AstroTrackAI — Asteroid Movement Prediction Prototype

1. Introduction

Asteroids are celestial objects orbiting the sun, and some pass close to Earth. Early detection and prediction of their paths are critical to prevent potential disasters. AstroTrackAI is a prototype AI system designed to predict asteroid movements over time and provide early warnings if an asteroid approaches dangerously close to Earth.

2. Project Objective

The primary goal of AstroTrackAI is to simulate asteroid distance data and apply machine learning to predict their future positions relative to Earth. If predictions indicate a potential threat (within 10,000 km of Earth), the system issues an automated alert.

3. Methodology

Data Simulation

Because real-time asteroid trajectory datasets can be complex, we simulate asteroid distance data for the purpose of this prototype. The simulated data represents an asteroid gradually approaching Earth with some random variations.

Model Training

A **Linear Regression** model is used:

- Input (X): Time (hours, days, arbitrary units)
- Output (y): Distance from Earth (km)

The model is trained on simulated data and tested for its prediction capabilities.

Alert System

If the predicted distance for a future time is less than 10,000 km, the system automatically triggers an alert message.

4. Technology Stack

- **Python 3.11**
- **Libraries Used:**
    - Pandas (for data handling)
    - NumPy (for numerical operations)

- Scikit-learn (for machine learning model)
- Matplotlib (for data visualization)

5. Testing Plan

The system was tested on multiple simulated asteroid paths:

- Predicting asteroid distances for times beyond the training data range.
- Verifying that the alert system correctly triggers warnings when distances fall below the 10,000 km threshold.

Example test case:

- Future time = 110 units → Predicted distance = 8,000 km → **Alert triggered!**

6. Results

The AI model successfully predicted asteroid distance trends over time. Alerts were triggered appropriately when the model predicted dangerously close distances. A plot was generated showing both observed and predicted paths, helping visualize the asteroid's trajectory.

(Insert a screenshot of your prediction graph here.)

7. Future Improvements

- Integrate real asteroid data from NASA APIs (e.g., Near Earth Object Web Service - NeoWs).
- Upgrade to more complex models (like time series forecasting or neural networks) for better accuracy.
- Add a web interface or real-time dashboard for monitoring asteroid data.

8. Conclusion

AstroTrackAI demonstrates how AI can assist in asteroid movement prediction and early warning systems. While this prototype is based on simulated data and basic linear regression, it establishes the foundation for more sophisticated space object tracking systems essential for planetary defense.