evaluate the model
model.eval()
with torch.no_grad():
    y_pred = torch.argmax(model(X_test_tensor), dim=1).numpy()
    accuracy = accuracy_score(y_test, y_pred)
    print("Accuracy on test set:", accuracy)
```

```
Accuracy on test set: 0.9407407407407408
```

In [41]:
```
# Make predictions on new data
new_data = [[97, 3.2531, 6.4658, 13.1411, 28.3962, 2, 0, 0, 0, 0, 0]]
new_data_scaled = scaler.transform(new_data)
new_data_tensor = torch.tensor(new_data_scaled, dtype=torch.float32)
with torch.no_grad():
    prediction = torch.argmax(model(new_data_tensor)).item()
    print('Predicted apnea severity:', prediction)
```

```
Predicted apnea severity: 0
```

In [42]:
```
new_data = [[58, 2.9477, 5.5462, 10.3739, 22.0865, 1, 1, 1, 1, 1, 1]]
new_data_scaled = scaler.transform(new_data)
new_data_tensor = torch.tensor(new_data_scaled, dtype=torch.float32)
with torch.no_grad():
    prediction = torch.argmax(model(new_data_tensor)).item()
    print('Predicted apnea severity:', prediction)
```

```
Predicted apnea severity: 1
```

In [43]:
```
new_data = [[22, 1.9366, 4.3574, 8.9079, 18.7077, 0, 2, 2, 2, 2, 2]]
new_data_scaled = scaler.transform(new_data)
new_data_tensor = torch.tensor(new_data_scaled, dtype=torch.float32)
with torch.no_grad():
    prediction = torch.argmax(model(new_data_tensor)).item()
    print('Predicted apnea severity:', prediction)
```

```
Predicted apnea severity: 2
```

In [ ]:
```

```