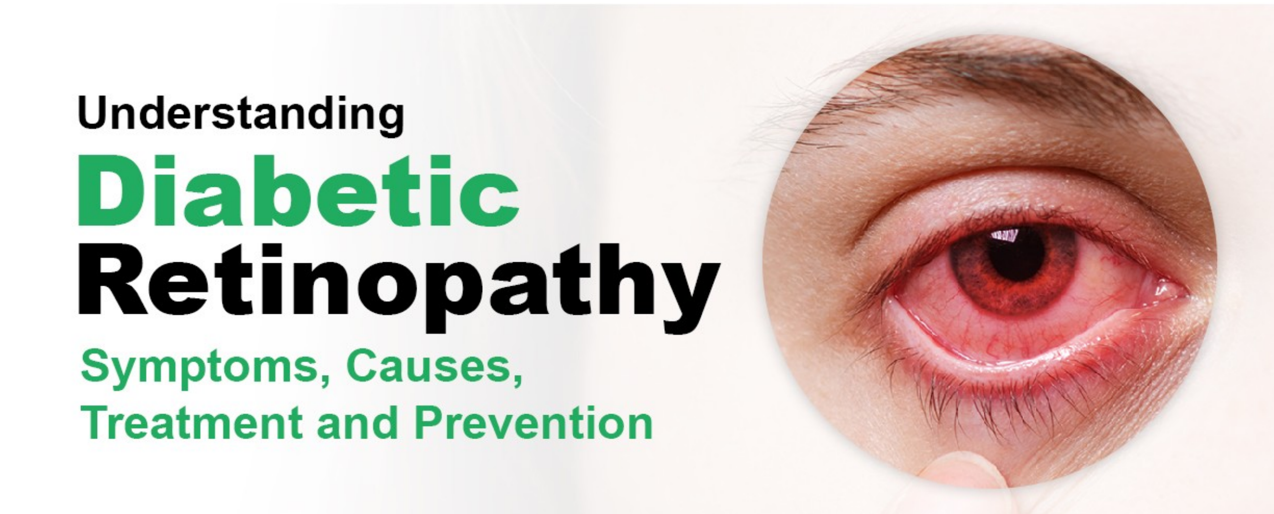
Retinopathy Disease Prediction using Machine Learning




```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

import warnings
warnings.filterwarnings('ignore')

df = pd.read_csv('retinopathy.csv')

df.head()
```

```
   Unnamed: 0        age  systolic_blood_pressure
diastolic_blood_pressure  \
0           0  77.196340                85.288742
80.021878
1           1  63.529850                99.379736
84.852361
2           2  69.003986               111.349455
109.850616
3           3  82.638210                95.056128
79.666851
4           4  78.346286               109.154591
90.713220

   cholesterol  has_retinopathy
0    79.957109                1
1   110.382411                1
```

```
2   100.828246                1
3    87.066303                1
4    92.511770                1
```

```
df.tail()
```

```
      Unnamed: 0        age  systolic_blood_pressure  \
5995        5995  49.611850                94.857639
5996        5996  63.099686               100.039527
5997        5997  55.562243                98.421446
5998        5998  63.468956               106.809289
5999        5999  62.506825                96.900784

      diastolic_blood_pressure  cholesterol  has_retinopathy
5995                 86.615671   107.643986                0
5996                 93.515186   104.971404                1
5997                102.697875   120.875951                1
5998                 88.060631   106.052213                1
5999                 86.878033   108.625436                0
```

```
df = df.drop('Unnamed: 0', axis = 1)
```

```
df.shape
```

```
(6000, 5)
```

```
df.columns
```

```
Index(['age', 'systolic_blood_pressure', 'diastolic_blood_pressure',
       'cholesterol', 'has_retinopathy'],
      dtype='object')
```

1. Data Overview

- **Features**:
  - **Age**: Continuous variable representing the age of the patient.
  - **Systolic Blood Pressure**: Continuous variable for the pressure in the arteries when the heart beats.
  - **Diastolic Blood Pressure**: Continuous variable for the pressure in the arteries when the heart rests between beats.
  - **Cholesterol**: Continuous variable for the cholesterol level.
- **Target**:
  - **Has Retinopathy**: Binary variable indicating the presence (1) or absence (0) of retinopathy.

```
df.duplicated().sum()
```

```
0
```

```
df.isnull().sum()
```

```
age                         0
systolic_blood_pressure     0
diastolic_blood_pressure    0
cholesterol                 0
has_retinopathy             0
dtype: int64
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6000 entries, 0 to 5999
Data columns (total 5 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   age                       6000 non-null   float64
 1   systolic_blood_pressure   6000 non-null   float64
 2   diastolic_blood_pressure  6000 non-null   float64
 3   cholesterol               6000 non-null   float64
 4   has_retinopathy           6000 non-null   int64  
dtypes: float64(4), int64(1)
memory usage: 234.5 KB
```

```
df.describe()
```

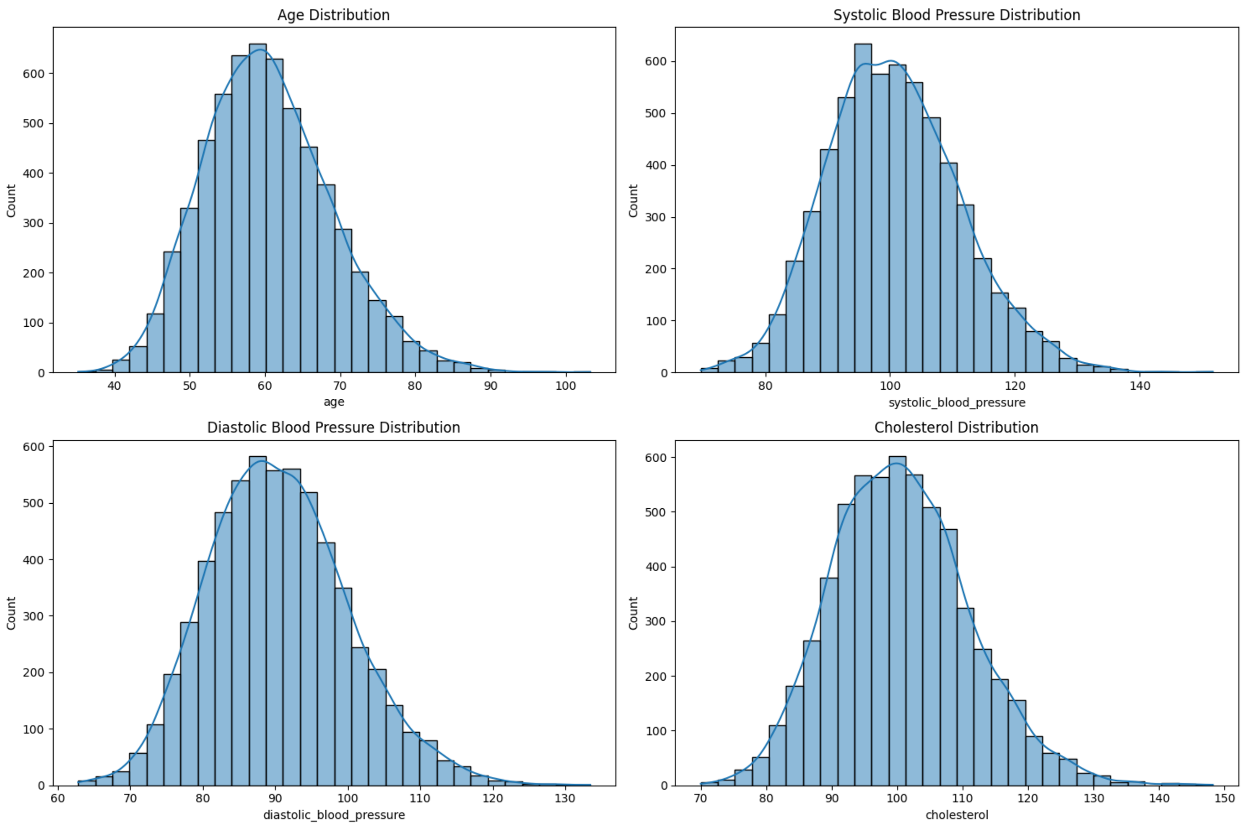
```
               age  systolic_blood_pressure  diastolic_blood_pressure  
\
count  6000.000000              6000.000000               6000.000000   

mean     60.464121               100.694822                 90.505547   

std       8.564392                10.669267                  9.648200   

min      35.164761                69.675429                 62.807105   

25%      54.371941                93.267420                 83.641788   

50%      59.831159               100.119926                 89.912429   

75%      65.809652               107.439501                 96.682405   

max     103.279497               151.699660                133.456382   


       cholesterol  has_retinopathy  
count  6000.000000      6000.000000  
mean    100.628255         0.514500  
std      10.433915         0.499831  
min      69.967453         0.000000  
25%      93.202373         0.000000  
50%     100.060637         1.000000  
```

```
75%      107.250829          1.000000
max      148.233544          1.000000
```

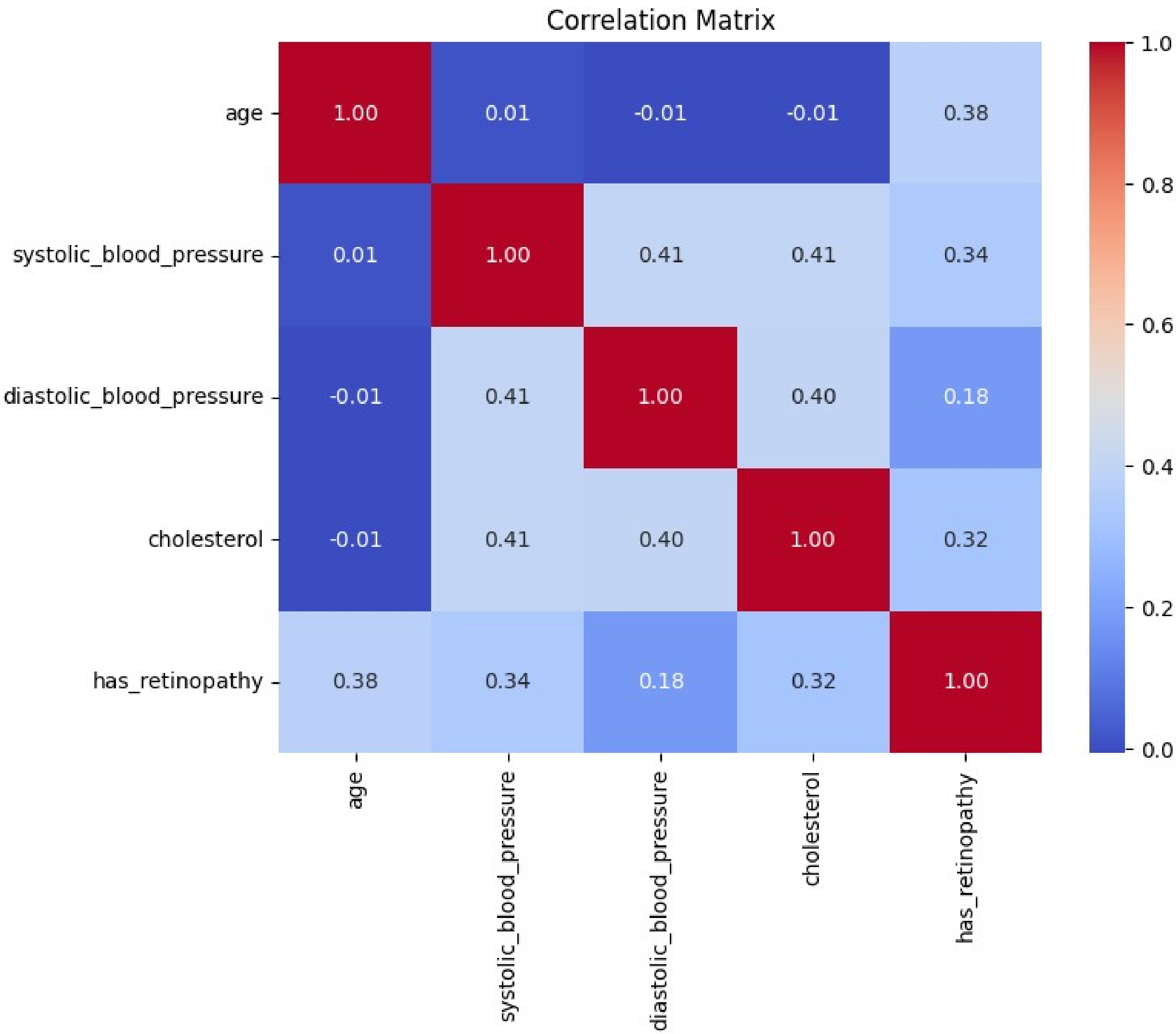
```
df.nunique()
```

```
age                           6000
systolic_blood_pressure       6000
diastolic_blood_pressure      6000
cholesterol                   6000
has_retinopathy                  2
dtype: int64
```

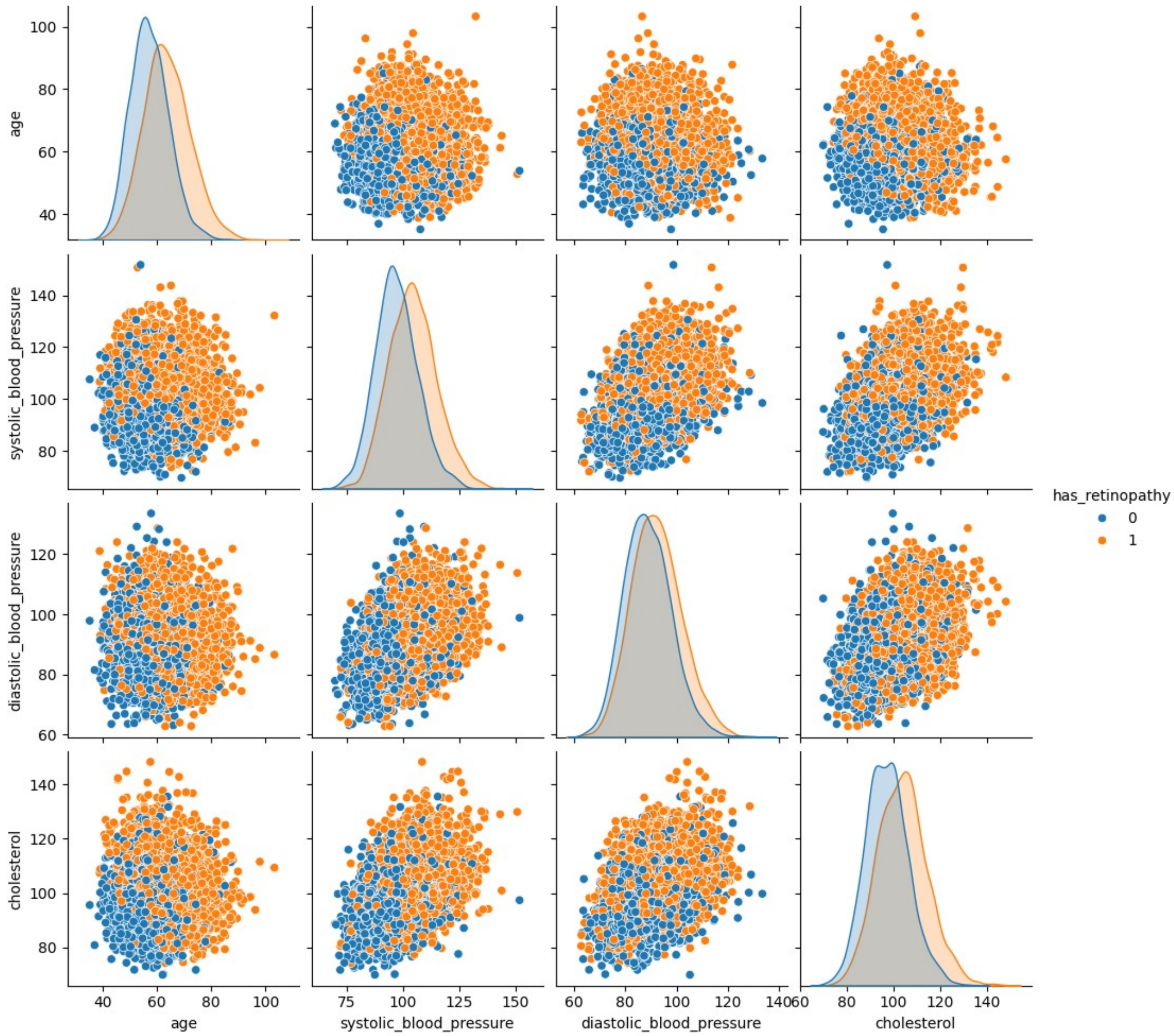
```
fig, axes = plt.subplots(2, 2, figsize=(15, 10))

sns.histplot(df['age'], bins=30, kde=True, ax=axes[0, 0])
axes[0, 0].set_title('Age Distribution')

sns.histplot(df['systolic_blood_pressure'], bins=30, kde=True,
ax=axes[0, 1])
axes[0, 1].set_title('Systolic Blood Pressure Distribution')

sns.histplot(df['diastolic_blood_pressure'], bins=30, kde=True,
ax=axes[1, 0])
axes[1, 0].set_title('Diastolic Blood Pressure Distribution')

sns.histplot(df['cholesterol'], bins=30, kde=True, ax=axes[1, 1])
axes[1, 1].set_title('Cholesterol Distribution')

plt.tight_layout()
plt.show()
```




```
corr = df.corr()

plt.figure(figsize=(8, 6))
sns.heatmap(corr, annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Matrix')
plt.show()
```

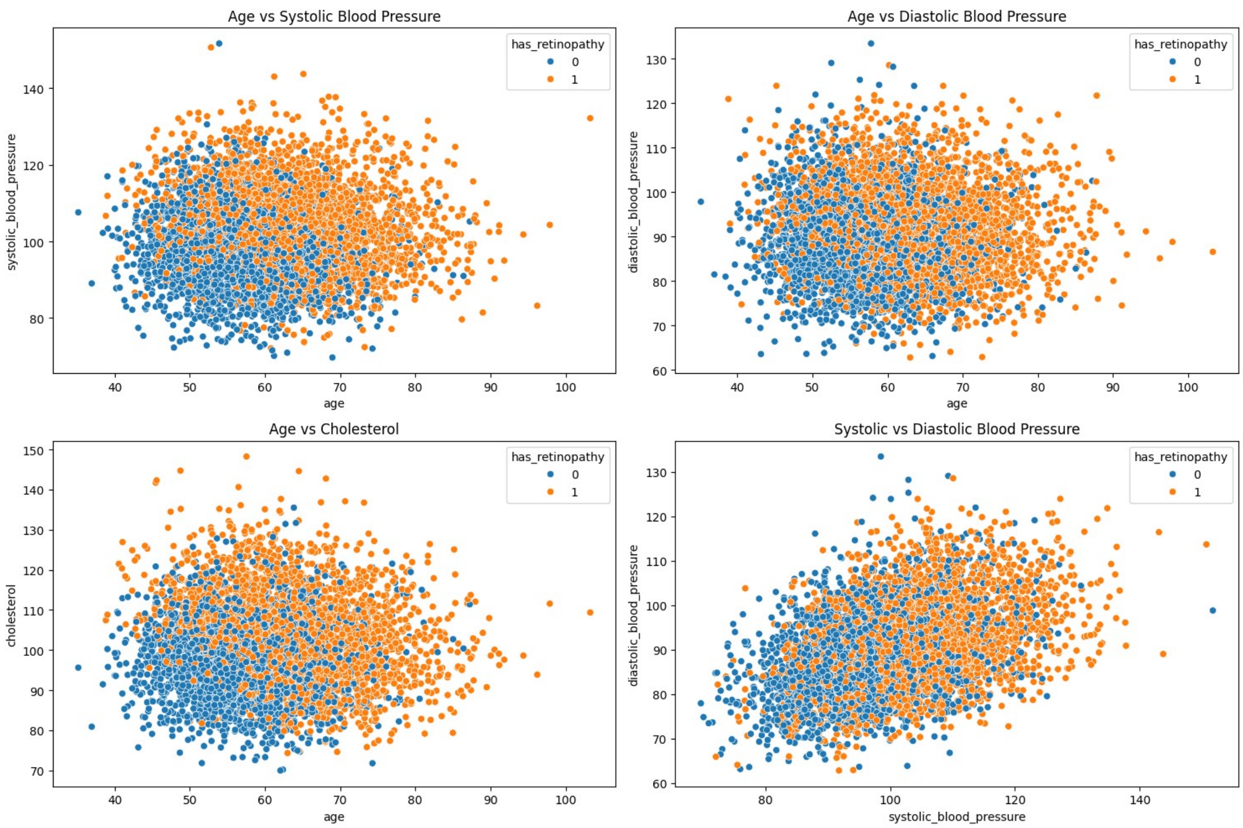



```
sns.pairplot(df, hue='has_retinopathy')
plt.show()
```

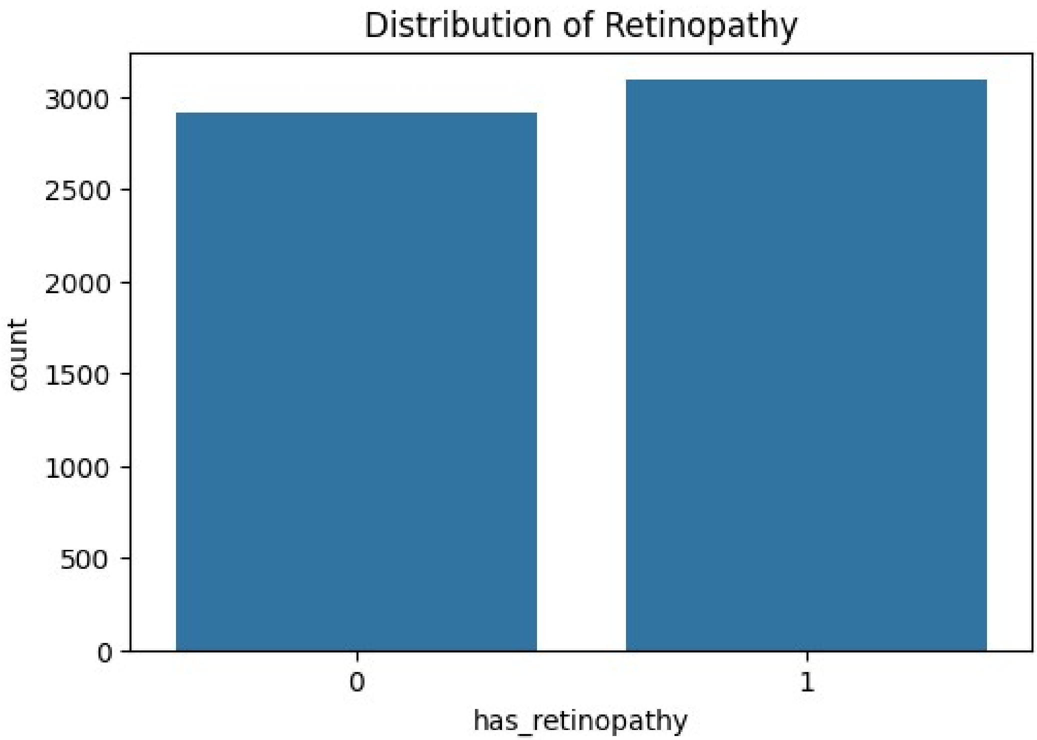



```
fig, axes = plt.subplots(2, 2, figsize=(15, 10))

sns.scatterplot(x='age', y='systolic_blood_pressure',
hue='has_retinopathy', data=df, ax=axes[0, 0])
axes[0, 0].set_title('Age vs Systolic Blood Pressure')

sns.scatterplot(x='age', y='diastolic_blood_pressure',
hue='has_retinopathy', data=df, ax=axes[0, 1])
axes[0, 1].set_title('Age vs Diastolic Blood Pressure')

sns.scatterplot(x='age', y='cholesterol', hue='has_retinopathy',
data=df, ax=axes[1, 0])
axes[1, 0].set_title('Age vs Cholesterol')

sns.scatterplot(x='systolic_blood_pressure',
y='diastolic_blood_pressure', hue='has_retinopathy', data=df,
ax=axes[1, 1])
```

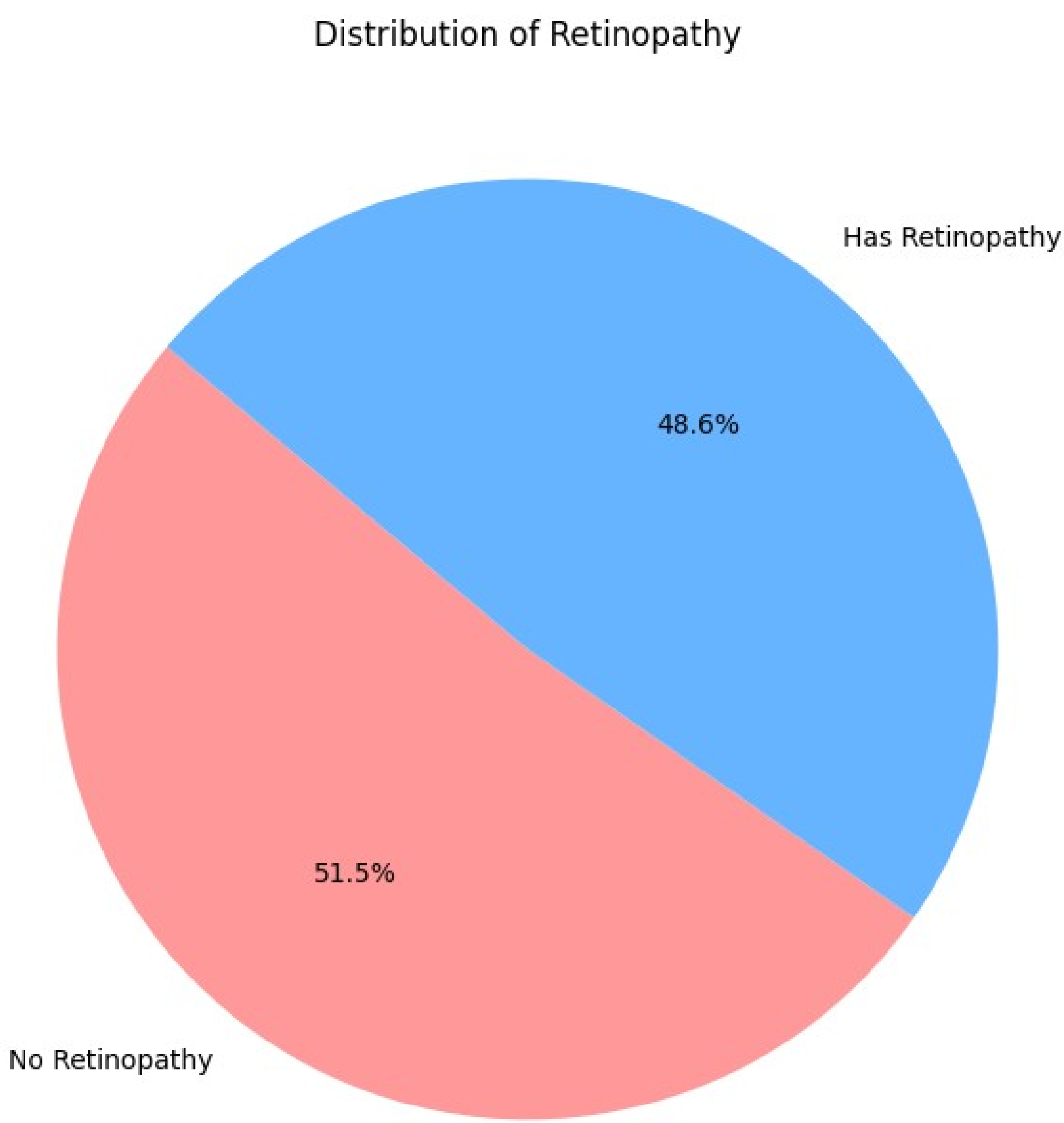
```
axes[1, 1].set_title('Systolic vs Diastolic Blood Pressure')

plt.tight_layout()
plt.show()
```




```
plt.figure(figsize=(6, 4))
sns.countplot(x='has_retinopathy', data=df)
plt.title('Distribution of Retinopathy')
plt.show()
```




```
retinopathy_counts = df['has_retinopathy'].value_counts()

labels = ['No Retinopathy', 'Has Retinopathy']
colors = ['#ff9999','#66b3ff']

plt.figure(figsize=(8, 8))
plt.pie(retinopathy_counts, labels=labels, colors=colors,
autopct='%1.1f%%', startangle=140)
plt.title('Distribution of Retinopathy')
plt.show()
```



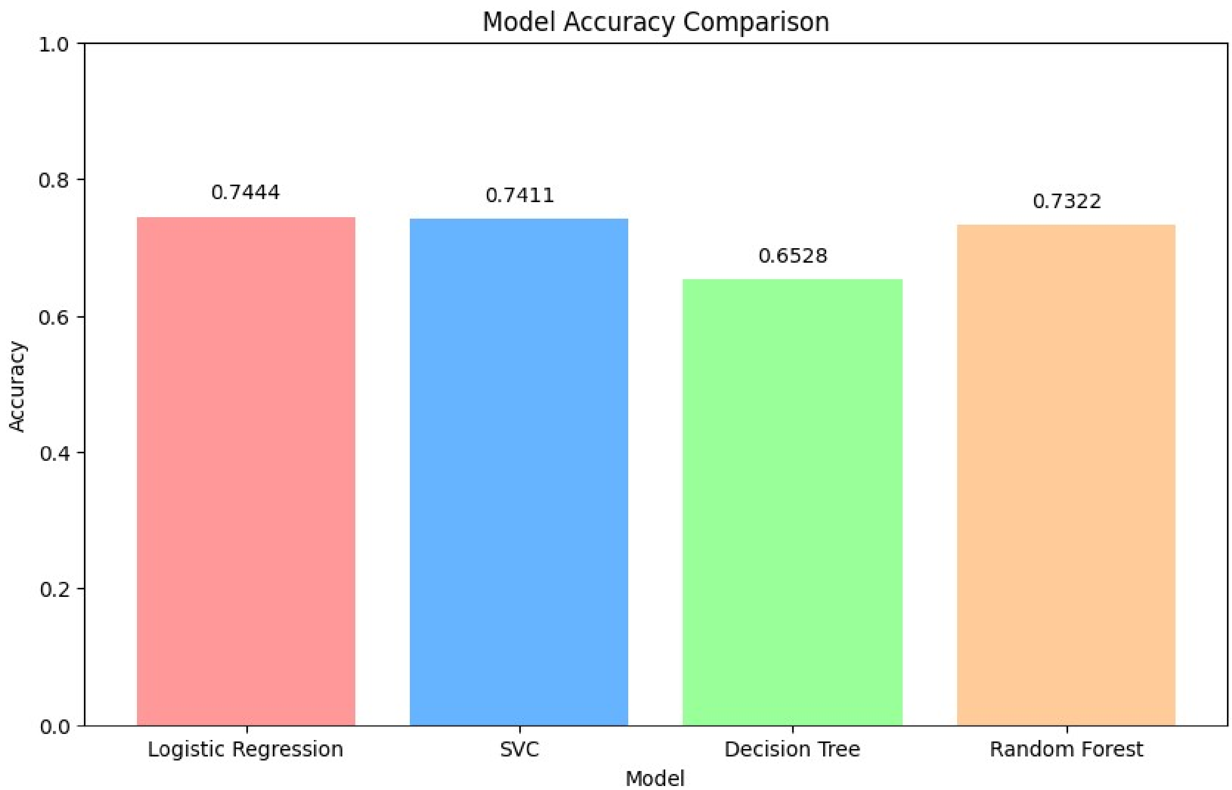

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

X = df[['age', 'systolic_blood_pressure', 'diastolic_blood_pressure',
'cholesterol']]
y = df['has_retinopathy']
```

```python
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3, random_state=42)

scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

log_reg = LogisticRegression()
log_reg.fit(X_train_scaled, y_train)
y_pred_log_reg = log_reg.predict(X_test_scaled)
accuracy_log_reg = accuracy_score(y_test, y_pred_log_reg)

svc = SVC()
svc.fit(X_train_scaled, y_train)
y_pred_svc = svc.predict(X_test_scaled)
accuracy_svc = accuracy_score(y_test, y_pred_svc)

dt = DecisionTreeClassifier()
dt.fit(X_train, y_train)
y_pred_dt = dt.predict(X_test)
accuracy_dt = accuracy_score(y_test, y_pred_dt)

rf = RandomForestClassifier()
rf.fit(X_train, y_train)
y_pred_rf = rf.predict(X_test)
accuracy_rf = accuracy_score(y_test, y_pred_rf)

print(f"Logistic Regression Accuracy: {accuracy_log_reg:.4f}")
print(f"SVC Accuracy: {accuracy_svc:.4f}")
print(f"Decision Tree Accuracy: {accuracy_dt:.4f}")
print(f"Random Forest Accuracy: {accuracy_rf:.4f}")
```

```
Logistic Regression Accuracy: 0.7444
SVC Accuracy: 0.7411
Decision Tree Accuracy: 0.6528
Random Forest Accuracy: 0.7322
```

```python
# Define the accuracy scores
accuracies = {
    'Logistic Regression': accuracy_log_reg,
    'SVC': accuracy_svc,
    'Decision Tree': accuracy_dt,
    'Random Forest': accuracy_rf
}

plt.figure(figsize=(10, 6))
bars = plt.bar(accuracies.keys(), accuracies.values(),
color=['#ff9999', '#66b3ff', '#99ff99', '#ffcc99'])
plt.xlabel('Model')
plt.ylabel('Accuracy')
plt.title('Model Accuracy Comparison')
```

```
plt.ylim(0, 1)

for bar in bars:
    yval = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, yval + 0.02,
f'{yval:.4f}', ha='center', va='bottom')

plt.show()
```



Thanks !!!