⚛️ 1. Exoplanet Detection using Transit Photometry

Goal: Use machine learning to detect dips in stellar brightness that indicate exoplanets.

- **Tools**: Python, Scikit-learn, TensorFlow/Keras, Lightkurve library
- **Datasets**: NASA Kepler, TESS
- **Resources**:
    - Kepler ML Tutorial
    - Lightkurve Docs

🌌 2. Galaxy Morphological Classification using Deep Learning

Goal: Train a CNN to classify galaxy shapes (e.g., spiral, elliptical) from images.

- **Tools**: TensorFlow, PyTorch, OpenCV
- **Dataset**: Galaxy Zoo
- **Resources**:
    - Galaxy Zoo ML Paper
    - FastAI or TensorFlow image classification tutorials

🌠 3. Supernova Detection and Classification

Goal: Use LSTM or other temporal models to detect supernovae from light curve data.

- **Tools**: Keras, Pandas, Scikit-learn
- **Dataset**: Supernova Photometric Classification Challenge (SPCC)
- **Resources**:

- Harvard Astrophysics Supernovae Resources
- Time Series ML Guides

🌀 4. Gravitational Wave Event Detection

Goal: Train neural networks to identify gravitational wave signals in noisy data.

- **Tools**: PyTorch, TensorFlow
- **Dataset**: LIGO Open Science Center
- **Resources**:
  - Kaggle GWD Challenge
  - GW ML Paper

🌌 5. Star Cluster Identification in Astronomical Images

Goal: Use unsupervised learning (e.g., K-means, DBSCAN) to detect star clusters in dense stellar fields.

- **Tools**: Scikit-learn, Astropy, matplotlib
- **Dataset**: Gaia Archive
- **Resources**:
  - Gaia DR3 ML Papers
  - Scikit-learn clustering tutorials

☄️ 6. Meteor Shower Classification from Radio Data

Goal: Analyze and classify meteor showers using radio signal traces and ML.

- **Tools**: Librosa (audio analysis), TensorFlow
- **Dataset**: Radio astronomy observatories (manual collection or public datasets)
- **Resources**:
    - Radio Meteor Detection
    - Librosa Audio Analysis Guide

🌍 7. Predicting Solar Flares using Space Weather Data

Goal: Apply ML models to time-series data to predict solar flares or coronal mass ejections.

- **Tools**: LSTM, XGBoost, Prophet
- **Dataset**: NASA's Heliophysics Data Portal, GOES Satellite Data
- **Resources**:
    - NOAA Solar Dataset
    - AI for Space Weather

🌌 8. Mapping Dark Matter with Weak Lensing Data

Goal: Use ML to estimate gravitational lensing distortions and infer dark matter distribution.

- **Tools**: Convolutional Neural Networks (CNNs), Autoencoders
- **Dataset**: LSST Simulated Data
- **Resources**:
    - Euclid Weak Lensing Resources
    - Dark Energy Survey ML

🛰️ 9. Anomaly Detection in Satellite Telescope Data

Goal: Use unsupervised ML to find unexpected or rare astrophysical events in telescope imagery.

- **Tools**: Autoencoders, Isolation Forest
- **Dataset**: Zwicky Transient Facility (ZTF)
- **Resources**:
    - Outlier Detection with ML
    - AstroAnomaly Toolkit

🔭 10. AI for Automated Telescope Scheduling and Observation Planning

Goal: Use reinforcement learning to optimize telescope pointing and data acquisition.

- **Tools**: Reinforcement Learning (RLlib, OpenAI Gym), optimization libraries
- **Dataset**: Custom simulation or scheduling logs
- **Resources**:
    - AstroRL Papers
    - RL for Astronomical Observation