YOLOvCAPY

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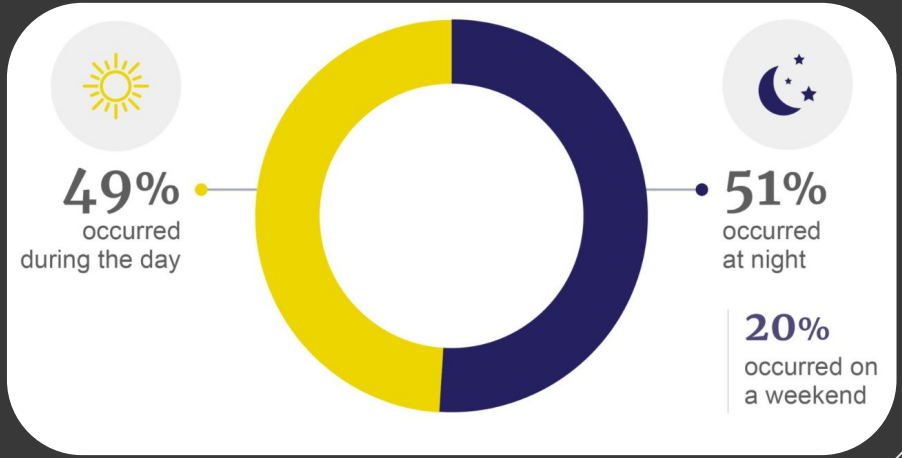
- Nominee Best Paper, 2016 Intelligent Tutoring Systems Conference
- Grace Hopper Scholar 2015
- UNT Graduate Exhibition, 1st Place 2014

Nighttime Driving

- ½ of traffic fatalities occur at night while only ¼ of travel occurs after dark
- Why
  - Drunk driving
  - Fatigue
  - **Impaired Vision**



Thermal Cameras

Research Question

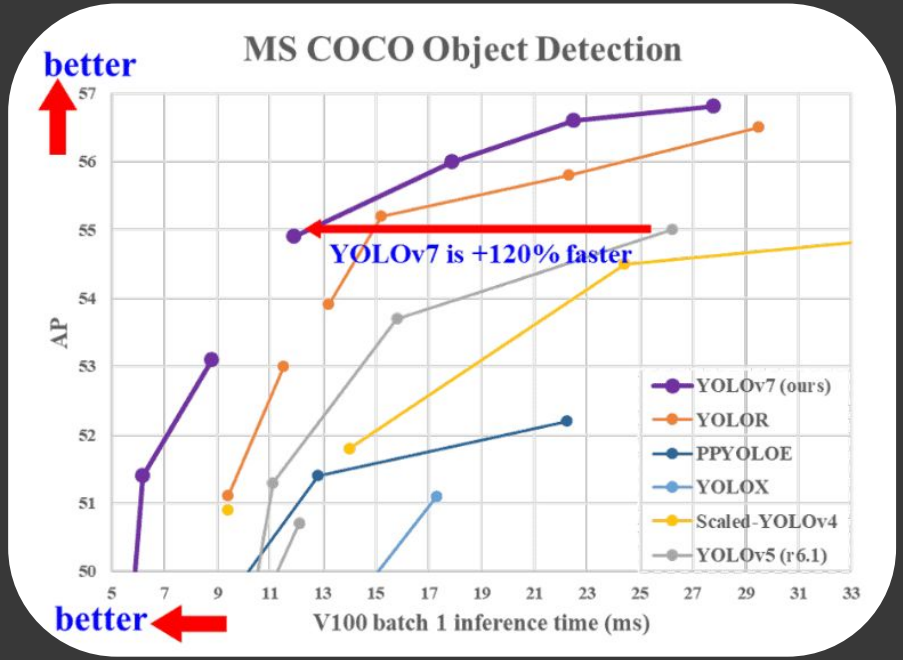
Can we train an AI model such that it is able to effectively detect objects in thermal images?

Data Collection

- Teledyne FLIR
  - Color photos and videos and their thermal counterpart at night.
  - Over 26,442 frames Subjects from more than 15 categories
    - People, bikes, cars, motorcycles, busses, trains, trucks, traffic lights, fire hydrants, street signs, dogs, skateboards, strollers, scooters
    - For our purposes we decreased the number of classes to 12 excluding trains, dogs, scooters, replacing them with “other vehicle” label

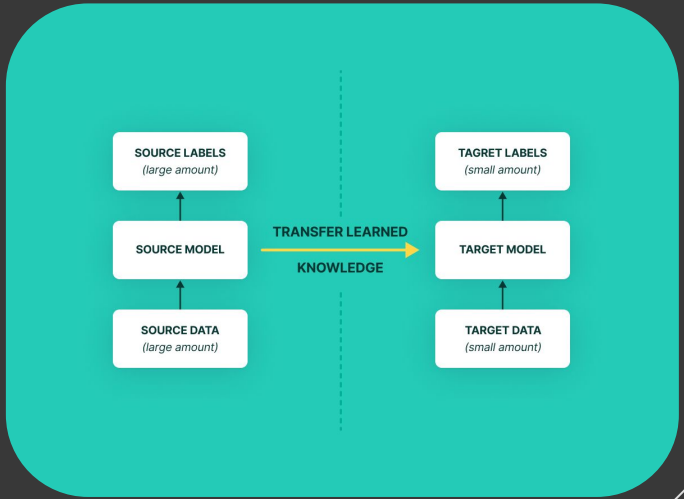
YOLO

- Most popular open source object detection model
- YOLOv7 is the newest iteration
- Fast and Diverse



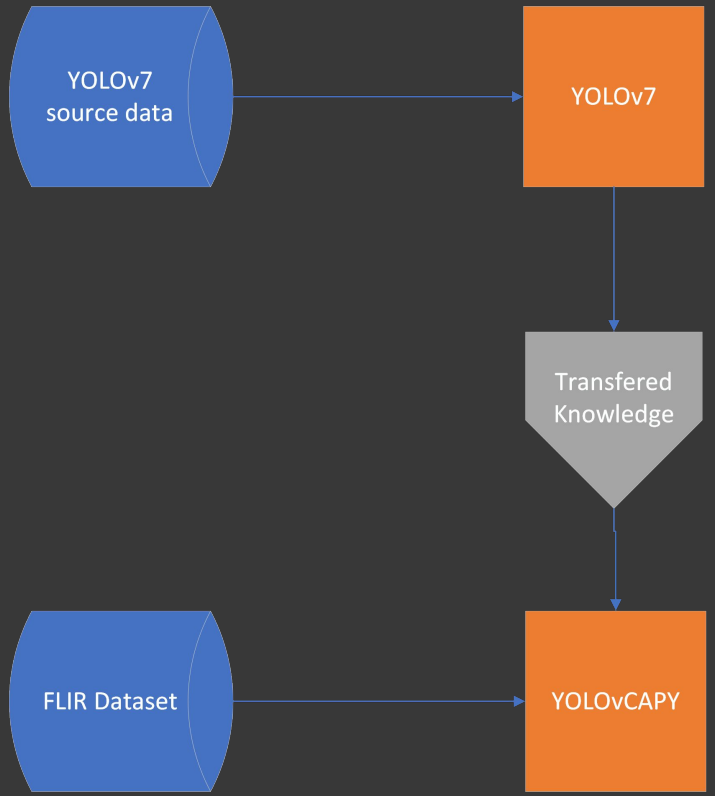
Development Process for YOLOvCapy

- Inductive Transfer learning
  - Using existing **supervised** training model on new (labeled) dataset
  - Many benefits
    - Requires lots of data, time, and resources to train and adjust a neural network from scratch
    - Transfer learning is the cheaper and faster way of adapting neural networks



YOLOvCAPY

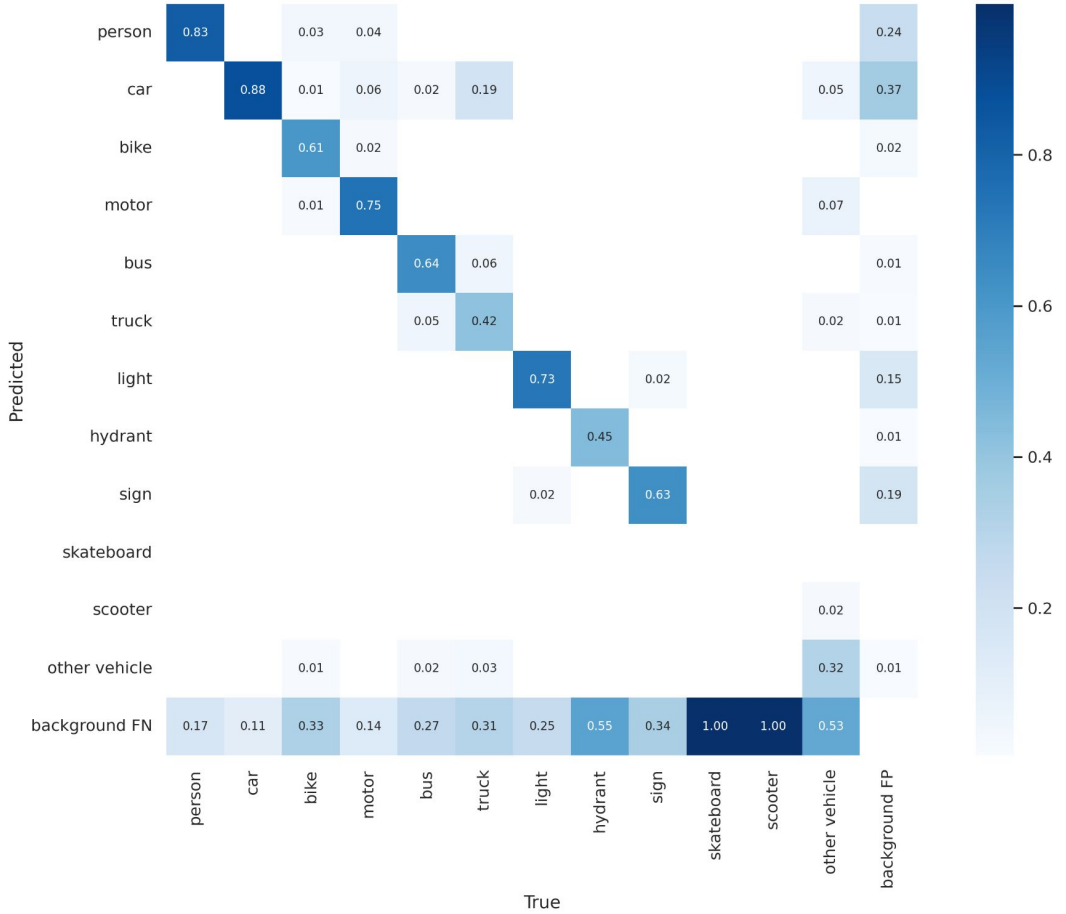
- Inductive Train YOLOv7 on FLIR dataset with new weights
  - Computer Analyzed Photos with Yolo



YOLOvCAPY - DEMO

Confusion Matrix

Label Name	Count
person	50,478
bike	7,237
car	73,623
motor	1,116
bus	2,245
truck	829
light	16,198
hydrant	1,095
sign	20,770
skateboard	29
scooter	15
other vehicle	1,373



F1 SCORE CURVE

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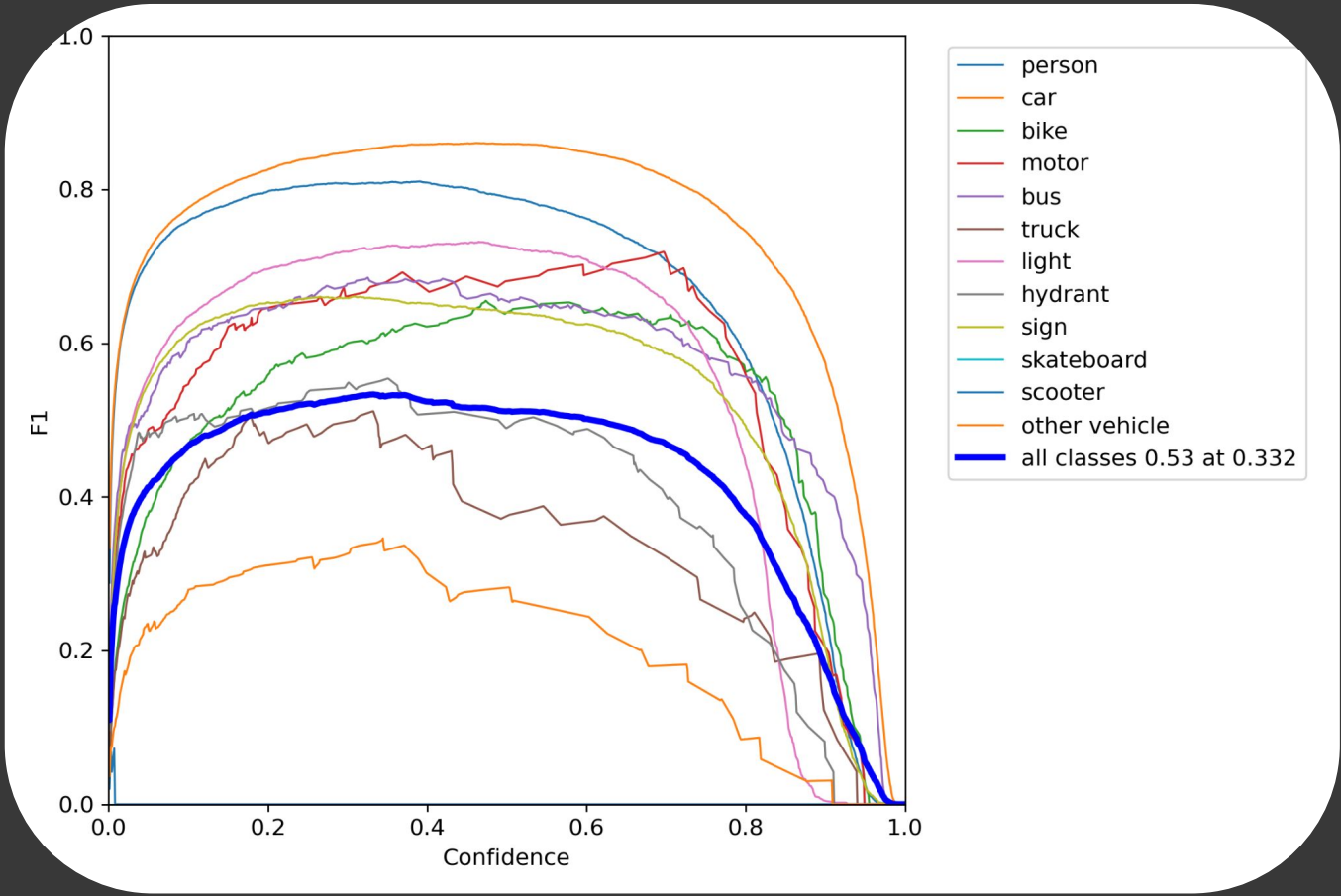
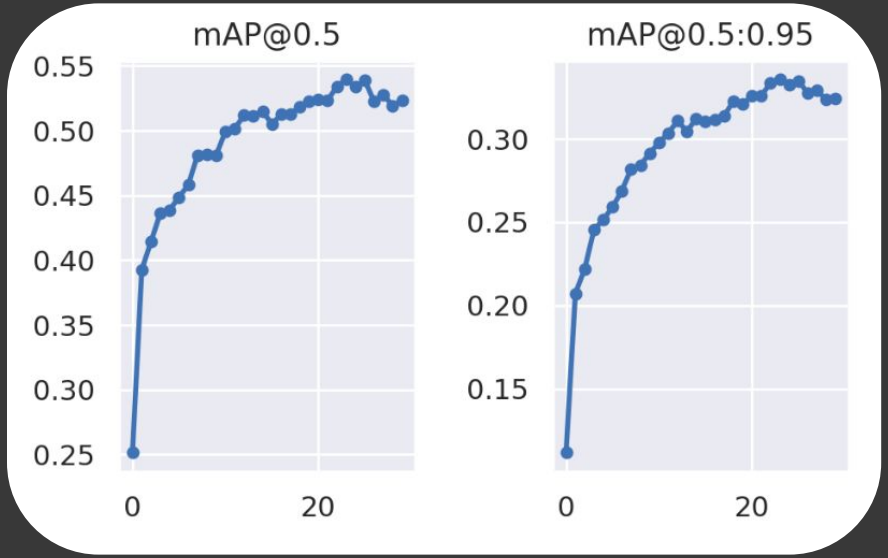


RESULTS

Mean average precision

mAP captures the tradeoff between **precision** and **recall** and maximizes the effect of both metrics on a model

Class	Labels	P	R	mAP@.5	mAP@.5:.95
all	16460	0.745	0.501	0.523	0.324
person	4275	0.832	0.787	0.859	0.519
car	7106	0.851	0.856	0.903	0.652
bike	170	0.596	0.612	0.611	0.394
motor	54	0.682	0.667	0.713	0.403
bus	176	0.756	0.616	0.692	0.497
truck	46	0.55	0.478	0.425	0.292
light	1996	0.756	0.692	0.725	0.351
hydrant	94	0.739	0.436	0.486	0.275
sign	2471	0.726	0.602	0.677	0.425
skateboard	3	1	0	0	0
scooter	6	1	0	0.0156	0.0129
other vehicle	0.457	0.27	0.173	0.0716	



0.523

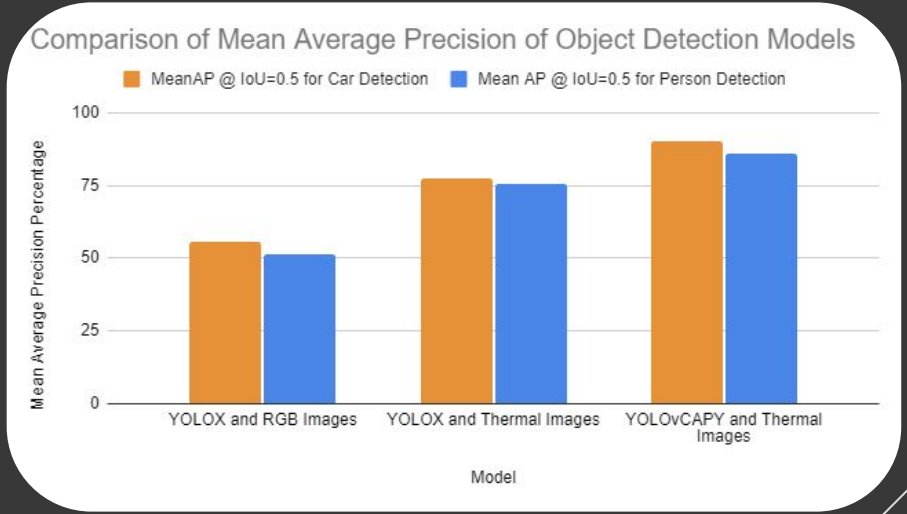
0.324

RESULTS


sign 0.91
light 0.66
sign 0.36
sign 0.32
sign 0.52
car 0.90
person 0.57
car 0.88
car 0.89
person 0.84
motor 0.72
motor 0.71

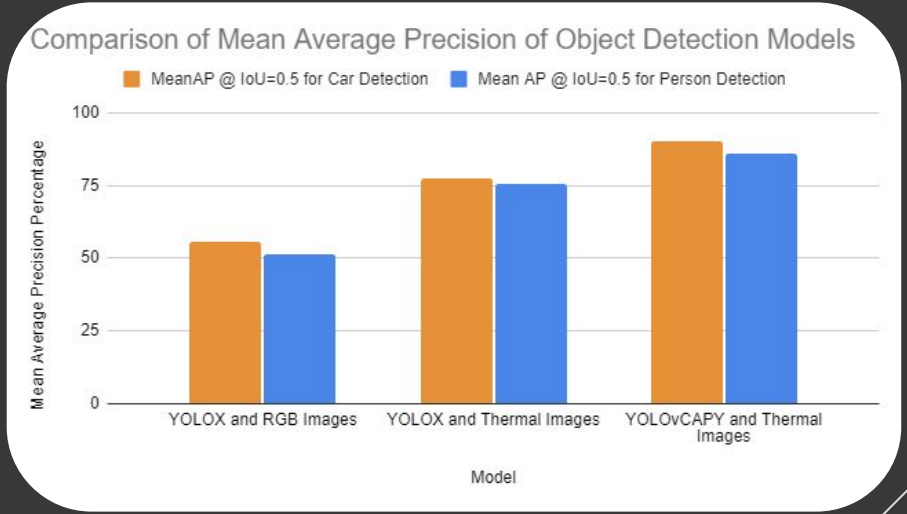
Comparison

- YOLOX
  - FLIR trains YOLOX, a YOLO based model, on the flir dataset
- YOLOvCAPY performs better than FLIR's YOLOX on thermal images
- Both FLIR's YOLOX and YOLOvCAPY run on thermal images outperform FLIR's YOLOX on RGB images
  - Thermal images more effective for night time object detection



Why Does YOLOvCAPY Yield Better Results Than Other Benchmark Models?

- YOLOX is based on an outdated model of YOLO (YOLOv5) while YOLOvCAPY is based the newer generation of YOLO (YOLOv7)
- YOLOvCAPY uses a different set of weights compared to FLIR's YOLOX when they were being trained

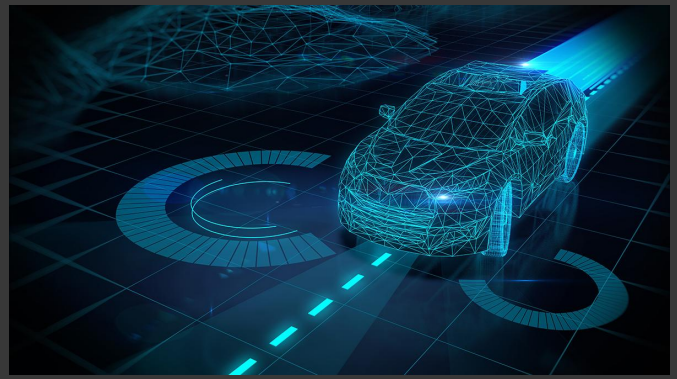


Relevance

- Improved safety in the automotive industry
- Quicker and more accurate reaction times in driving
- Feasibility and applicability in modern technologies

Future Endeavors

- Diversity of Data
  - Current data does not include certain test cases and objects
- Additional Features
  - Improve a vehicles perception of their surrounding
    - Distance from objects
    - Trajectory of objects



Credits: JackyLeung/Getty Images

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“Download Free Adas Dataset V2 - Teledyne FLIR.” Teledyne FLIR, https://adas-dataset-v2.flirconservator.com/#fulldownloadsection.

THANK YOU!