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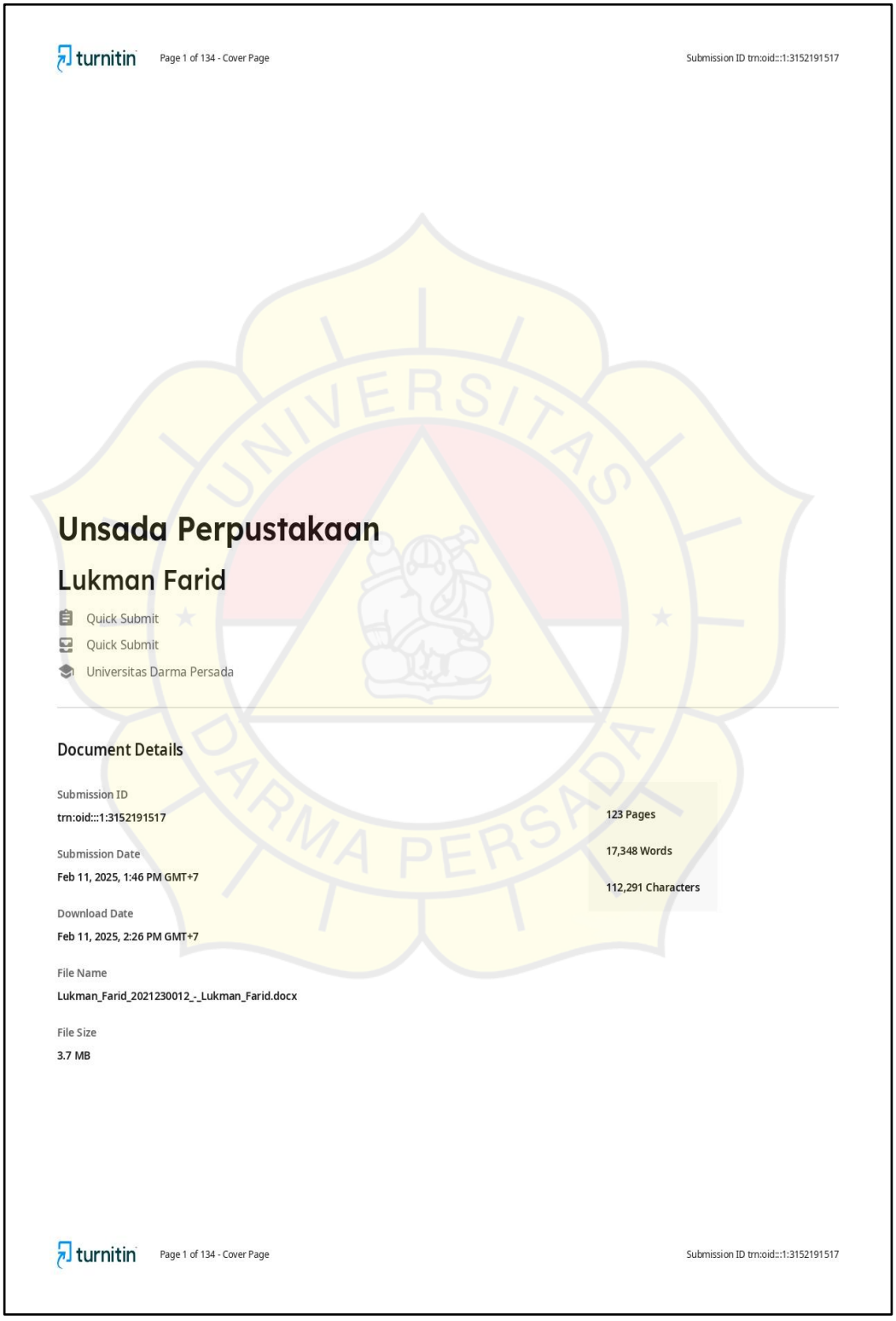

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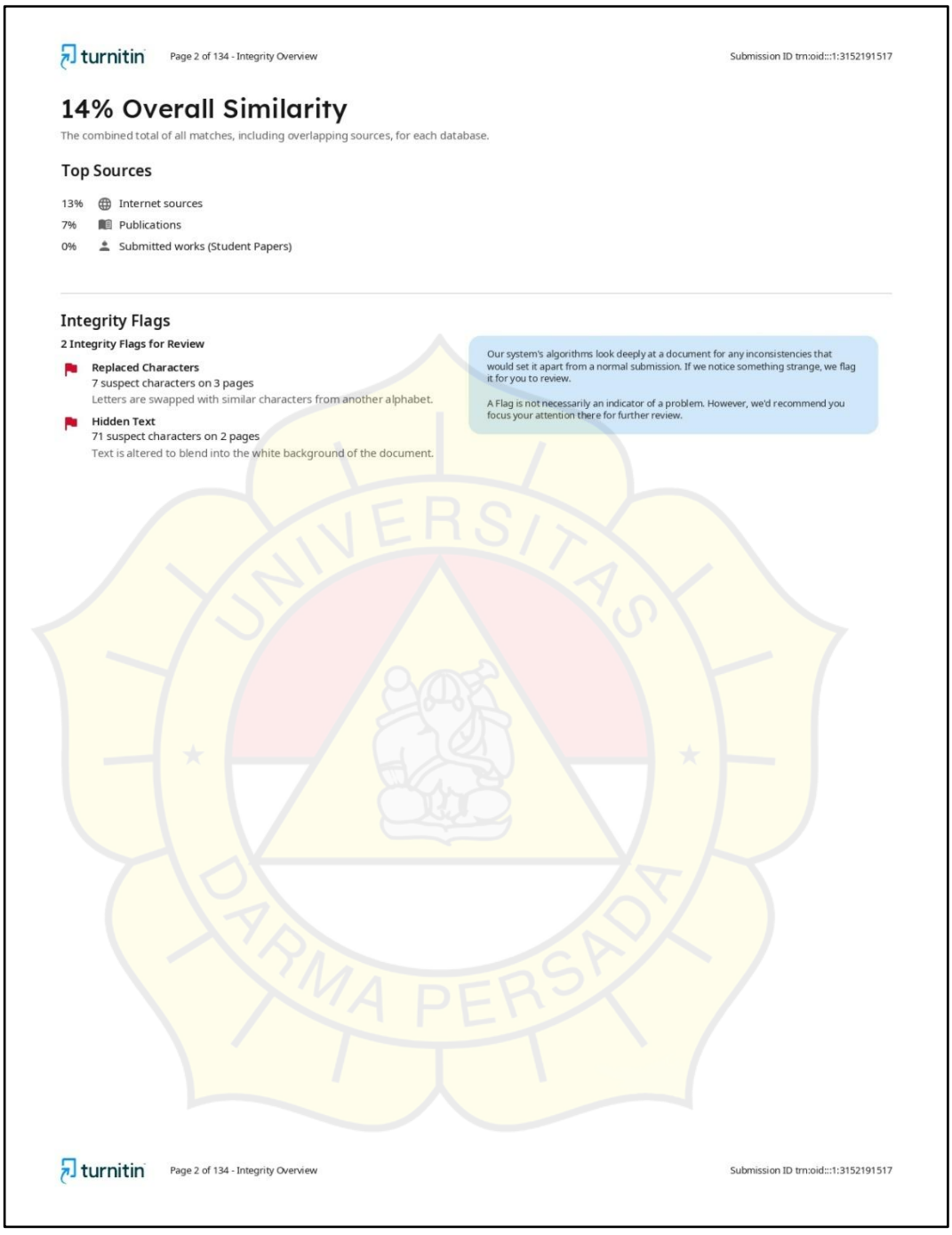
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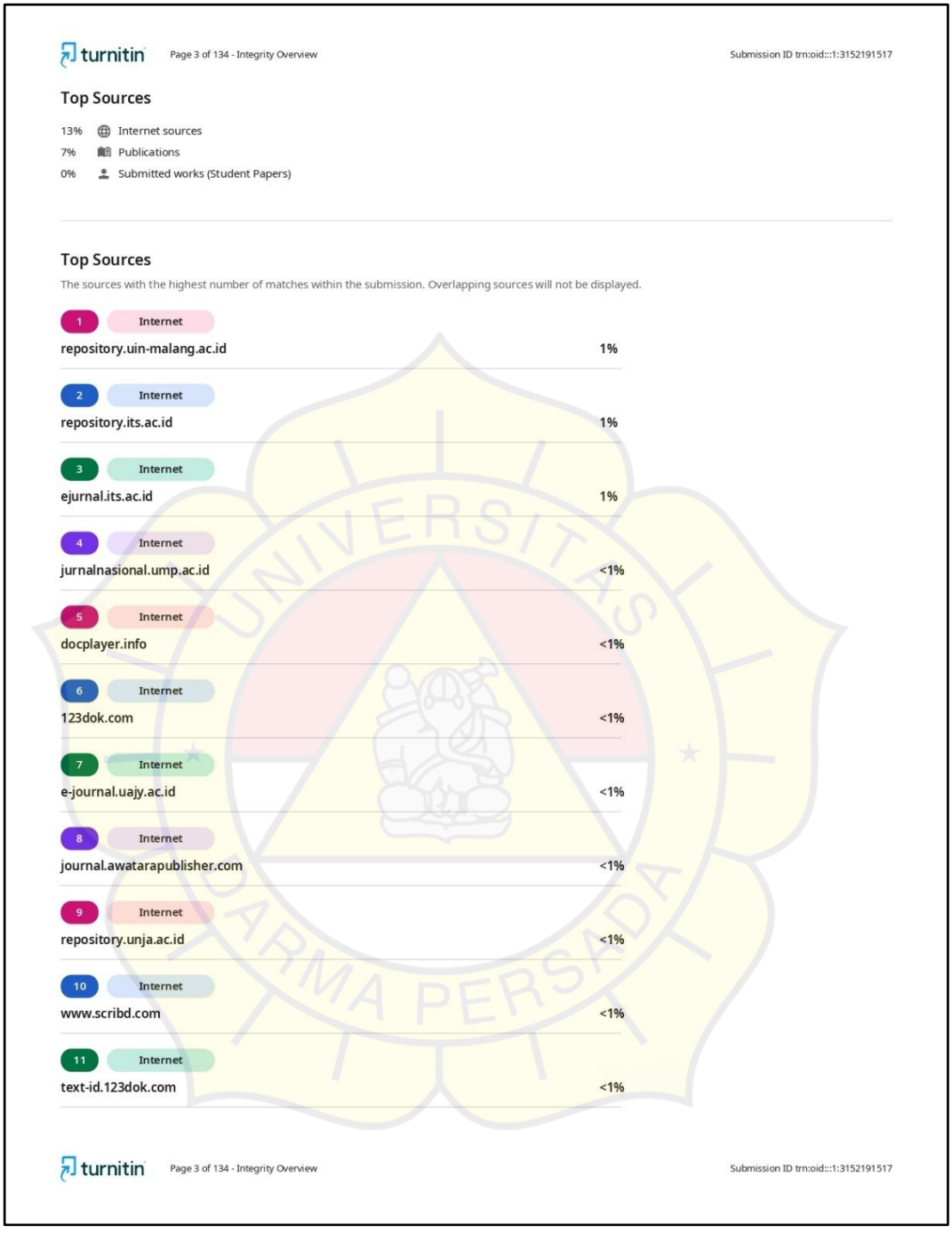

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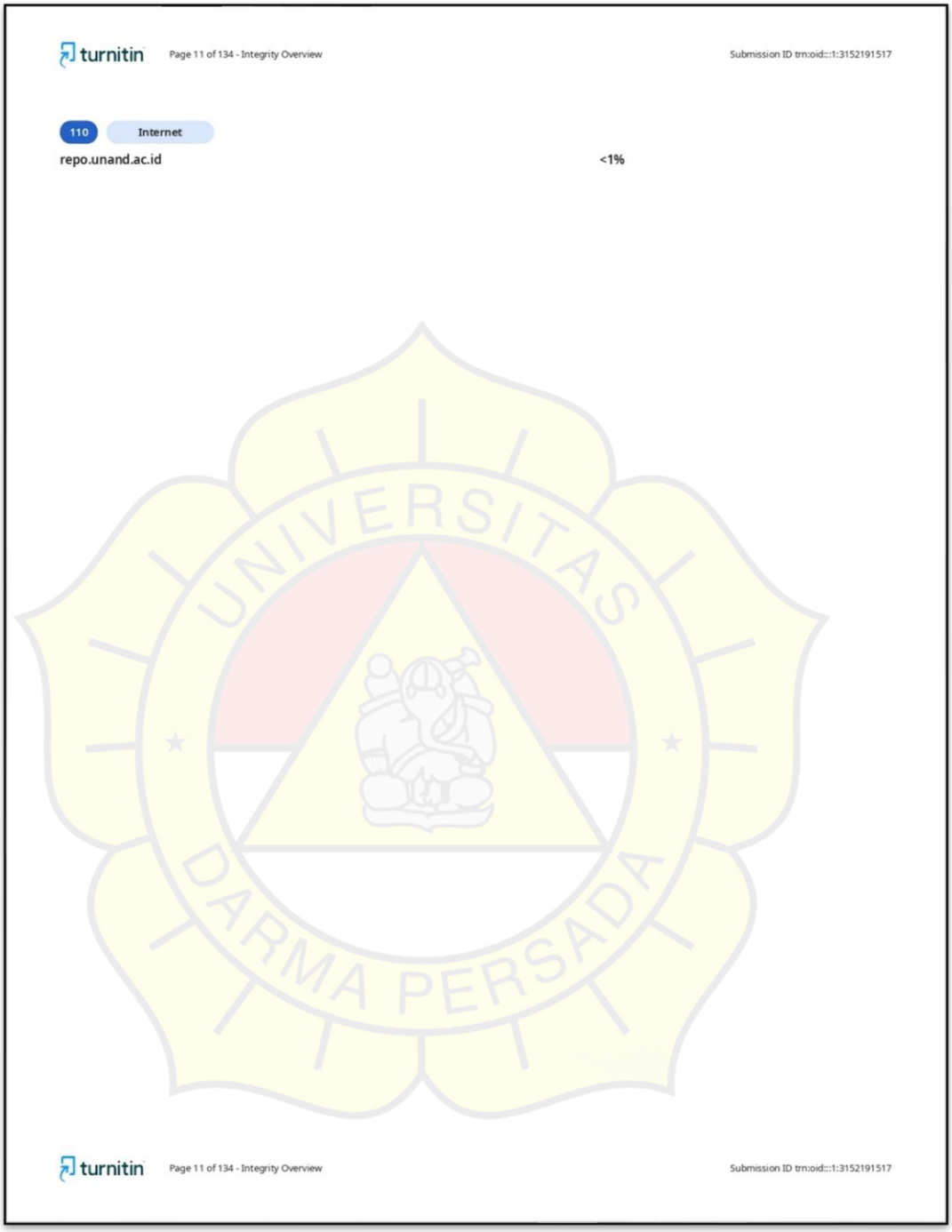
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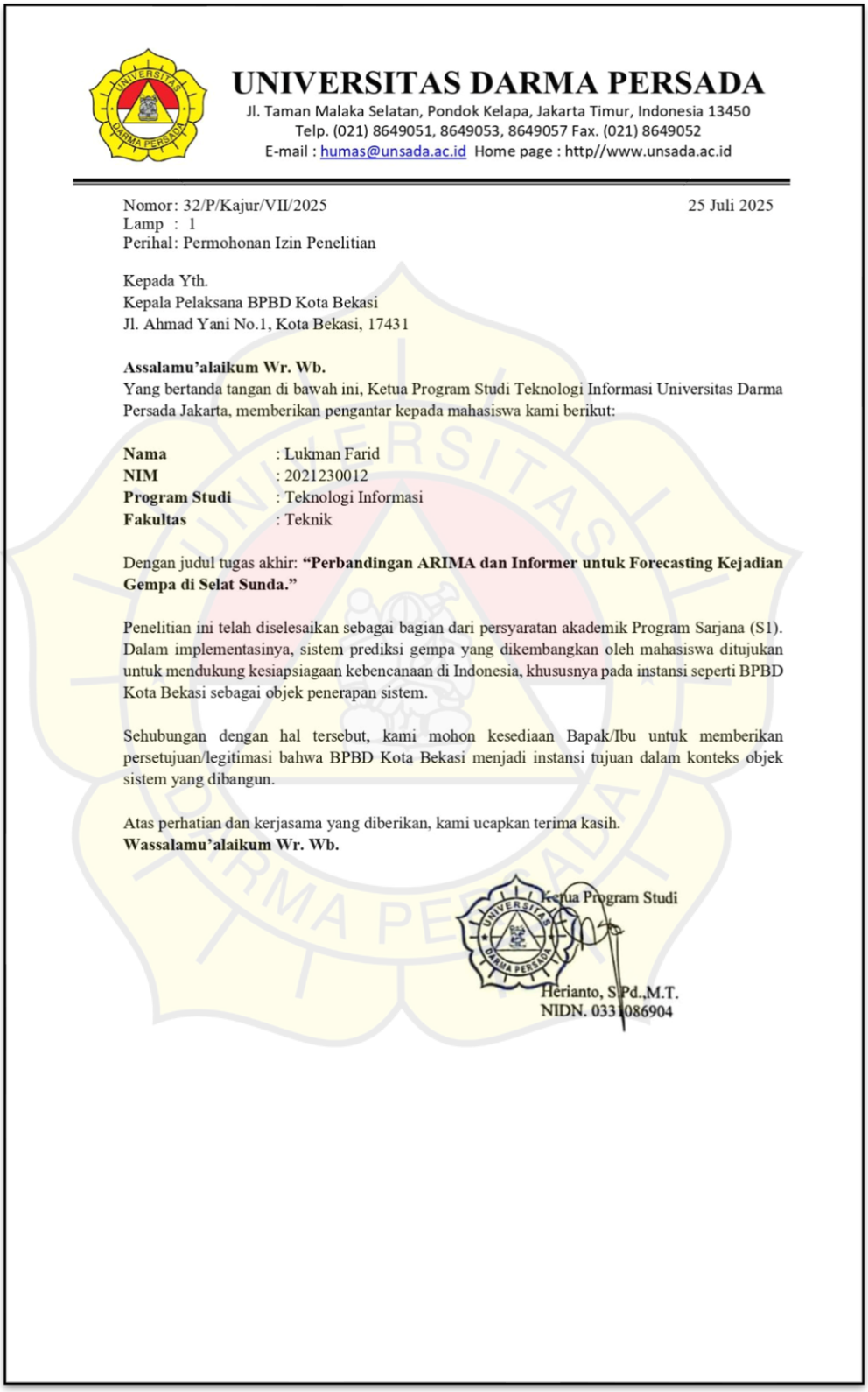

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Perihal: Permohonan Izin Penelitian

Kepada Yth.
Kepala Pelaksana BPBD Kota Bekasi
Jl. Ahmad Yani No.1, Kota Bekasi, 17431

Assalamu'alaikum Wr. Wb.
Yang bertanda tangan di bawah ini, Ketua Program Studi Teknologi Informasi Universitas Darma Persada Jakarta, memberikan pengantar kepada mahasiswa kami berikut:

Nama : Lukman Farid
NIM : 2021230012
Program Studi : Teknologi Informasi
Fakultas : Teknik

Dengan judul tugas akhir: **"Perbandingan ARIMA dan Informer untuk Forecasting Kejadian Gempa di Selat Sunda."**

Penelitian ini telah diselesaikan sebagai bagian dari persyaratan akademik Program Sarjana (S1). Dalam implementasinya, sistem prediksi gempa yang dikembangkan oleh mahasiswa ditujukan untuk mendukung kesiapsiagaan kebencanaan di Indonesia, khususnya pada instansi seperti BPBD Kota Bekasi sebagai objek penerapan sistem.

Sehubungan dengan hal tersebut, kami mohon kesediaan Bapak/Ibu untuk memberikan persetujuan/legitimasi bahwa BPBD Kota Bekasi menjadi instansi tujuan dalam konteks objek sistem yang dibangun.

Atas perhatian dan kerjasama yang diberikan, kami ucapkan terima kasih.
Wassalamu'alaikum Wr. Wb.

Ketua Program Studi

Herianto, S.Pd.,M.T.
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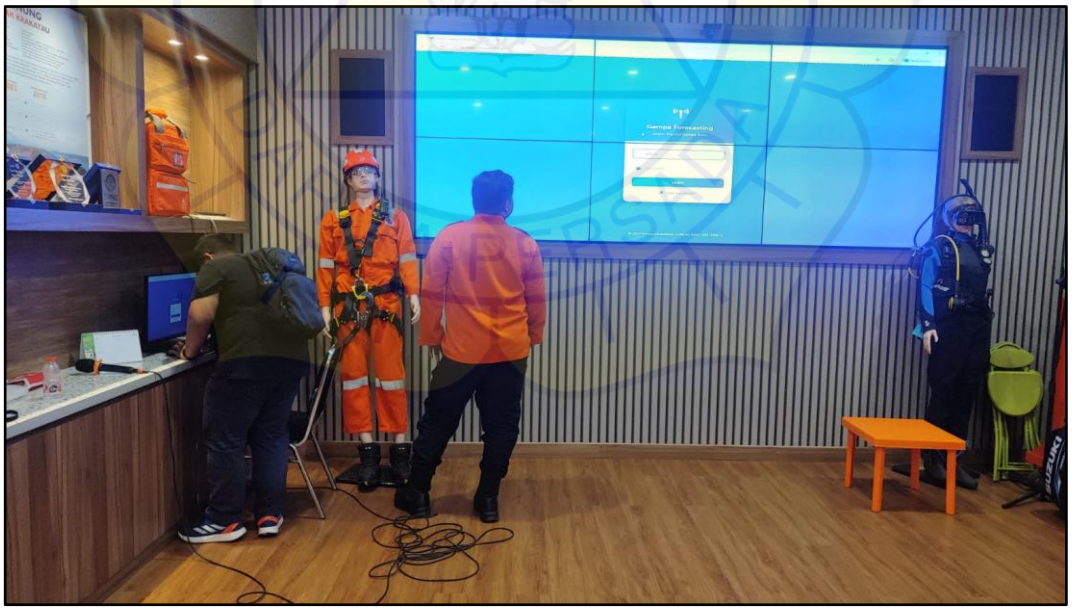
Lampiran 4 Dokumentasi Bersama Instansi



Lampiran 5 *Source Code* Aplikasi Utama

```
from flask import Flask, render_template, request, jsonify,
redirect, url_for, flash, session
import pandas as pd
import os
from flask_sqlalchemy import SQLAlchemy
from flask_login import LoginManager, UserMixin, login_user,
login_required, logout_user, current_user
from datetime import datetime, timedelta
from functools import wraps
from statsmodels.tsa.arima.model import ARIMA
import matplotlib.pyplot as plt
import requests
import io
import base64
from sklearn.metrics import mean_absolute_error,
mean_squared_error
import numpy as np


# Setup Flask
app = Flask(__name__)

# Konfigurasi database
app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///app.db'  #
Database SQLite untuk log
app.config['SQLALCHEMY_TRACK_MODIFICATIONS'] = False
app.secret_key = 'your_secret_key'

# Set waktu kedaluwarsa sesi menjadi 30 menit
app.permanent_session_lifetime = timedelta(minutes=30)  # Sesi
akan kedaluwarsa setelah 30 menit


# Inisialisasi SQLAlchemy dan LoginManager
db = SQLAlchemy(app)
login_manager = LoginManager()
login_manager.init_app(app)
login_manager.login_view = 'login'


# Model untuk mencatat log aktivitas user
class UserLog(db.Model):
    id = db.Column(db.Integer, primary_key=True)
    username = db.Column(db.String(80), nullable=False)
```

```
    activity = db.Column(db.String(200), nullable=False)
    timestamp = db.Column(db.DateTime, default=datetime.utcnow)

    def __repr__(self):
        return f'<UserLog {self.username} - {self.activity}>'

# Model User untuk login
class User(UserMixin, db.Model):
    id = db.Column(db.Integer, primary_key=True,
autoincrement=True)
    username = db.Column(db.String(80), unique=True,
nullable=False)
    password = db.Column(db.String(200), nullable=False)
    role = db.Column(db.String(50), nullable=False,
default='user')

# Fungsi user_loader
@login_manager.user_loader
def load_user(user_id):
    return User.query.get(user_id)

# Membuat tabel jika belum ada
with app.app_context():
    db.create_all()

    # Tambahkan user default jika belum ada
    if not User.query.filter_by(username='admin').first():
        admin_user = User(username='admin', password='admin123',
role='admin')
        db.session.add(admin_user)
        db.session.commit()

# Fungsi untuk mencatat log aktivitas user
def log_user_activity(username, activity):
    new_log = UserLog(username=username, activity=activity)
    db.session.add(new_log)
    db.session.commit()

# Middleware untuk membatasi akses berdasarkan peran
def role_required(role):
    def decorator(func):
        @wraps(func)
        def wrapped_view(*args, **kwargs):
            if current_user.role != role:
```

```
                return "Akses ditolak: Anda tidak memiliki izin
untuk mengakses halaman ini."
            return func(*args, **kwargs)
        return wrapped_view
    return decorator

# Halaman Utama
@app.route('/')
@login_required
def index():
    if current_user.role == 'admin':
        return redirect(url_for('admin_dashboard'))
    return redirect(url_for('user_dashboard'))

# Fungsi login
@app.route('/login', methods=['GET', 'POST'])
def login():
    if current_user.is_authenticated:
        return redirect(url_for('index'))  # Jika sudah login,
arahkan ke halaman utama (index)

    if request.method == 'POST':
        username = request.form['username']
        password = request.form['password']

        # Cek kredensial
        user = User.query.filter_by(username=username).first()
        if user and user.password == password:
            login_user(user)
            log_user_activity(username, 'Logged in')  # Catat
aktivitas login
            return redirect(url_for('index'))
        else:
            return 'Invalid username or password', 401

    return render_template('login.html')

# Fungsi untuk menangani lupa password
@app.route('/forgot_password', methods=['GET', 'POST'])
def forgot_password():
    if request.method == 'POST':
        username = request.form['username']
        user = User.query.filter_by(username=username).first()

        if user:
```

```
            # Jika username ditemukan, tampilkan password asli
(untuk logika dasar)
            return render_template('forgot_password.html',
success=f'Password Anda adalah: {user.password}')
        else:
            # Jika username tidak ditemukan, tampilkan pesan
kesalahan
            return render_template('forgot_password.html',
error='Username tidak ditemukan.')

    return render_template('forgot_password.html')

# Fungsi logout
@app.route('/logout')
@login_required
def logout():
    log_user_activity(current_user.username, 'Logged out')  #
Catat aktivitas logout
    logout_user()
    session.clear()  # Hapus semua data sesi
    return redirect(url_for('login'))  # Redirect ke halaman login
setelah logout

# Dashboard Admin
@app.route('/admin')
@login_required
@role_required('admin')
def admin_dashboard():
    logs = UserLog.query.all()
    return render_template('admin_dashboard.html', logs=logs)

# Dashboard User
@app.route('/dashboard')
@login_required
@role_required('user')
def user_dashboard():
    return render_template('user_dashboard.html')

DATA_FOLDER = './data'

# Definisikan path file CSV yang digunakan untuk prediksi
UPLOAD_FILEPATH = os.path.join(DATA_FOLDER, 'uploaded_data.csv')

if not os.path.exists(DATA_FOLDER):
    os.makedirs(DATA_FOLDER)
```

```python
# CRUD User
@app.route('/manage_users', methods=['GET', 'POST'])
@login_required
@role_required('admin')
def manage_users():
    if request.method == 'POST':
        username = request.form['username']
        password = request.form['password']
        role = request.form['role']

        # Tambah user baru
        new_user = User(username=username, role=role,
password=password)
        db.session.add(new_user)
        db.session.commit()
        log_user_activity(current_user.username, f'Added new user:
{username}')
        return redirect(url_for('manage_users'))

    users = User.query.all()
    return render_template('manage_user.html', users=users)

# Route to add a user
@app.route('/add_user', methods=['POST'])
@login_required
@role_required('admin')
def add_user():
    username = request.form['username']
    password = request.form['password']
    role = request.form['role']

    if User.query.filter_by(username=username).first():
        flash('Username already exists!', 'error')
        return redirect(url_for('manage_users'))

    new_user = User(username=username, password=password,
role=role)

    db.session.add(new_user)
    db.session.commit()
    print(f"User added with ID: {new_user.id}")  # Debugging
    flash('User added successfully!', 'success')
    return redirect(url_for('manage_users'))
```

```
@app.route('/edit_user/<user_id>', methods=['GET', 'POST'])
@login_required
@role_required('admin')
def edit_user(user_id):
    user = User.query.get(user_id)
    if request.method == 'POST':
        user.username = request.form['username']
        if request.form['password']:
            user.password = request.form['password']
        user.role = request.form['role']
        db.session.commit()
        log_user_activity(current_user.username, f'Edited user:
{user.username}')
        return redirect(url_for('manage_users'))

    return render_template('edit_user.html', user=user)

@app.route('/delete_user/<user_id>', methods=['POST'])
@login_required
@role_required('admin')
def delete_user(user_id):
    user = User.query.get(user_id)
    db.session.delete(user)
    db.session.commit()
    log_user_activity(current_user.username, f'Deleted user:
{user.username}')
    return redirect(url_for('manage_users'))


@app.route('/maps', methods=['GET'])
@login_required
def train_model():
    # Logic untuk mempersiapkan data dan model
    return render_template('map1.html')


@app.route('/upload', methods=['GET', 'POST'])
@login_required
def upload_data():
    if request.method == 'POST':
        file = request.files['file']
        if file:
            # Simpan file CSV yang diunggah
```

```
            filepath = os.path.join(DATA_FOLDER,
'uploaded_data.csv')
            file.save(filepath)

            # Log aktivitas user
            log_user_activity(current_user.username, 'Uploaded new
data')

            # Redirect ke halaman visualisasi
            return redirect(url_for('visualize_csv',
filename='uploaded_data.csv'))

    return render_template('upload.html')

# Halaman untuk menampilkan grafik dari file CSV
@app.route('/visualize/<filename>', methods=['GET'])
@login_required
def visualize_csv(filename):
    filepath = os.path.join(DATA_FOLDER, filename)

    try:
        # Membaca file CSV
        df = pd.read_csv(filepath)

        # Memeriksa apakah CSV memiliki setidaknya dua kolom
        if len(df.columns) < 2:
            return "File CSV harus memiliki minimal 2 kolom.", 400

        # Membuat grafik
        fig, ax = plt.subplots(figsize=(10, 6))
        ax.plot(df.iloc[:, 0], df.iloc[:, 1], label='Data',
color='b')

        # Menambahkan label
        ax.set_xlabel(df.columns[0])
        ax.set_ylabel(df.columns[4])
        ax.set_title(f'Grafik {filename}')

        # Menyimpan grafik dalam format PNG ke dalam memori
        img = io.BytesIO()
        plt.savefig(img, format='png')
        img.seek(0)

        # Mengencode gambar menjadi base64
```

```
        img_base64 =
base64.b64encode(img.getvalue()).decode('utf8')

        # Tampilkan grafik pada halaman HTML
        return render_template('visualize.html',
img_data=img_base64)

    except Exception as e:
        return f"Terjadi kesalahan saat memproses file: {str(e)}",
500

@app.route('/pengetahuan')
@login_required
def pengetahuan():
    return render_template('pengetahuan.html')


@app.route('/redirect_informer')
def redirect_informer():
    return redirect('http://127.0.0.1:5001/')  # Port Flask
Informer

# Route untuk mengunggah dan memproses data dengan ARIMA

@app.route('/predict_arima', methods=['GET', 'POST'])
def predict_arima():
    if not os.path.exists(UPLOAD_FILEPATH):
        flash("Tidak ada file yang tersedia untuk prediksi.
Silakan unggah file terlebih dahulu.", "danger")
        return redirect(url_for('upload_file'))

    if request.method == 'POST':
        try:
            steps = int(request.form.get('steps', 10))  # Ambil
input jumlah hari prediksi, default 10
            if steps <= 0:
                flash("Jumlah hari prediksi harus lebih dari 0.",
"danger")
                return redirect(url_for('predict_arima'))

            df = pd.read_csv(UPLOAD_FILEPATH, parse_dates=[0],
index_col=0)

            if df.empty or len(df.columns) < 1:
```

```
                flash("File CSV kosong atau tidak memiliki cukup
data.", "danger")
                return redirect(url_for('predict_arima'))

            series = df.iloc[:, 0]  # Ambil kolom pertama

            # Melatih model ARIMA
            model = ARIMA(series, order=(5,1,0))  # Order bisa
disesuaikan
            model_fit = model.fit()

            # Prediksi sesuai jumlah hari yang diinput
            forecast = model_fit.forecast(steps=steps)
            forecast_dates = pd.date_range(start=series.index[-1],
periods=steps+1, freq='D')[1:]

            # Menghitung MSE & MAPE menggunakan data terakhir
sebagai perbandingan
            actual_values = series[-steps:] if len(series) >=
steps else series
            mse = mean_squared_error(actual_values,
forecast[:len(actual_values)])

            # MAPE = Mean Absolute Percentage Error
            mape = np.mean(np.abs((actual_values -
forecast[:len(actual_values)]) / actual_values))

            # Menampilkan hasil dalam bentuk grafik
            fig, ax = plt.subplots(figsize=(10, 6))
            ax.plot(forecast_dates, forecast, label='Prediksi',
color='red', marker='o')
            ax.legend()
            ax.set_title(f'Prediksi ARIMA {steps} Hari ke Depan')

            img = io.BytesIO()
            plt.savefig(img, format='png')
            img.seek(0)
            img_base64 =
base64.b64encode(img.getvalue()).decode('utf8')

            # Membuat tabel prediksi dalam format list
            prediction_table = pd.DataFrame({
                'Tanggal': forecast_dates.strftime('%Y-%m-%d'),
                'Prediksi': forecast.values
            }).to_dict(orient='records')
```

```
            return render_template(
                'predict_arima.html',
                img_data=img_base64,
                predictions=prediction_table,
                mse=mse,
                mape=mape,
                steps=steps
            )

        except Exception as e:
            flash(f"Terjadi kesalahan: {str(e)}", "danger")
            return redirect(url_for('predict_arima'))

    return render_template('input_steps.html')  # Redirect ke
halaman upload jika error

# Lihat Log Aktivitas
@app.route('/logs')
@login_required
@role_required('admin')
def view_logs():
    logs = UserLog.query.all()
    return render_template('logs.html', logs=logs)

if __name__ == '__main__':
    app.run(debug=True)
```

Lampiran 5 *Source Code* Aplikasi Informer

```
from flask import Flask, request, jsonify, render_template
import torch
import numpy as np
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
from models.model import Informer
import logging
import requests
from flask_cors import CORS

# --- FUNGSI AMBIL DATA USGS (SESUAI KOORDINAT SELAT SUNDA) ---
def download_usgs_earthquake_data(starttime, endtime, minlatitude,
maxlatitude,
```

```
                                    minlongitude, maxlongitude,
                                    minmagnitude=2.0,
                                    limit=200):
    url = "https://earthquake.usgs.gov/fdsnws/event/1/query"
    params = {
        "format": "geojson",
        "starttime": starttime,
        "endtime": endtime,
        "minlatitude": minlatitude,
        "maxlatitude": maxlatitude,
        "minlongitude": minlongitude,
        "maxlongitude": maxlongitude,
        "minmagnitude": minmagnitude,
        "orderby": "time",  # urutan terbaru
        "limit": limit
    }

    response = requests.get(url, params=params)
    data = response.json()
    records = []
    for feature in data.get("features", []):
        props = feature["properties"]
        coords = feature["geometry"]["coordinates"]
        records.append({
            "time": props["time"],
            "place": props["place"],
            "mag": props["mag"],
            "longitude": coords[0],
            "latitude": coords[1],
            "depth": coords[2],
        })
    df = pd.DataFrame(records)
    if not df.empty:
        df["time"] = pd.to_datetime(df["time"], unit="ms")
        df = df.sort_values("time").reset_index(drop=True)
    return df

# --- FUNGSI WAKTU ---
def time_features(df, freq):
    if "date" not in df.columns:
        raise ValueError("Kolom 'date' tidak ditemukan dalam
DataFrame.")
    if not pd.api.types.is_datetime64_any_dtype(df["date"]):
        df["date"] = pd.to_datetime(df["date"])
    time_feats = []
```

```
    if freq == "d":
        time_feats.append(df["date"].dt.day.values)
        time_feats.append(df["date"].dt.dayofweek.values)
        time_feats.append(df["date"].dt.month.values)
    else:
        raise ValueError(f"Frekuensi {freq} tidak didukung.")
    return np.stack(time_feats, axis=1)

# --- FLASK APP ---
app = Flask(__name__)
CORS(app)

@app.route("/")
def index():
    return render_template("index.html")

# --- LOAD MODEL ---
device = torch.device("cuda" if torch.cuda.is_available() else
"cpu")
model = Informer(
    enc_in=1, dec_in=1, c_out=1,
    seq_len=100, label_len=7, out_len=7,
    factor=5, d_model=512, n_heads=8,
    e_layers=2, d_layers=1, d_ff=512,
    dropout=0.05, attn="prob", embed="timeF",
    freq="d", activation="gelu",
    output_attention=False, distil=True,
    mix=True, device=device
)
model.load_state_dict(torch.load("informer_model.pth",
map_location=device), strict=False)
model.to(device)
model.eval()
scaler = MinMaxScaler()
logging.basicConfig(level=logging.DEBUG)

@app.route('/predict', methods=['POST'])
def predict():
    try:
        logging.debug("Masuk ke endpoint /predict")

        df_realtime = download_usgs_earthquake_data(
            starttime="1990-01-01",
            endtime="2024-12-31",
            minlatitude=-8.494,
```

```
            maxlatitude=-5.703,
            minlongitude=103.052,
            maxlongitude=106.743,
            minmagnitude=2.0,
            limit=107
        )

        df_realtime =
df_realtime.sort_values("time").tail(107).reset_index(drop=True)


        if df_realtime.empty:
            return jsonify({"error": "Data gempa tidak
ditemukan!"}), 404

        # ambil 107 data terakhir
        df_realtime = df_realtime.tail(107).reset_index(drop=True)
        print("Jumlah data akhir:", len(df_realtime))
        if len(df_realtime) < 107:
            return jsonify({"error": "Data tidak cukup untuk
prediksi!"}), 400

        df_test = df_realtime.rename(columns={"time": "date",
"mag": "value"})[["date", "value"]]
        df_test["date"] = pd.to_datetime(df_test["date"])
        df_test["value"] = pd.to_numeric(df_test["value"],
errors="coerce")
        df_test["value"].fillna(df_test["value"].mean(),
inplace=True)
        df_test["value"] =
scaler.fit_transform(df_test["value"].values.reshape(-1, 1))

        if len(df_test) < 2:
            return jsonify({"error": "Data terlalu sedikit untuk
hitung delta waktu"}), 400

        delta = df_test["date"].iloc[1] - df_test["date"].iloc[0]
        for _ in range(7):
            new_row = {"date": df_test["date"].iloc[-1] + delta,
"value": 0}
            df_test = pd.concat([df_test,
pd.DataFrame([new_row])], ignore_index=True)
        df_test.fillna(0, inplace=True)

        df_test_x = df_test.iloc[-100-7:-7].copy()
```

```
        df_test_y = df_test.iloc[-7:].copy()
        test_time_x = time_features(df_test_x, freq="d")
        test_time_y = time_features(df_test_y, freq="d")
        df_test_numpy = df_test.to_numpy()[:, 1:].astype("float")

        test_data_x = df_test_numpy[-100-7:-7]
        test_data_y = np.zeros((7, 1))

        batch_x =
torch.tensor(test_data_x).unsqueeze(0).float().to(device)
        batch_x_mark =
torch.tensor(test_time_x).unsqueeze(0).float().to(device)
        batch_y =
torch.tensor(test_data_y).unsqueeze(0).float().to(device)
        batch_y_mark =
torch.tensor(test_time_y).unsqueeze(0).float().to(device)

        with torch.no_grad():
            outputs = model(batch_x, batch_x_mark, batch_y,
batch_y_mark)
            preds = outputs.detach().cpu().numpy()

        preds = scaler.inverse_transform(preds[0])

        def classify_value(value):
            if value < 4:
                return "waspada"
            elif 4 <= value < 6:
                return "siaga"
            else:
                return "berbahaya"

        pred_dates = [str(df_test["date"].iloc[-7 + i]) for i in
range(7)]
        response = {
            "predictions": [
                {
                    "date": date,
                    "value": float(value),
                    "classification": classify_value(value)
                }
                for date, value in zip(pred_dates,
preds.flatten().tolist())
            ]
        }
```

```
        print("Prediksi sukses:\n", response)
        return jsonify(response)

    except Exception as e:
        logging.error(f"Error terjadi: {e}")
        return jsonify({"error": str(e)}), 500

if __name__ == '__main__':
    app.run(debug=True, host='0.0.0.0', port=5001)
```