

# Protecting National Airspaces: Improved Object Detection and Classification

Author: Prarabdha (Osho) Yonzon

Lincoln Laboratory Advisors: Dr. Lily Lee, Dr. Joe Belarge, and Justin Yao

Faculty Advisor: Jordan Levine



## Lincoln Laboratory



Massachusetts Institute of Technology Lincoln Laboratory (MIT LL) is a Federally Funded Research Development Center (FFRDC).



MIT LL's mission is to develop a wide range of technology for the Department of Defense and other agencies to support national security.

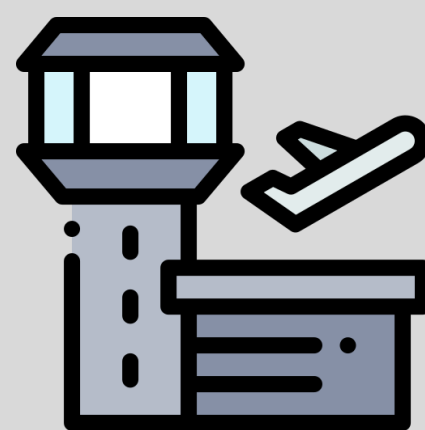
## Problem Statement



**Problem:** Classify 20 unique objects, including aircraft, vehicles, people, and animals in different images.



**Importance:** Fine-grain information enables operators, ranging from military to national and state agencies, to make critical decisions accurately.



## Image Data

### Data Information



22,691 images



53,887 bounding box annotations



Two Sets of Classes:  
20 Fine-Grain  
7 Coarse-Grain

### Public Data Sources

Military Aircraft Kaggle Dataset

Roboflow Helicopters

USC Drone Dataset

ImageNet

Fine-Grain Visualization Classification Airplane Dataset

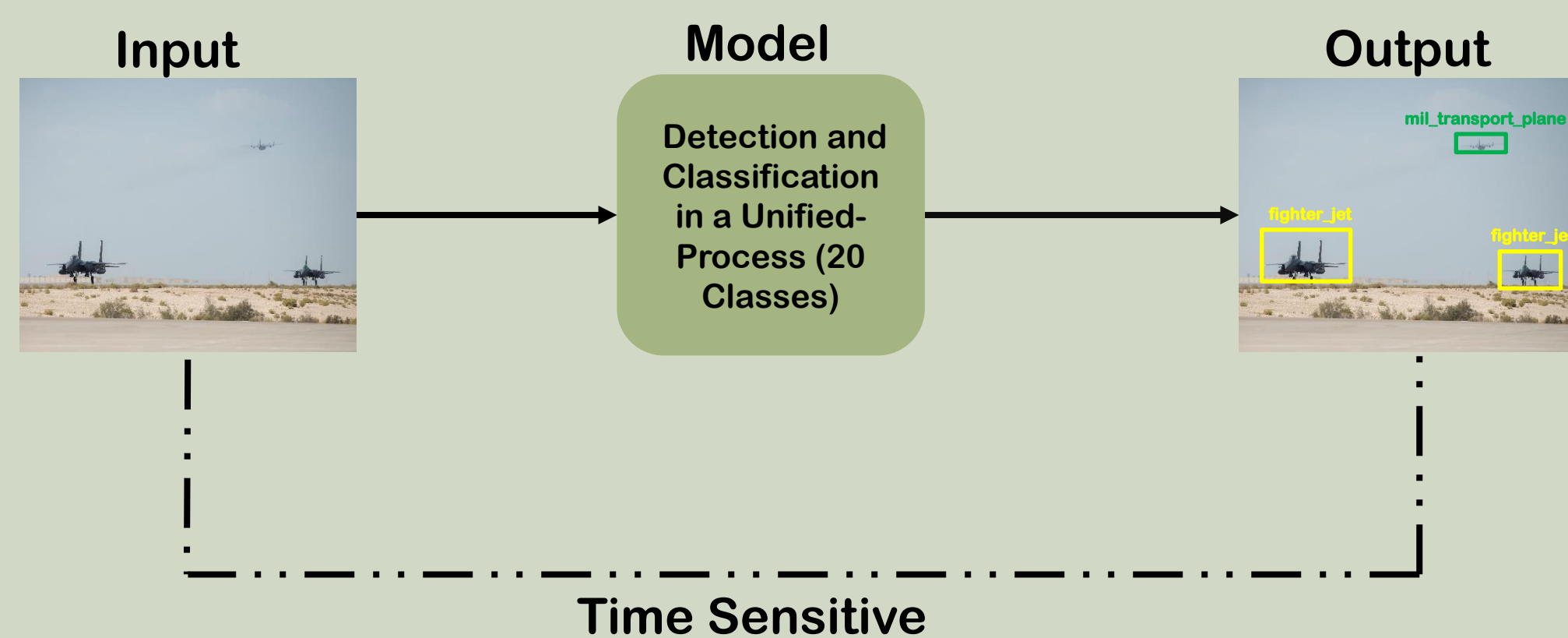
Berkeley Deep Drive Vehicle Dataset

Bicycle Kaggle Dataset

## Objective

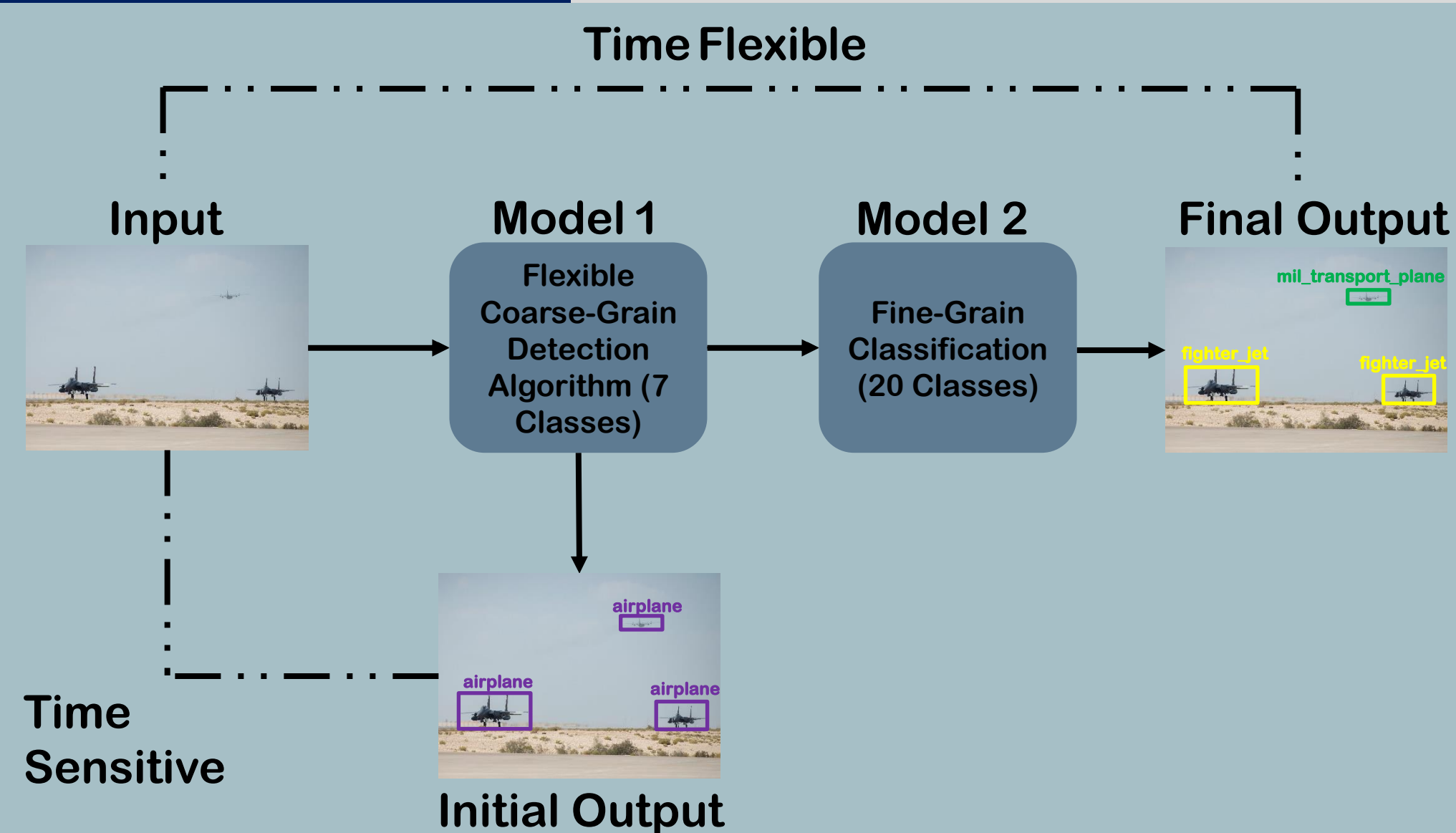
Our goal is to develop a model pipeline capable of both fast inference time and high accuracy in an effort to improve on established MIT LL algorithms.

## Model Pipeline 1



Models: DETECTION TRANSFORMER (DETR)

## Model Pipeline 2



Models:

DETR & Residual Network (ResNet)

DETR & Context-aware Attentional Pooling (CAP)

## Results

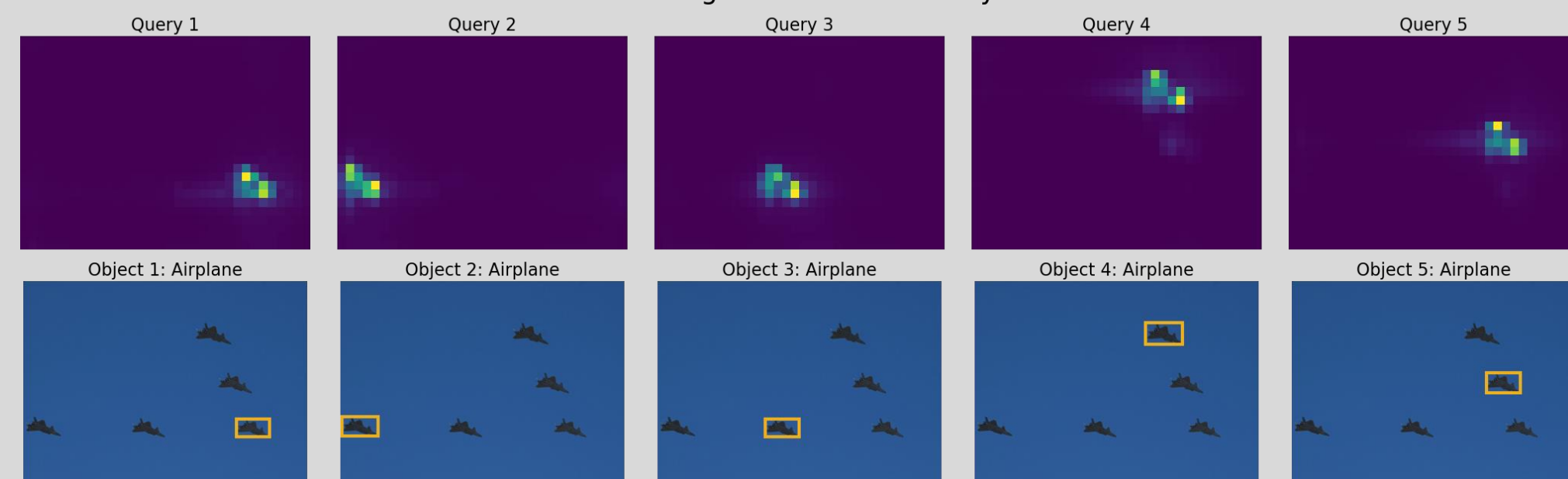


Model Pipeline 2's DETR & CAP was the best performing model.



CAP obtained 0.47% class error which is a 89.52% point class error improvement from Model Pipeline 1.

Visualizing DETR's Decoder Layer



## Impact

Curated a unique fine-grain classification dataset.

Created a model pipeline capable of giving end users fine-grain information allowing them to make informed decisions regarding airspace safety.