```
# ==============================
# 1. Libraries
# ==============================
import numpy as np
import pandas as pd

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classifica

# ==============================
# 2. Synthetic HR Dataset
# ==============================
np.random.seed(42)
n = 2000

df = pd.DataFrame({
    "age": np.random.randint(21, 60, n),
    "experience_years": np.random.randint(0, 20, n),
    "attendance_rate": np.clip(np.random.normal(0.9, 0
    "training_score": np.clip(np.random.normal(70, 10,
    "engagement_score": np.clip(np.random.normal(75, 1
    "num_warnings_issued": np.random.choice([0,1,2,3],
    "department": np.random.choice(
        ["Operations", "HR", "Finance", "Tech", "Suppo
    )
})

# ==============================
# 3. Performance Label Creation
# ==============================
latent_score = (
    0.3 * df["attendance_rate"] * 100 +
    0.25 * df["training_score"] +
    0.2 * df["engagement_score"] -
    5 * df["num_warnings_issued"]
)
```

```
)

df["performance_label"] = pd.qcut(
    latent_score,
    q=[0, 0.4, 0.75, 1.0],
    labels=["Low", "Average", "High"]
)

# ==============================
# 4. Preprocessing
# ==============================
dept_encoder = LabelEncoder()
df["department"] = dept_encoder.fit_transform(df["depa

X = df.drop("performance_label", axis=1)
y = df["performance_label"]

# ==============================
# 5. Train-Test Split
# ==============================
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.2, random_state=42
)

# ==============================
# 6. Model Training (ML Core)
# ==============================
rf_model = RandomForestClassifier(
    n_estimators=100,
    random_state=42
)

rf_model.fit(X_train, y_train)

# ==============================
# 7. Model Evaluation
# ==============================
y_pred = rf_model.predict(X_test)
```

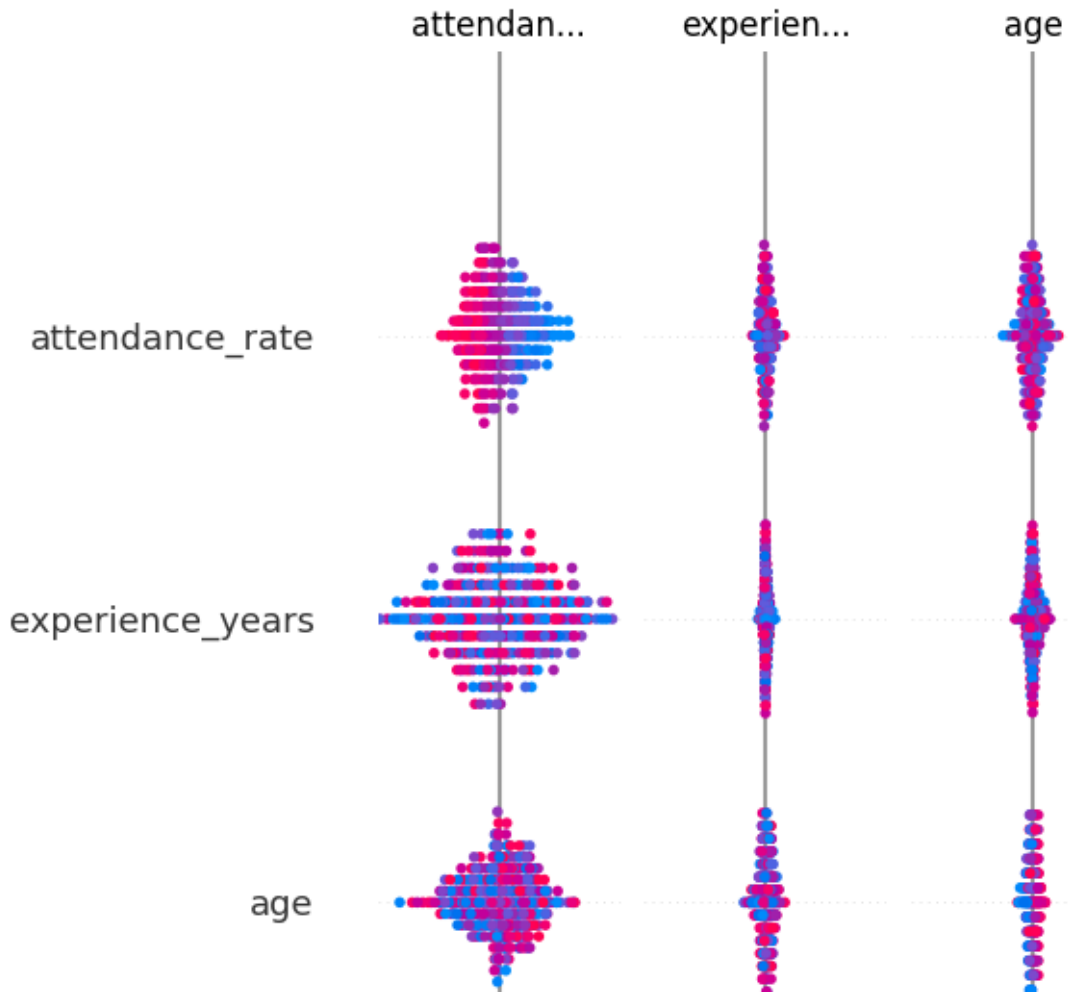
```
print("Accuracy:", accuracy_score(y_test, y_pred))
print("\nClassification Report:\n")
print(classification_report(y_test, y_pred))
print("\nConfusion Matrix:\n")
print(confusion_matrix(y_test, y_pred))

# ================================
# 8. Sample Case Prediction (FINAL DEMO PART)
# ================================
sample_employee = pd.DataFrame({
    "age": [34],
    "experience_years": [7],
    "attendance_rate": [0.94],
    "training_score": [78],
    "engagement_score": [82],
    "num_warnings_issued": [0],
    "department": dept_encoder.transform(["Operations"
})

sample_prediction = rf_model.predict(sample_employee)

print("\nPredicted Performance for Sample Employee:",
```

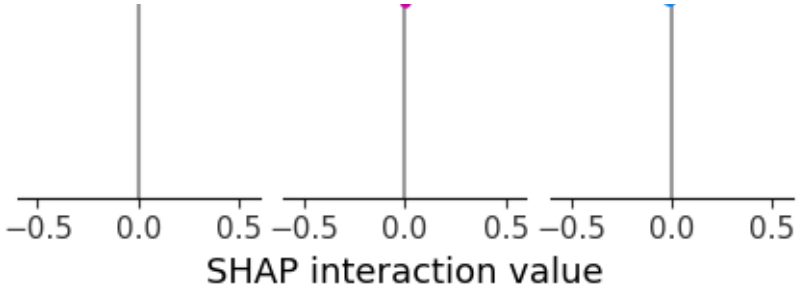
```
Accuracy: 0.92

Classification Report:

              precision    recall  f1-score   support

     Average       0.85      0.94      0.89       141
        High       0.96      0.91      0.93        93
         Low       0.97      0.91      0.94       166

    accuracy                           0.92       400
   macro avg       0.92      0.92      0.92       400
weighted avg       0.92      0.92      0.92       400


Confusion Matrix:

[[132   4   5]
 [  8  85   0]
 [ 15   0 151]]
```

```
Predicted Performance for Sample Employee: High
```

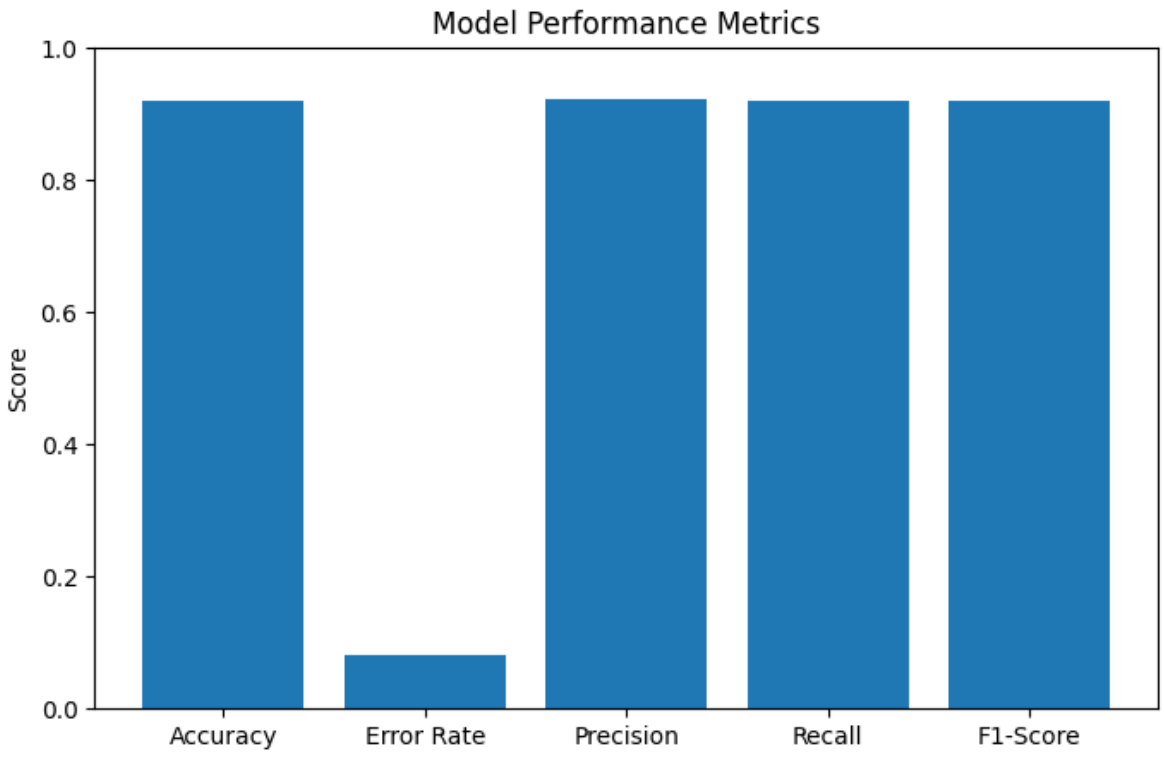
```
import shap

# Create SHAP explainer
explainer = shap.TreeExplainer(model)

# Calculate SHAP values
shap_values = explainer.shap_values(X_test)

# Global feature importance plot
shap.summary_plot(shap_values, X_test)
```

```
/tmp/ipython-input-3036699843.py:10: FutureWarning: The NumPy global RNG was
  shap.summary_plot(shap_values, X_test)
/usr/local/lib/python3.12/dist-packages/shap/plots/_beeswarm.py:723: FutureWa
  summary_legacy(
/usr/local/lib/python3.12/dist-packages/shap/plots/_beeswarm.py:743: FutureWa
  summary_legacy(
/usr/local/lib/python3.12/dist-packages/shap/plots/_beeswarm.py:743: FutureWa
  summary_legacy(
```






```
import matplotlib.pyplot as plt

plt.figure(figsize=(8, 5))
plt.bar(metrics_df["Metric"], metrics_df["Value"])
plt.title("Model Performance Metrics")
plt.ylabel("Score")
plt.ylim(0, 1)
plt.show()
```



Start coding or generate with AI.