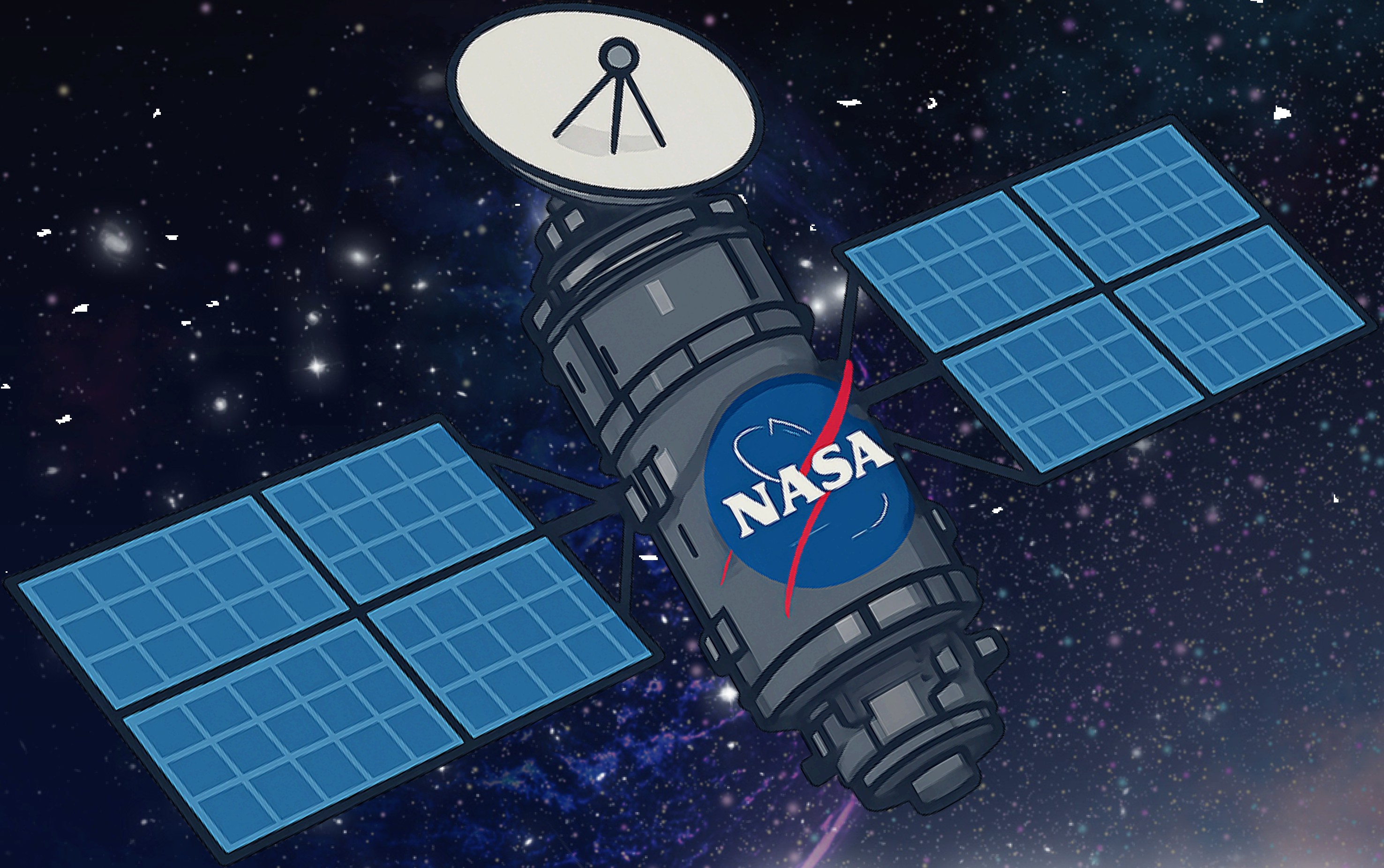
PROJECT PRESENTATION



NASA SPACE APPS
FOLSOM

BHIMASPHERE

HUNTING FOR EXOPLANETS WITH AI

BHIMASPHERE

TEAM MEMBERS:
Bhavika Bhima
Lalithendra Reddy Bhima

PROJECT OBJECTIVES

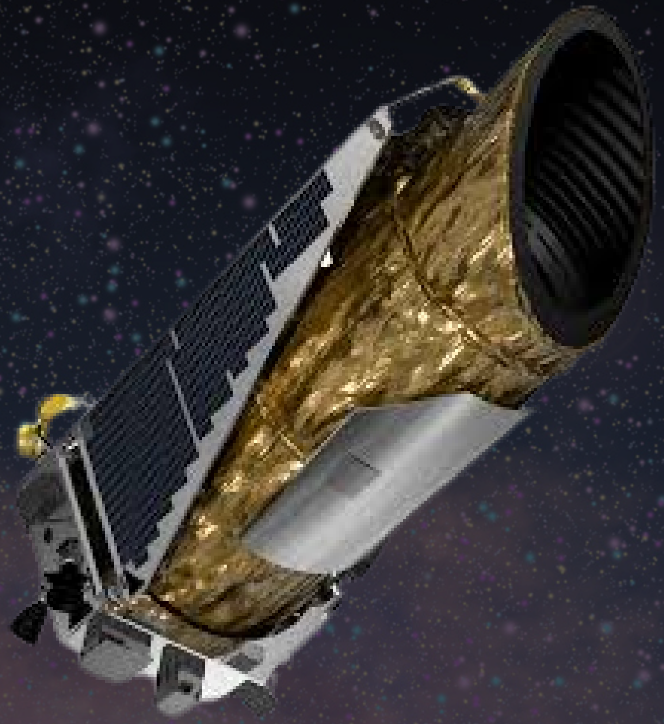
01. Build an AI/ML model using NASA’s Kepler, K2, and TESS datasets.

02. Using features like orbital period, transit duration, and planetary radius.

03. Enable options for data upload, retraining, and exploration

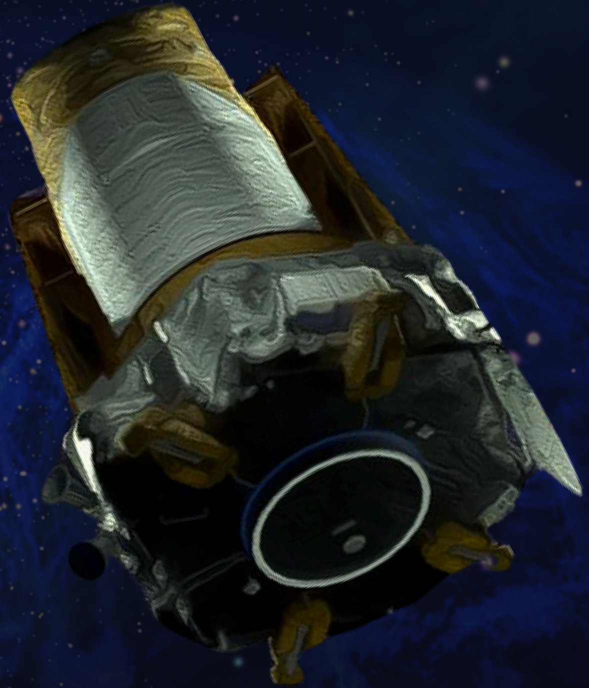
OUR GOAL: To create a web interface for scientists and the public to interact with a model that classifies exoplanets if they are *Confirmed*, *Candidate*, or *False Positive*. Trying to discover new worlds more accurately, efficiently, and accessibly.

NASA DATA SETS



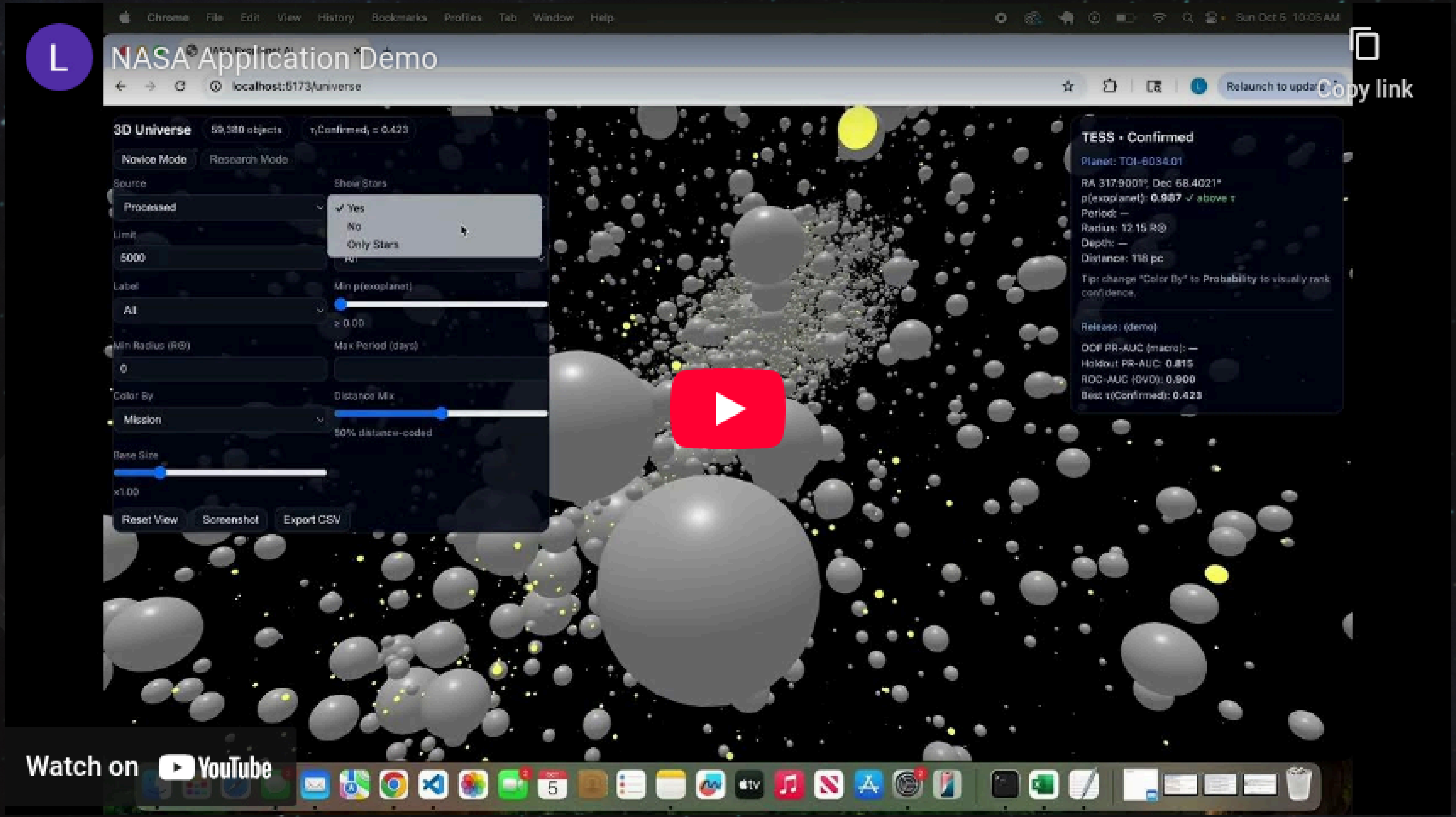
KEPLER OBJECTS OF INTEREST (KOI) (2009-2018)

TESS OBJECTS OF INTEREST (TOI) (2018-2020)



K2 PLANETS AND CANDIDATES (2014-2018)

OUR SOLUTION:



PHYSICS

1. Astrometry and 3D Kinematics

$$x = R\cos\delta\cos\alpha, \quad y = R\cos\delta\sin\alpha, \quad z = R\sin\delta$$

- Converts RA/Dec/Distance to Cartesian coordinates (x, y, z) in parsecs for the 3D Universe visualization module

2. Stellar Structure and Radiation Laws

- Surface gravity:

$$g = \frac{GM_*}{R_*^2}$$

- Enables recovery of stellar mass from radius and log g when missing.

3. Stellar density: $$\rho_* = \frac{3M_*}{4\pi R_*^3}$$

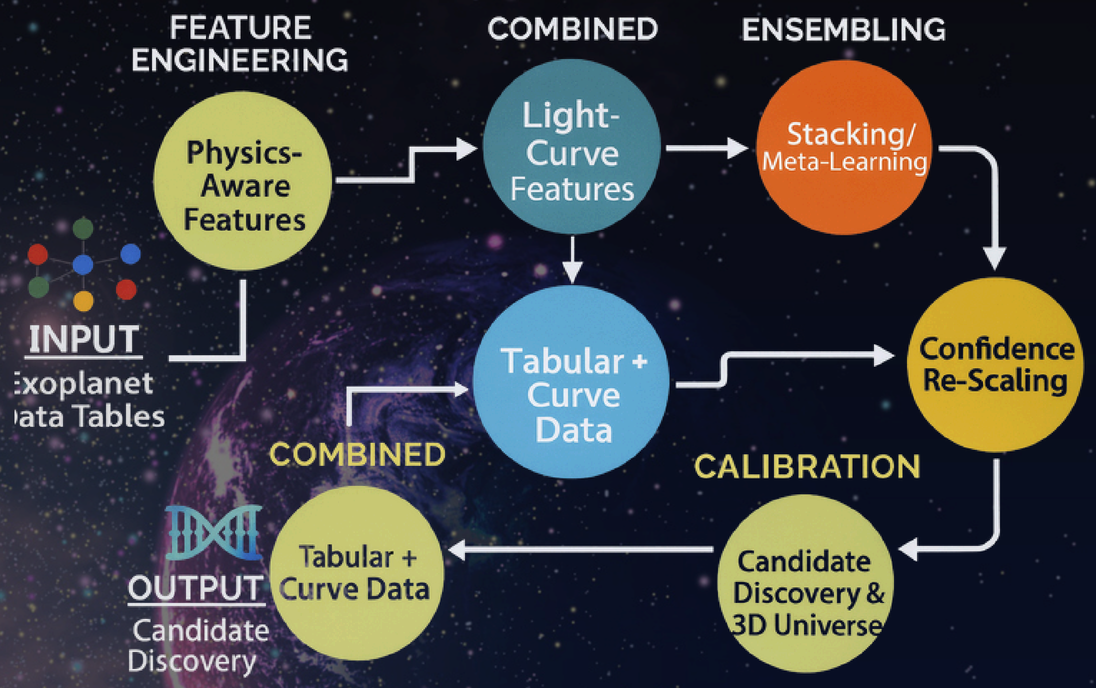
- Used to calculate the star’s density to check if the planet’s transit shape makes physical sense.

4. Transit Geometry & Light-Curve Physics:

$$\delta = \left(\frac{R_p}{R_*}\right)^2, \quad T_{14} \approx \frac{P}{\pi}\frac{R_*}{a}\frac{\sqrt{(1+R_p/R_*)^2 - b^2}}{\sin i}$$

- This centers on detecting light dips from planetary transits. Our model encodes the exact transit-duration equation and depth relation

AI/ML PART



A left-to-right pipeline with six stages:

1. Data Preparation
2. Feature Extraction (TSFRESH for light curves)
3. Deep Learning Core (TabTransformer/MLP for tabular + CNN→BiLSTM for sequences)
4. Ensemble + Stacking (trees + neural outputs → logistic meta-learner)
5. Calibration & Explainability (temperature scaling, SHAP)
6. Discovery & 3D Universe viewer (RA/Dec/Distance; mission/confidence coloring; retrain via CSV)

- A call-out at the bottom: Deep learning begins at Stage 3, feeds stacking, then gets calibrated and explained before rendering in the 3D viewer.

WORK CITED

1

2

Research Article #1:
Exoplanet Detection Using Machine Learning

Research Article #2:
Assessment of Ensemble-Based Machine Learning Algorithms for Exoplanet Identification

GITHUB LINK:
HTTPS://GITHUB.COM/LALITHBHIMA/BHIMASPHERE

THANK YOU

NASA Space Apps
Challenge 2025