MIT | Academy of Engineering
(An Autonomous Institute Affiliated to Savitribai Phule University)

Title : Identifying Potentially Hazardous Asteroids

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Project Motivation

- **Space Safety:**
  - Early detection of potentially hazardous asteroids can help in planning effective planetary defense strategies.
- **Technological Opportunity:**
  - Advances in machine learning and data science provide new methods for accurately classifying and analyzing asteroid threats.
- **Astronomical Solutions:**
  - The need for robust and scalable tools for real-time monitoring of asteroids approaching Earth.
- **Global Impact:**
  - Addressing potential asteroid threats supports international space safety efforts and long-term global preparedness.

Project Objectives

- Develop a predictive model to classify asteroids as hazardous or non-hazardous based on features like size, speed, and trajectory.
- Ensure accuracy and reliability using advanced machine learning algorithms.
- Integrate the MLOPs with APIs for seamless deployment and monitoring.
- Provide insights into the key characteristics that make an asteroid potentially hazardous.

Project Aim

To identify and analyze features that determine whether an asteroid is potentially hazardous or non-hazardous by leveraging data from the NeoWs (Near Earth Object Web Service). The goal is to develop a machine learning model that accurately classifies asteroids based on key features like size, speed, and trajectory. This solution should integrate MLOps for seamless real-time deployment and monitoring, providing insights into characteristics influencing asteroid classification to enhance prediction models, contribute to space safety, and support proactive planetary defense measures.

References

QR for Datset information

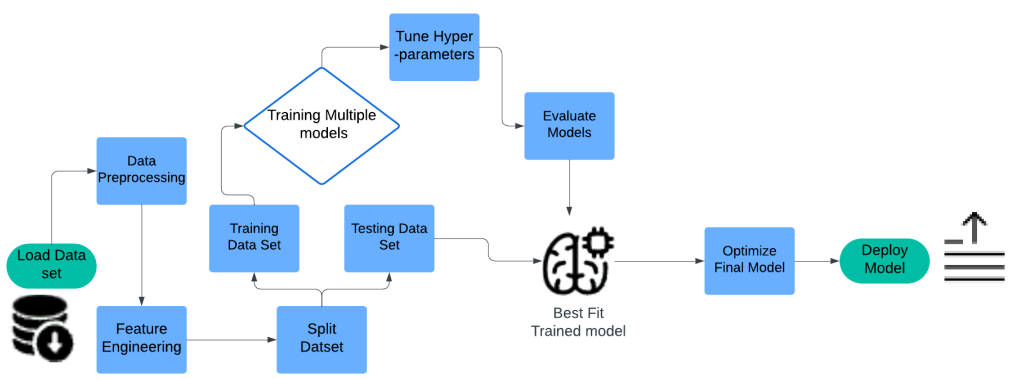
QR for Colab notebook

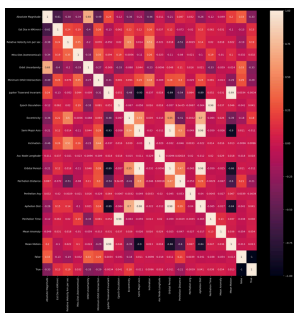
CI and CD Pipelines

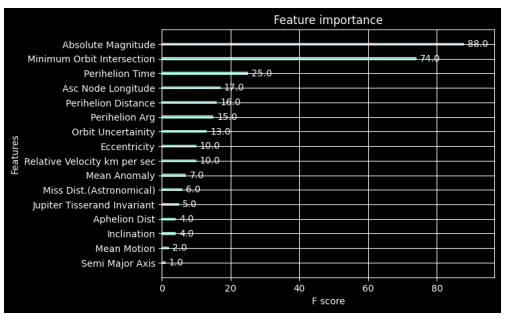
CI Pipeline:
Code commit → Automated Testing → Model Training → Validation → Versioning

CD Pipeline: Fetch Trained Models → Build API endpoint → Deploy to production → Monitor Performance

Flowchart





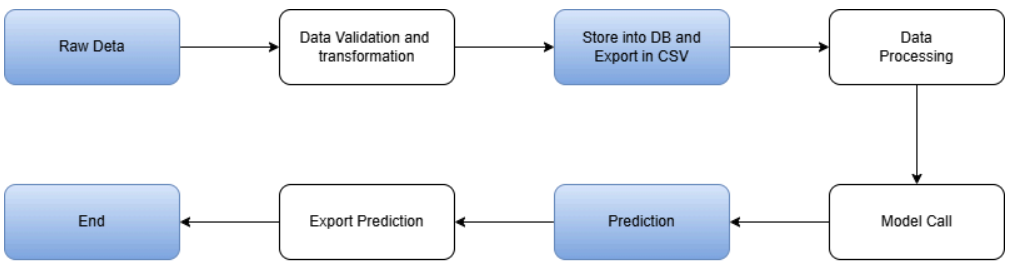


Experimental Results

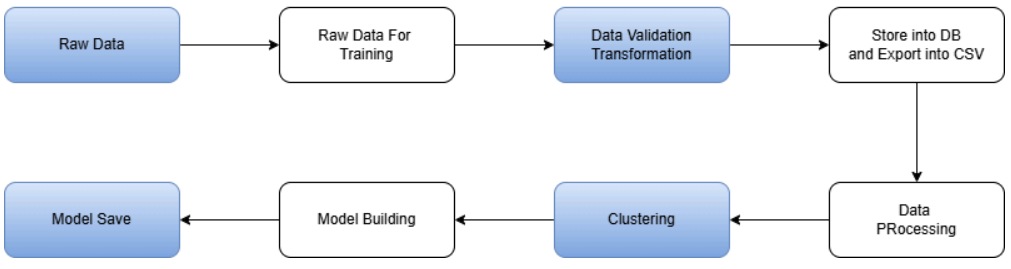
- **The Decision Tree model achieved the highest performance, with an accuracy of 99.57%, proving its reliability in classifying asteroids as hazardous or non-hazardous.**
- Identified key features influencing hazard classification, such as relative speed and size.
- Integrated MLOps to implement an automated system for real-time classification and monitoring, ensuring seamless deployment and reduced time-to-warning for improved space safety.

The experimental analysis confirmed the Decision Tree model as the most effective for accurate, real-time asteroid classification.

Prediction model



Training model



Conclusion

The project achieved 99.57% accuracy in classifying hazardous and non-hazardous asteroids, with key features like speed and size influencing the classification. The integration of MLOps enabled real-time deployment and monitoring, enhancing space safety measures. Future work will focus on refining the model and incorporating additional data for improved predictions.