Data preprocessing and Model building

In [1]:
```
# import libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

In [2]:
```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report, roc_auc_score, roc_curve, prec
from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import roc_curve
```

In [3]:
```
import pickle
```

In [4]:
```
# Load dataset
data = pd.read_csv(r"D:\Unified mentor\bank+marketing\bank\bank-full.csv",sep=';')
data.head()
```

Out[4]:

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutco
0	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unkno
1	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unkno
2	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unkno
3	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unkno
4	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unkno

In [5]:
```
# Drop unnecessary columns
data.drop(columns=['duration'], inplace=True)
```

In [6]:
```
# Encode categorical variables
data = pd.get_dummies(data, drop_first=True)
data.head()
```

Out[6]:

	age	balance	day	campaign	pdays	previous	job_blue-collar	job_entrepreneur	job_housemaid	job_management	...	month_jun	month_mar
0	58	2143	5	1	-1	0	False	False	False	True	...	False	False
1	44	29	5	1	-1	0	False	False	False	False	...	False	False
2	33	2	5	1	-1	0	False	True	False	False	...	False	False
3	47	1506	5	1	-1	0	True	False	False	False	...	False	False
4	33	1	5	1	-1	0	False	False	False	False	...	False	False

5 rows × 42 columns

In [7]:
```
# Target encoding
data['y'] = data['y_yes'].map({True: 1, False: 0})
```

In [8]:
```
# Dropping the 'y_yes' column after encoding
data.drop(columns=['y_yes'], inplace=True)
data.head()
```

Out[8]:

	age	balance	day	campaign	pdays	previous	job_blue-collar	job_entrepreneur	job_housemaid	job_management	...	month_jun	month_mar
0	58	2143	5	1	-1	0	False	False	False	True	...	False	False
1	44	29	5	1	-1	0	False	False	False	False	...	False	False
2	33	2	5	1	-1	0	False	True	False	False	...	False	False
3	47	1506	5	1	-1	0	True	False	False	False	...	False	False
4	33	1	5	1	-1	0	False	False	False	False	...	False	False

5 rows × 42 columns

In [9]:

```
# Standardize numerical columns
scaler = StandardScaler()
data[['age', 'balance', 'day', 'campaign', 'pdays', 'previous']] = scaler.fit_transform(data[['age', 'balance', 'da
```

In [10]:

```
X = data.drop(columns = ['y'])
y = data['y']
```

In [11]:

```
# split data into features(X)and target(y)
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size = 0.2,random_state = 50)
```

In [12]:

```
# Initialize Models
models ={
    'Decision Tree':DecisionTreeClassifier(),
    'Logistic Regression':LogisticRegression(),
    'Random Forest':RandomForestClassifier(),
    'Naiv Bayes':GaussianNB(),
    'K-Nearest Neighbors':KNeighborsClassifier()
}
```

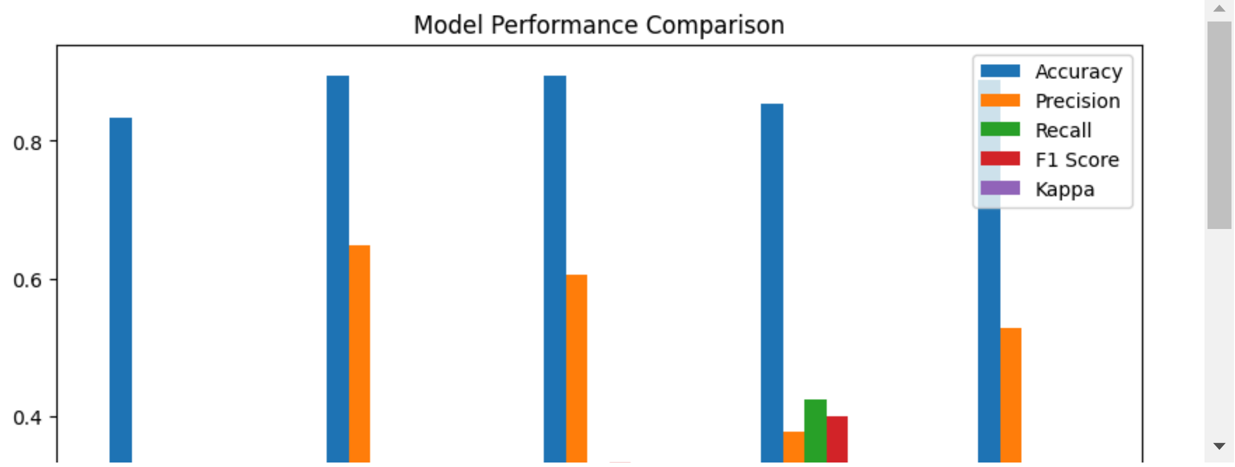
In [13]:

```
# Train models and evaluate
model_performance = {}

for model_name,model in models.items():
    #train model
    model.fit(X_train,y_train)
    #Predict on test set
    y_pred = model.predict(X_test)

    #Evaluate the model

    accuracy = accuracy_score(y_test, y_pred)
    precision = precision_score(y_test, y_pred)
    recall = recall_score(y_test, y_pred)
    f1 = f1_score(y_test, y_pred)
    kappa = cohen_kappa_score(y_test, y_pred)
    auc = roc_auc_score(y_test, model.predict_proba(X_test)[:, 1])

    #Store performance
    model_performance[model_name] = {
        'Accuracy': accuracy,
        'Precision': precision,
        'Recall': recall,
        'F1 Score': f1,
        'Kappa': kappa,
        'AUC': auc
    }

    # Print classification report and confusion matrix
    print(f"Model: {model_name}")
    print("Confusion Matrix:")
    print(confusion_matrix(y_test, y_pred))
    print("Classification Report:")
    print(classification_report(y_test, y_pred))
    print("="*60)
```

```
Model: Decision Tree
Confusion Matrix:
[[7203  802]
 [ 700  338]]
Classification Report:
              precision    recall  f1-score   support

           0       0.91      0.90      0.91      8005
           1       0.30      0.33      0.31      1038

    accuracy                           0.83      9043
   macro avg       0.60      0.61      0.61      9043
weighted avg       0.84      0.83      0.84      9043

============================================================
Model: Logistic Regression
Confusion Matrix:
[[7900  105]
 [ 845  193]]
Classification Report:
              precision    recall  f1-score   support

           0       0.90      0.99      0.94      8005
           1       0.65      0.19      0.29      1038

    accuracy                           0.89      9043
   macro avg       0.78      0.59      0.62      9043
weighted avg       0.87      0.89      0.87      9043

============================================================
Model: Random Forest
Confusion Matrix:
[[7850  155]
 [ 799  239]]
Classification Report:
              precision    recall  f1-score   support

           0       0.91      0.98      0.94      8005
           1       0.61      0.23      0.33      1038

    accuracy                           0.89      9043
   macro avg       0.76      0.61      0.64      9043
weighted avg       0.87      0.89      0.87      9043

============================================================
Model: Naiv Bayes
Confusion Matrix:
[[7282  723]
 [ 598  440]]
Classification Report:
              precision    recall  f1-score   support

           0       0.92      0.91      0.92      8005
           1       0.38      0.42      0.40      1038

    accuracy                           0.85      9043
   macro avg       0.65      0.67      0.66      9043
weighted avg       0.86      0.85      0.86      9043

============================================================
Model: K-Nearest Neighbors
Confusion Matrix:
[[7806  199]
 [ 815  223]]
Classification Report:
              precision    recall  f1-score   support

           0       0.91      0.98      0.94      8005
           1       0.53      0.21      0.31      1038

    accuracy                           0.89      9043
   macro avg       0.72      0.59      0.62      9043
weighted avg       0.86      0.89      0.87      9043

============================================================
```

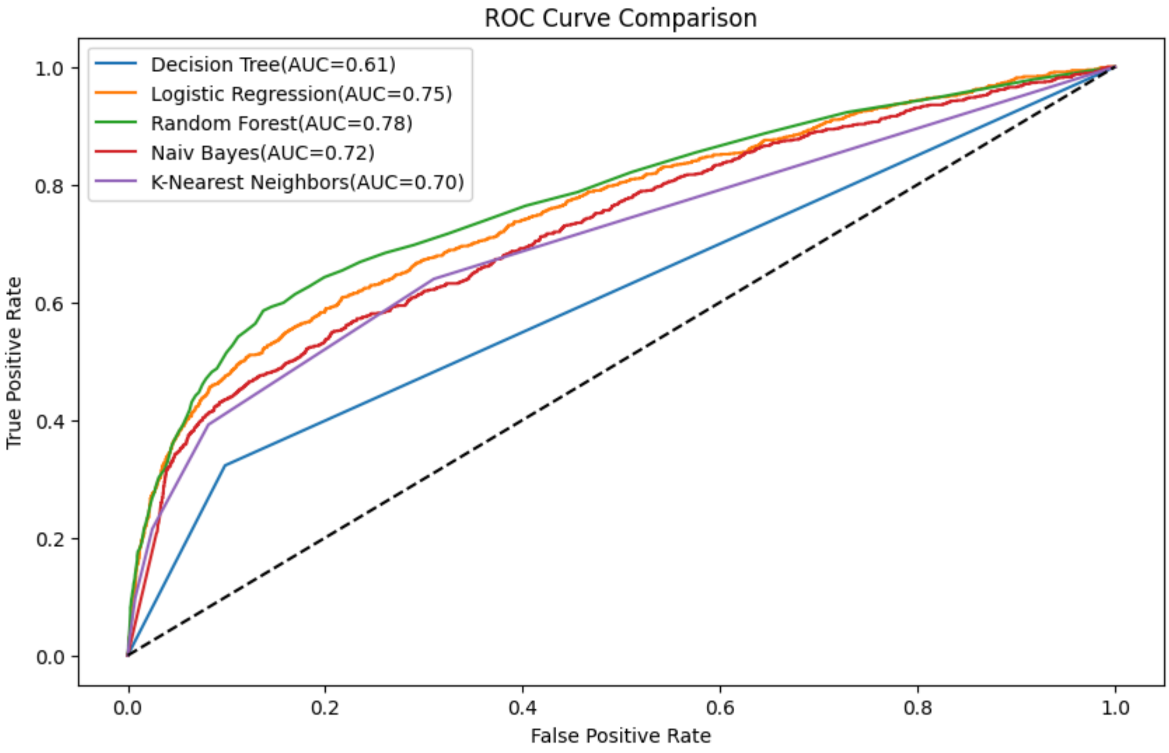
In [14]:

```
# Plot comparison of model performance
performance_df = pd.DataFrame(model_performance).T
performance_df[['Accuracy', 'Precision', 'Recall', 'F1 Score', 'Kappa']].plot(kind='bar', figsize=(10, 6))
plt.title('Model Performance Comparison')
plt.show()
```



In [15]:

```
plt.figure(figsize=(10,6))
for model_name,model in models.items():
    model.fit(X_train ,y_train)

    y_proba = model.predict_proba(X_test)[:,1]
    fpr,tpr, _= roc_curve(y_test,y_proba)
    plt.plot(fpr,tpr,label = f'{model_name}(AUC={model_performance[model_name]["AUC"]:.2f})')

# Additional settings for the plot
plt.plot([0, 1], [0, 1], 'k--')  # Diagonal line for reference
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve Comparison')
plt.legend(loc='best')
plt.show()
```



In [16]:

```
best_model = models['Random Forest']
with open('best_model.pkl','wb') as file:
    pickle.dump(best_model,file)
```

In [17]:

```
# Import necessary libraries
from flask import Flask, request, jsonify
```

In [ ]:

```python

# Load the trained model
model = pickle.load(open('best_model.pkl', 'rb'))

app = Flask(__name__)

@app.route('/')
def home():
    return "Welcome to the Prediction API!"

# Define the prediction route
@app.route('/predict', methods=['POST'])
def predict():
    try:
        # Get data from the request
        data = request.get_json(force=True)

        # Prepare input data (this is an example, make sure the keys match your JSON input)
        """input_data = np.array([data['age'],
                               data['job'],
                               data['marital'],
                               data['education'],
                               data['default'],
                               data['balance'],
                               data['housing'],
                               data['loan'],
                               data['contact'],
                               data['day'],
                               data['month'],
                               data['campaign'],
                               data['pdays'],
                               data['previous'],
                               data['poutcome']]).reshape(1, -1)"""
        # Convert input data to DataFrame
        input_data = pd.DataFrame([data])

        # Apply one-hot encoding similar to the training data
        input_data = pd.get_dummies(input_data, drop_first=True)

        # Ensure the same dummy columns
        missing_cols = set(X.columns) - set(input_data.columns)
        for col in missing_cols:
            input_data[col] = 0

        input_data = input_data[X.columns] # Reorder to match the training columns

        # Standardize numerical columns
        input_data[['age', 'balance', 'day', 'campaign', 'pdays', 'previous']] = scaler.transform(input_data[['age'

        # Preprocess the input data (apply any scaling or encoding used during training)
        # For example:
        # input_data = scaler.transform(input_data)  # if you used StandardScaler

        # Make prediction
        prediction = model.predict(input_data)

        # Return prediction as JSON
        return jsonify({'prediction': int(prediction[0])})

    except Exception as e:
        return jsonify({'error': str(e)}), 400

# Run the Flask app
if __name__ == '__main__':
    app.run(debug=True, use_reloader=False)
```

```
 * Serving Flask app '__main__'
 * Debug mode: on

WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server inst
ead.
 * Running on http://127.0.0.1:5000 (http://127.0.0.1:5000)
Press CTRL+C to quit
127.0.0.1 - - [18/Oct/2024 21:54:27] "GET / HTTP/1.1" 200 -
127.0.0.1 - - [18/Oct/2024 21:55:26] "POST /predict HTTP/1.1" 400 -
127.0.0.1 - - [19/Oct/2024 09:09:46] "POST /predict HTTP/1.1" 200 -
```

In [ ]:

```
# run this code in cmd
# curl -X POST http://127.0.0.1:5000/predict -H "Content-Type: application/json" -d "{\"age\": 30, \"job\": \"manag
```