




# HackOrbit 2025

## TEAM CORBETT

# THEME & PROBLEM STATEMENT

Theme: AI&ML

# FIRE SENTINEL

## Simulation/Modeling of forest fire spread using AI/ML techniques

Objectives:

- Predict forest fire risk (binary classification map) for the next day.
- Simulate fire spread for 1, 2, 3, 6, and 12 hours.

Challenges Addressed:

- Biodiversity loss
- Real-time hazard forecasting

# PROPOSED SOLUTION

A two-stage pipeline:

- **Stage 1**: Predict forest fire probability using historical weather, terrain, and fuel data via **U-Net / ConvLSTM**.

- **Stage 2**: Simulate dynamic fire spread from high-risk zones using **Cellular Automata**, guided by wind, slope, and fuel availability.

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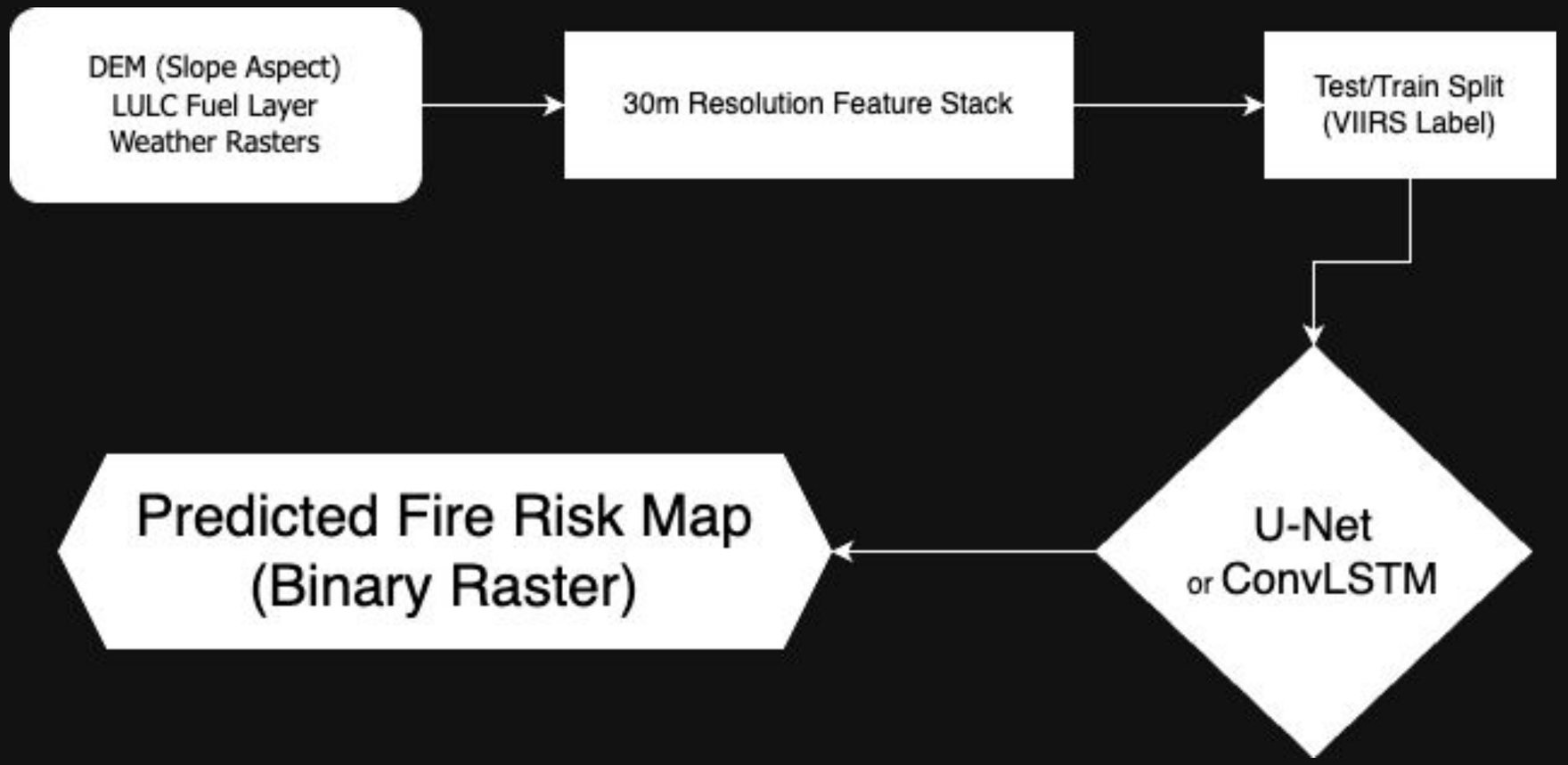
**Core Technologies**:

- Python, PyTorch, Rasterio, GDAL, QGIS, ERA5, IMD, Sentinel Hub

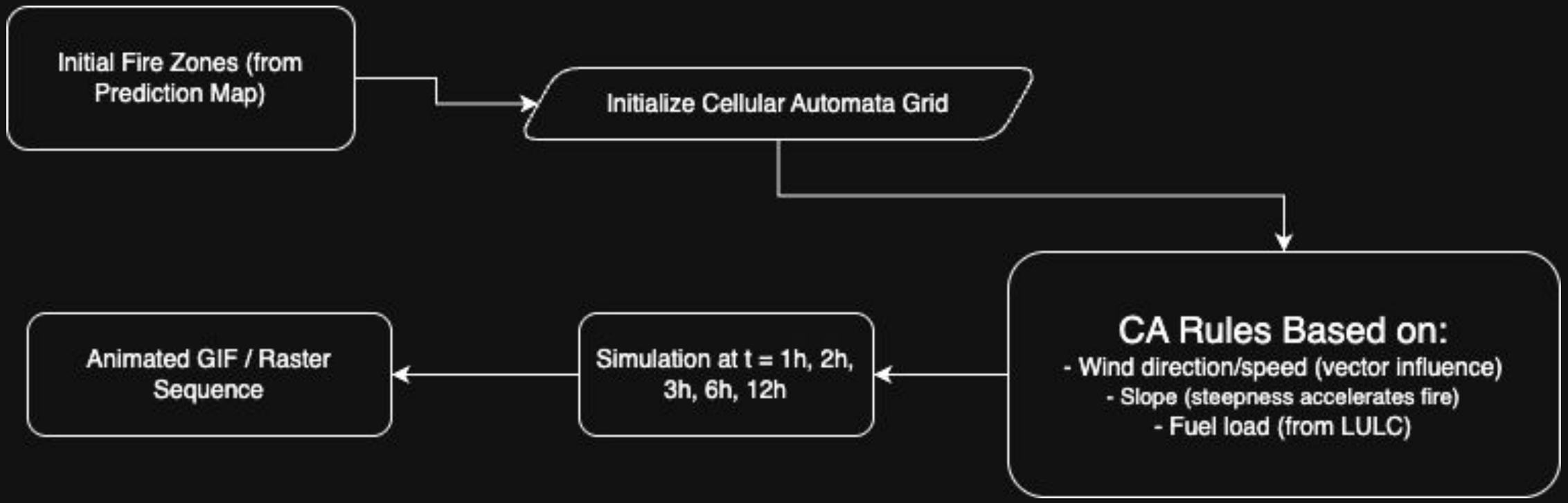
- ML Models: U-Net, ConvLSTM, Cellular Automata

# STAGE 1 - Fire Risk Prediction




- **Labels**: Historical VIIRS hotspots
- **Output**: GeoTIFF classification map – fire/no fire

# STAGE 2 - Fire Spread Simulation




**Output**: Animated spread simulation using `matplotlib.animation` or OpenCV

# Tech Stack and Datasets

## Programming & ML Frameworks:

- **Python 3.10**
- **PyTorch / Keras** – for U-Net, ConvLSTM
- **Scikit-learn** – for preprocessing & metrics

## Geospatial & Raster Processing:

- **Rasterio**, **GDAL**, **rioxarray**
- **xarray** – for handling NetCDF/ERA5 data
- **QGIS** – for terrain map visualizations & raster overlays

## Data Sources:

- **ERA5** – Weather variables (wind, temp, humidity)
- **IMD** – Indian Meteorological Department (rainfall, temp)
- **Bhoonidhi Portal** – 30m DEM (slope & aspect)
- **Bhuvan / Sentinel Hub** – LULC/Fuel maps
- **VIIRS / FIRMS** – Historical fire incidents

## Simulation & Visualization:

- **Cellular Automata Models (NumPy-based)**
- **matplotlib.animation**, **OpenCV**, **Folium**

# Drawbacks & Showstoppers

**Drawbacks**:

- Inconsistent LULC & weather resolution across time
- Bias in historical fire detection data (cloud cover, gaps)
- Real-time model latency for large areas

**Showstoppers**:

- Resampling all rasters to 30m using GDAL
- Use of transfer learning (pretrained U-Net on Sentinel-2)
- Modular CA rules for dynamic scalability

# TEAM CORBETT

Team **CORBETT** is a squad of four undergraduate **Second Year Students** of **Mathematics and Computing** at the **Rajiv Gandhi Institute of Petroleum Technology** (RGIPT - An Institution of National Importance).

NEWBIE Track Winner

**IIT Patna Hackmatrix 2025**

Runner Up

**IIT BHU (Varanasi) Planet Hunt ML Hackathon 2025**

## ANURAG SHARMA

**Team Lead**

- AI Intern at **IIT Ropar** and **Prodigal AI**
- Focuses on Geospatial ML

## NITYANSH PANT

**The ML Guy**

- Automation Intern at **CDOT Delhi**
- DS and AI Specialist

## MAITTRI TRIPATHI

**Strategist and Design**

- Data Analysis
- Designs

## JAYESH KAPOOR

**The 'Guy'**

- Jack of all trades
- Master of none

# Thank You