In [2]:

```
import pandas as pd
df = pd.read_csv("AI_heart.csv")
```

In [3]:

```
df
```

Out[3]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 52.0 | M | 0 | 125 | 212 | 0 | 1 | 168 | 0 | 1.0 | 2 | 2 | 3 |
| **1** | 53.0 | M | 0 | 140 | 203 | 1 | 0 | 155 | 1 | 3.1 | 0 | 0 | 3 |
| **2** | 70.0 | M | 0 | 145 | 174 | 0 | 1 | 125 | 1 | 2.6 | 0 | 0 | 3 |
| **3** | 61.0 | M | 0 | 148 | 203 | 0 | 1 | 161 | 0 | 0.0 | 2 | 1 | 3 |
| **4** | 62.0 | F | 0 | 138 | 294 | 1 | 1 | 106 | 0 | 1.9 | 1 | 3 | 2 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **1020** | 59.0 | M | 1 | 140 | 221 | 0 | 1 | 164 | 1 | 0.0 | 2 | 0 | 2 |
| **1021** | 60.0 | M | 0 | 125 | 258 | 0 | 0 | 141 | 1 | 2.8 | 1 | 1 | 3 |
| **1022** | 47.0 | M | 0 | 110 | 275 | 0 | 0 | 118 | 1 | 1.0 | 1 | 1 | 2 |
| **1023** | 50.0 | F | 0 | 110 | 254 | 0 | 0 | 159 | 0 | 0.0 | 2 | 0 | 2 |
| **1024** | NaN | M | 0 | 120 | 188 | 0 | 1 | 113 | 0 | 1.4 | 1 | 1 | 3 |

1025 rows × 14 columns

In [6]:

```
target_counts = df['target'].value_counts()
print("Target counts:")
print(target_counts)
```

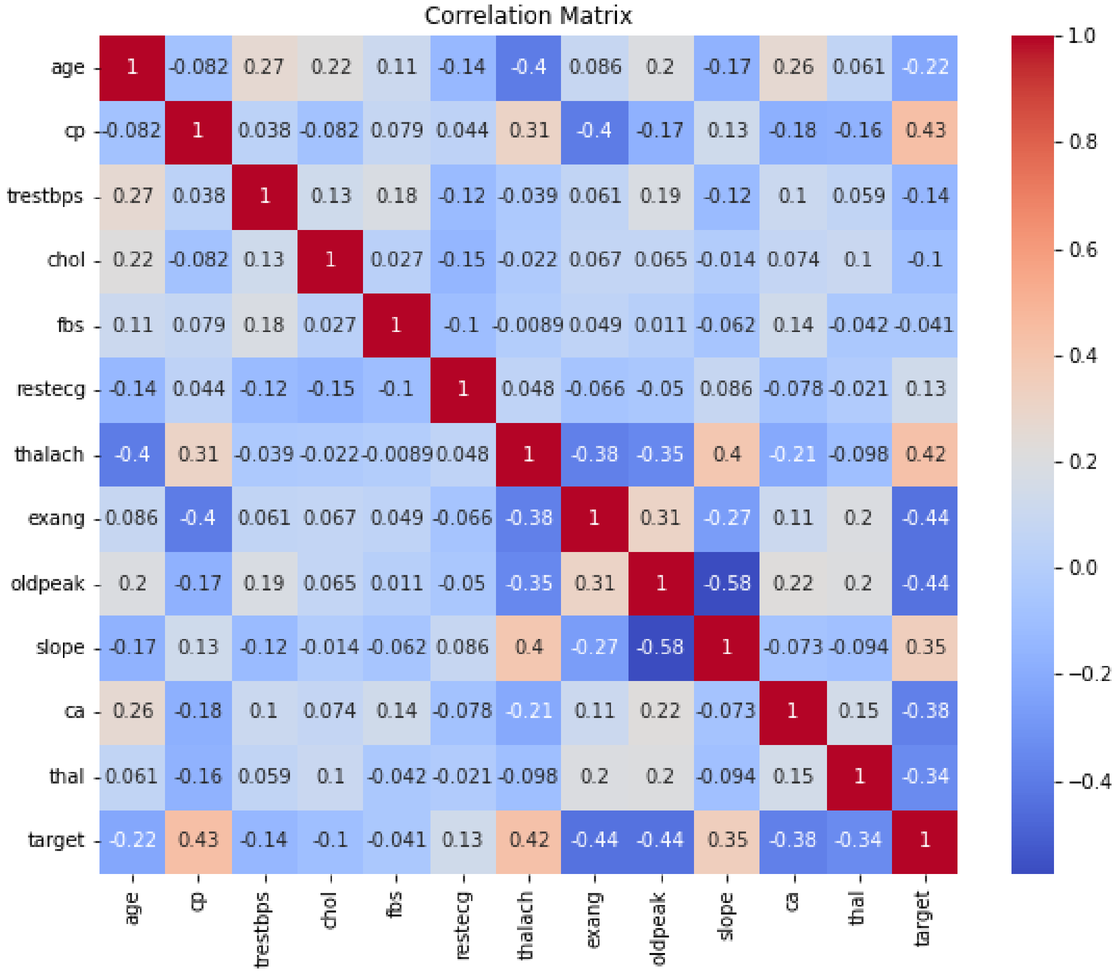
```
Target counts:
1    526
0    499
Name: target, dtype: int64
```

In [ ]:

In [7]:

```
import seaborn as sns
import matplotlib.pyplot as plt

corr_matrix = df.corr()
plt.figure(figsize=(10, 8))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm')
plt.title("Correlation Matrix")
plt.show()
```

```
/tmp/ipykernel_24451/1307843007.py:5: FutureWarning: The default va
lue of numeric_only in DataFrame.corr is deprecated. In a future ve
rsion, it will default to False. Select only valid columns or speci
fy the value of numeric_only to silence this warning.
  corr_matrix = df.corr()
```



| | age | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | 1 | -0.082 | 0.27 | 0.22 | 0.11 | -0.14 | -0.4 | 0.086 | 0.2 | -0.17 | 0.26 | 0.061 | -0.22 |
| cp | -0.082 | 1 | 0.038 | -0.082 | 0.079 | 0.044 | 0.31 | -0.4 | -0.17 | 0.13 | -0.18 | -0.16 | 0.43 |
| trestbps | 0.27 | 0.038 | 1 | 0.13 | 0.18 | -0.12 | -0.039 | 0.061 | 0.19 | -0.12 | 0.1 | 0.059 | -0.14 |
| chol | 0.22 | -0.082 | 0.13 | 1 | 0.027 | -0.15 | -0.022 | 0.067 | 0.065 | -0.014 | 0.074 | 0.1 | -0.1 |
| fbs | 0.11 | 0.079 | 0.18 | 0.027 | 1 | -0.1 | -0.0089 | 0.049 | 0.011 | -0.062 | 0.14 | -0.042 | -0.041 |
| restecg | -0.14 | 0.044 | -0.12 | -0.15 | -0.1 | 1 | 0.048 | -0.066 | -0.05 | 0.086 | -0.078 | -0.021 | 0.13 |
| thalach | -0.4 | 0.31 | -0.039 | -0.022 | -0.0089 | 0.048 | 1 | -0.38 | -0.35 | 0.4 | -0.21 | -0.098 | 0.42 |
| exang | 0.086 | -0.4 | 0.061 | 0.067 | 0.049 | -0.066 | -0.38 | 1 | 0.31 | -0.27 | 0.11 | 0.2 | -0.44 |
| oldpeak | 0.2 | -0.17 | 0.19 | 0.065 | 0.011 | -0.05 | -0.35 | 0.31 | 1 | -0.58 | 0.22 | 0.2 | -0.44 |
| slope | -0.17 | 0.13 | -0.12 | -0.014 | -0.062 | 0.086 | 0.4 | -0.27 | -0.58 | 1 | -0.073 | -0.094 | 0.35 |
| ca | 0.26 | -0.18 | 0.1 | 0.074 | 0.14 | -0.078 | -0.21 | 0.11 | 0.22 | -0.073 | 1 | 0.15 | -0.38 |
| thal | 0.061 | -0.16 | 0.059 | 0.1 | -0.042 | -0.021 | -0.098 | 0.2 | 0.2 | -0.094 | 0.15 | 1 | -0.34 |
| target | -0.22 | 0.43 | -0.14 | -0.1 | -0.041 | 0.13 | 0.42 | -0.44 | -0.44 | 0.35 | -0.38 | -0.34 | 1 |

In [26]:

```
df.dropna(inplace=True)
```

In [27]:

```
from sklearn.preprocessing import LabelEncoder
le_sex = LabelEncoder()
df['sex'] = le_sex.fit_transform(df['sex'])
df
```

Out[27]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 52.0 | 1 | 0 | 125 | 212 | 0 | 1 | 168 | 0 | 1.0 | 2 | 2 | 3 |
| **1** | 53.0 | 1 | 0 | 140 | 203 | 1 | 0 | 155 | 1 | 3.1 | 0 | 0 | 3 |
| **2** | 70.0 | 1 | 0 | 145 | 174 | 0 | 1 | 125 | 1 | 2.6 | 0 | 0 | 3 |
| **3** | 61.0 | 1 | 0 | 148 | 203 | 0 | 1 | 161 | 0 | 0.0 | 2 | 1 | 3 |
| **4** | 62.0 | 0 | 0 | 138 | 294 | 1 | 1 | 106 | 0 | 1.9 | 1 | 3 | 2 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **1019** | 47.0 | 1 | 0 | 112 | 204 | 0 | 1 | 143 | 0 | 0.1 | 2 | 0 | 2 |
| **1020** | 59.0 | 1 | 1 | 140 | 221 | 0 | 1 | 164 | 1 | 0.0 | 2 | 0 | 2 |
| **1021** | 60.0 | 1 | 0 | 125 | 258 | 0 | 0 | 141 | 1 | 2.8 | 1 | 1 | 3 |
| **1022** | 47.0 | 1 | 0 | 110 | 275 | 0 | 0 | 118 | 1 | 1.0 | 1 | 1 | 2 |
| **1023** | 50.0 | 0 | 0 | 110 | 254 | 0 | 0 | 159 | 0 | 0.0 | 2 | 0 | 2 |

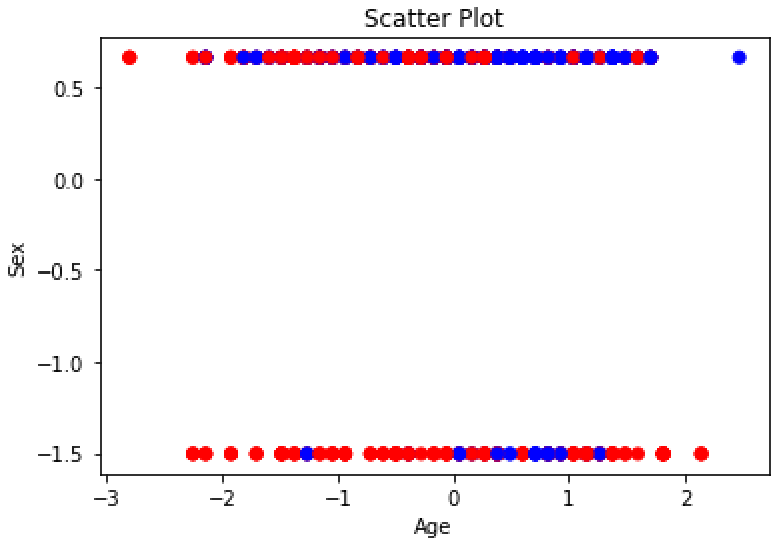
923 rows × 14 columns

In [28]:

```
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split

X = df.drop('target', axis=1)
y = df['target']

# Scale the features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.3, r
```

In [34]:

```
plt.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap='bwr')
plt.xlabel("Age")
plt.ylabel("Sex")
plt.title("Scatter Plot")
plt.show()
```



In [30]:

```
from sklearn.neural_network import MLPClassifier

# Initialize the MLP classifier
mlp1 = MLPClassifier(hidden_layer_sizes=(10, 10), activation='relu', random_state
mlp2 = MLPClassifier(hidden_layer_sizes=(20, 20), activation='relu', random_state
```

In [31]:

```
# Train the first MLP classifier
mlp1.fit(X_train, y_train)

# Train the second MLP classifier
mlp2.fit(X_train, y_train)
```

```
/home/waqar/.local/lib/python3.10/site-packages/sklearn/neural_netw
ork/_multilayer_perceptron.py:684: ConvergenceWarning: Stochastic O
ptimizer: Maximum iterations (200) reached and the optimization has
n't converged yet.
  warnings.warn(
/home/waqar/.local/lib/python3.10/site-packages/sklearn/neural_netw
ork/_multilayer_perceptron.py:684: ConvergenceWarning: Stochastic O
ptimizer: Maximum iterations (200) reached and the optimization has
n't converged yet.
  warnings.warn(
```

Out[31]:

```
▾                    MLPClassifier
MLPClassifier(hidden_layer_sizes=(20, 20), random_state=42)
```

In [ ]:

```

```

In [32]:

```
df
```

Out[32]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 52.0 | 1 | 0 | 125 | 212 | 0 | 1 | 168 | 0 | 1.0 | 2 | 2 | 3 |
| **1** | 53.0 | 1 | 0 | 140 | 203 | 1 | 0 | 155 | 1 | 3.1 | 0 | 0 | 3 |
| **2** | 70.0 | 1 | 0 | 145 | 174 | 0 | 1 | 125 | 1 | 2.6 | 0 | 0 | 3 |
| **3** | 61.0 | 1 | 0 | 148 | 203 | 0 | 1 | 161 | 0 | 0.0 | 2 | 1 | 3 |
| **4** | 62.0 | 0 | 0 | 138 | 294 | 1 | 1 | 106 | 0 | 1.9 | 1 | 3 | 2 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **1019** | 47.0 | 1 | 0 | 112 | 204 | 0 | 1 | 143 | 0 | 0.1 | 2 | 0 | 2 |
| **1020** | 59.0 | 1 | 1 | 140 | 221 | 0 | 1 | 164 | 1 | 0.0 | 2 | 0 | 2 |
| **1021** | 60.0 | 1 | 0 | 125 | 258 | 0 | 0 | 141 | 1 | 2.8 | 1 | 1 | 3 |
| **1022** | 47.0 | 1 | 0 | 110 | 275 | 0 | 0 | 118 | 1 | 1.0 | 1 | 1 | 2 |
| **1023** | 50.0 | 0 | 0 | 110 | 254 | 0 | 0 | 159 | 0 | 0.0 | 2 | 0 | 2 |

923 rows × 14 columns

In [33]:

```
from sklearn.metrics import accuracy_score

y_pred1 = mlp1.predict(X_test)
accuracy1 = accuracy_score(y_test, y_pred1)
print("Accuracy of MLP1:", accuracy1)

y_pred2 = mlp2.predict(X_test)
accuracy2 = accuracy_score(y_test, y_pred2)
print("Accuracy of MLP2:", accuracy2)
```

```
Accuracy of MLP1: 0.855595667870036
Accuracy of MLP2: 0.9422382671480144
```

In [ ]:

```

```