LAPORAN PERTEMUAN 7

Artificial Neural Network

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Pendahuluan

Pada pertemuan ini dilakukan percobaan penerapan Artificial Neural Network (ANN) dalam memprediksi kelulusan mahasiswa berdasarkan beberapa faktor seperti IPK, jumlah absensi, dan waktu belajar per minggu.

Tahapan yang dilakukan:

- Load dan preprocessing dataset
- Pembagian data menjadi Train, Validation, Test
- Standarisasi fitur
- Pembuatan model ANN dengan TensorFlow Keras
- Early Stopping untuk mencegah overfitting
- Evaluasi menggunakan Accuracy, AUC, Confusion Matrix, dan Classification Report
- Visualisasi Learning Curve

Tujuan akhir:
Model ANN mampu memprediksi status kelulusan mahasiswa dengan akurat.

Langkah 1 – Load Dataset

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

# === 1. Load dataset ===
df = pd.read_csv("processed_kelulusan.csv")
X = df.drop("Lulus", axis=1)
y = df["Lulus"]
```

Langkah 2 – Pembagian Data (Train, Val, Test)

```
X_train, X_temp, y_train, y_temp = train_test_split(
    X, y, test_size=0.4, stratify=y, random_state=42
)

X_val, X_test, y_val, y_test = train_test_split(
    X_temp, y_temp, test_size=0.5, stratify=y_temp, random_state=42
)

print("Train:", X_train.shape, "Val:", X_val.shape, "Test:", X_test.shape)
```

Penjelasan: Data dibagi 60% train, 20% val, 20% test.

Langkah 3 – Standardisasi Data

```
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_val = sc.transform(X_val)
X_test = sc.transform(X_test)
```

Data dinormalisasi agar semua fitur berada pada skala yang sama.

Langkah 4 – Membangun Model Artificial Neural Network

```
import tensorflow as tf
from tensorflow.keras import layers, callbacks

model = tf.keras.Sequential([
    layers.Input(shape=(X_train.shape[1],)),
    layers.Dense(32, activation="relu"),
    layers.Dropout(0.3),
    layers.Dense(16, activation="relu"),
    layers.Dense(1, activation="sigmoid")
])

model.compile(
    optimizer=tf.keras.optimizers.Adam(1e-3),
    loss="binary_crossentropy",
    metrics=["accuracy", "AUC"]
)

model.summary()
```

penjelasan:

- `relu` → mempercepat pembelajaran
- `sigmoid` → karena output hanya 0/1 (lulus atau tidak)
- `Dropout(0.3)` → mencegah overfitting

Langkah 5 – Early Stopping

```
es = callbacks.EarlyStopping(
    monitor="val_loss", patience=10, restore_best_weights=True
)
```

Model otomatis berhenti jika tidak ada peningkatan.

Langkah 6 – Training Model

```
history = model.fit(
    X_train, y_train,
    validation_data=(X_val, y_val),
    epochs=100,
    batch_size=16,
    callbacks=[es],
    verbose=1
)
```

Langkah 7 – Evaluasi Model

```
# === 7. Evaluasi ===
from sklearn.metrics import classification_report, confusion_matrix

loss, acc, auc = model.evaluate(X_test, y_test, verbose=0)
print("\nTest Accuracy:", acc)
print("Test AUC:", auc)

y_proba = model.predict(X_test).ravel()
y_pred = (y_proba >= 0.5).astype(int)

print("\nConfusion Matrix:")
print(confusion_matrix(y_test, y_pred))

print("\nClassification Report:")
print(classification_report(y_test, y_pred, digits=3))
```

AUC digunakan untuk melihat kemampuan model membedakan kelas.

Langkah 8 – Visualisasi Learning Curve

```python
# === 8. Visualisasi Learning Curve ===
import matplotlib.pyplot as plt

plt.plot(history.history["loss"], label="Train Loss")
plt.plot(history.history["val_loss"], label="Val Loss")
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.legend()
plt.title("Learning Curve")
plt.tight_layout()
plt.savefig("learning_curve_fixed.png", dpi=120)
plt.show()
```

digunakan untuk melihat apakah model mengalami overfitting.

HASIL OUTPUT PROGRAM

```
Train: (6, 5) Val: (2, 5) Test: (2, 5)
```

Model: "sequential_4"

Layer (type)	Output Shape	Param #
dense_12 (Dense)	(None, 32)	192
dropout_4 (Dropout)	(None, 32)	0
dense_13 (Dense)	(None, 16)	528
dense_14 (Dense)	(None, 1)	17

Total params: 737 (2.88 KB)

Trainable params: 737 (2.88 KB)

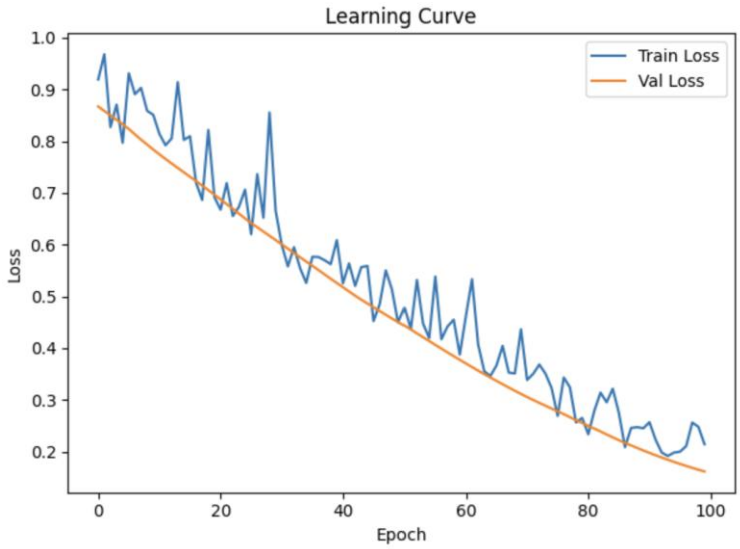
Non-trainable params: 0 (0.00 B)

```
Confusion Matrix:
[[1 0]
 [0 1]]

Classification Report:
              precision    recall  f1-score   support

           0      1.000     1.000     1.000         1
           1      1.000     1.000     1.000         1

    accuracy                         1.000         2
   macro avg      1.000     1.000     1.000         2
weighted avg      1.000     1.000     1.000         2
```


Learning Curve
Train Loss
Val Loss
Loss
Epoch
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
20
40
60
80
100