# AlertWildfire

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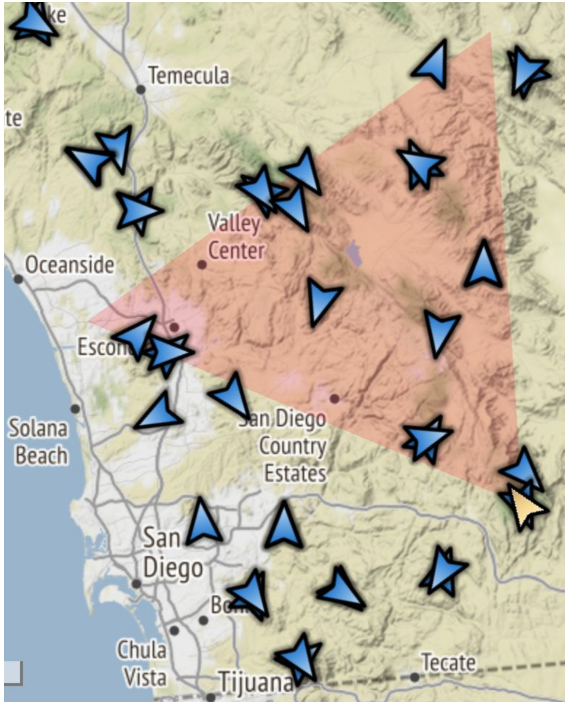
# Background

California suffers from thousands of wildfires each year

There is currently a massive network of cameras around CA, OR, and NV that firefighters and volunteers monitor for wildfires

Early detection of fires could prevent property damage and loss of human life




Cameras on AlertFire's website around San Diego

# Literature Review - Approaches to Fire/Smoke Detection

1. Support Vector Machines [2] - 96%
    a. Extract features with Gaussian Mixture Modeling (GMM)
2. Deep Belief Networks [3] - 95%
    a. Also extracts features with Gaussian Mixture Modeling
3. Deep Convolutional Long-Recurrent Network [4] - 93%
    a. Combine spatial learning (CNN) with sequence learning (LSTM)

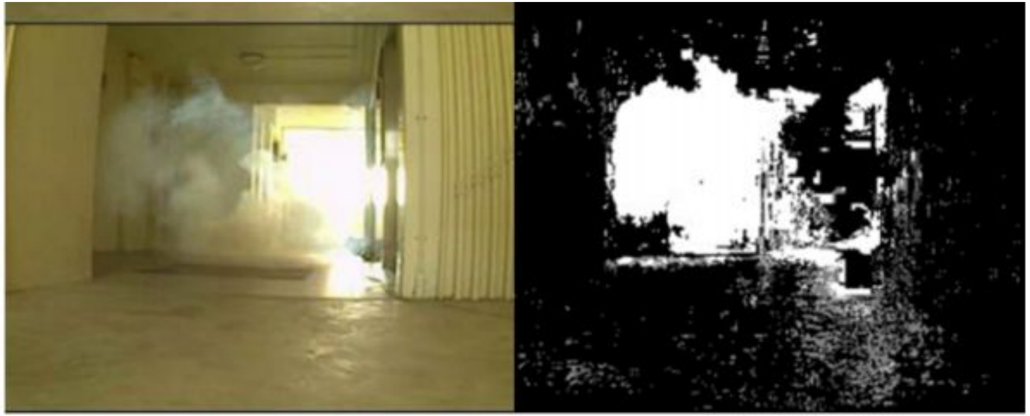


Fig. 2. Example of GMM [4]

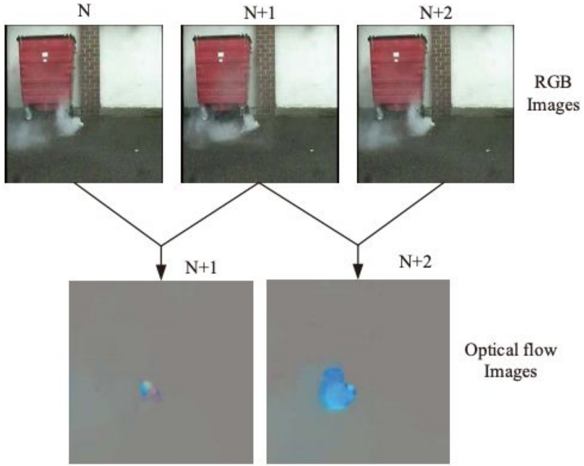


Fig. 3. Example of optical flow feature [5]

# Literature Review 2

**Real-time video fire/smoke detection based on CNN in antifire surveillance systems [5] - 96.8%**

YOLOv2 (You Only Look Once)

Lightweight NN architecture for deployment onto embedded systems

Aim for high detection, low false alarm rate, and processing speed

Use **Anchor Boxes** for detection

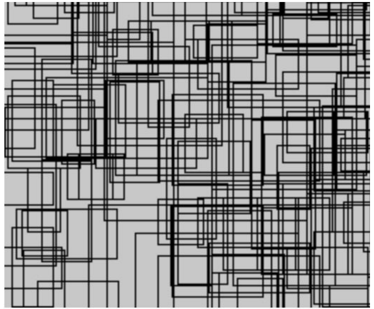


Fig. 4. Example of Anchor boxes [6]


Fig. 5. Sample image from YOLOv2 Results [5]

# How do you think machine learning can help solve this problem

1. **Reduce** human resources and **minimize** human error
2. Leverage **existing resources** to monitor more area
3. **Continuous** sensing
4. **Faster** detection

Fig. 6. Example of discrete smoke detector [7]

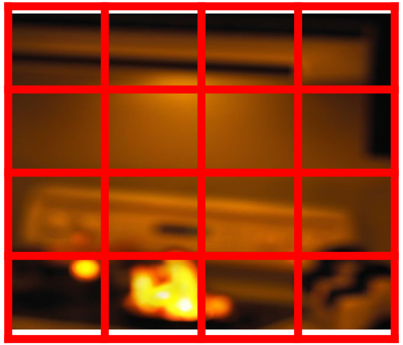


Fig. 7. Example of continuous sensing with digital imager

# Details on the datasets

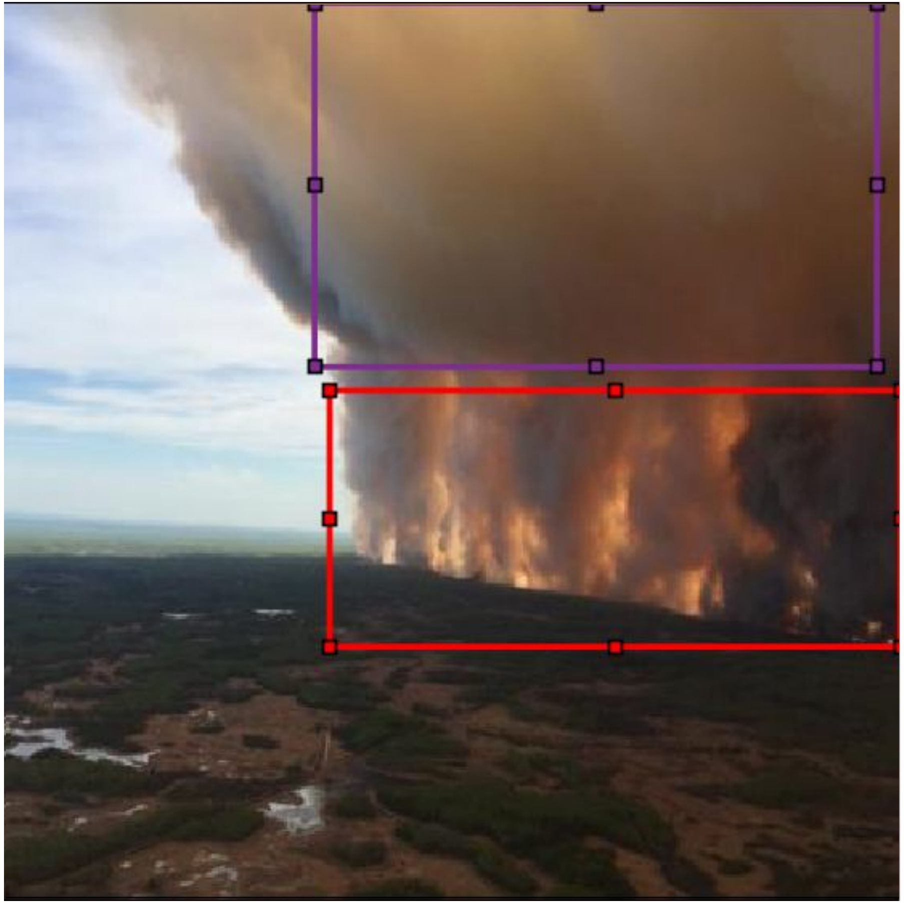
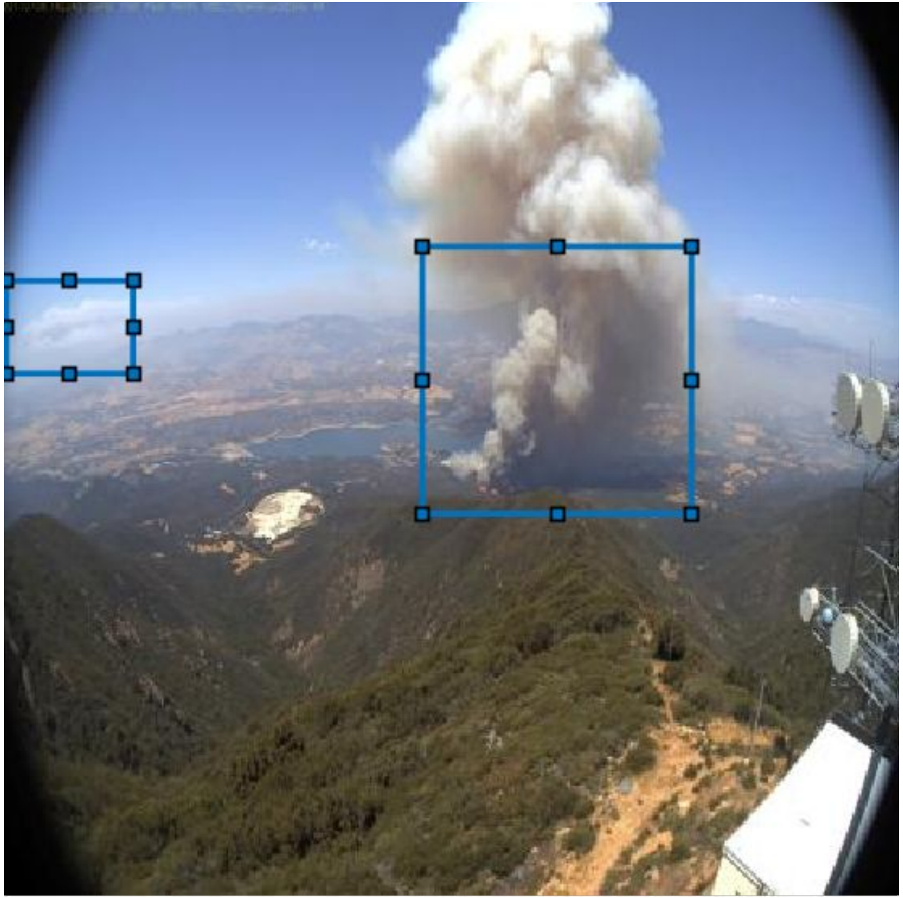
## Kaggle Dataset

Split 45/23/32 (% Train/Validation/Test)

Fig. 8. Sample Images from Kaggle Dataset [5]

## Team’s Wildfire Dataset

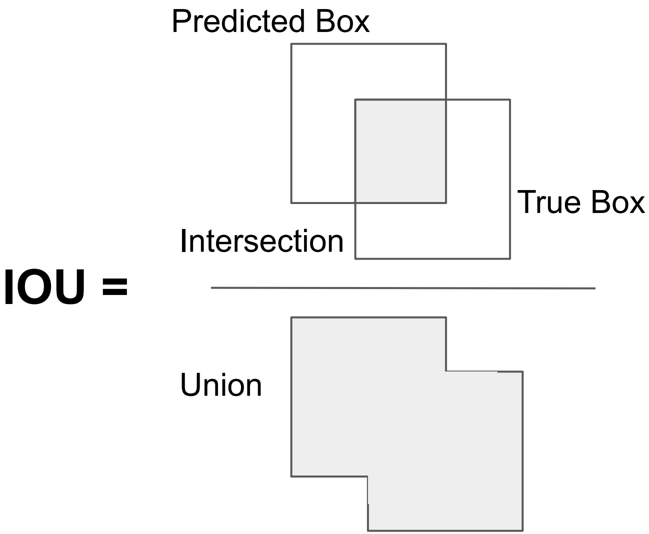
Split 80/10/10 (% Train/Validation/Test)

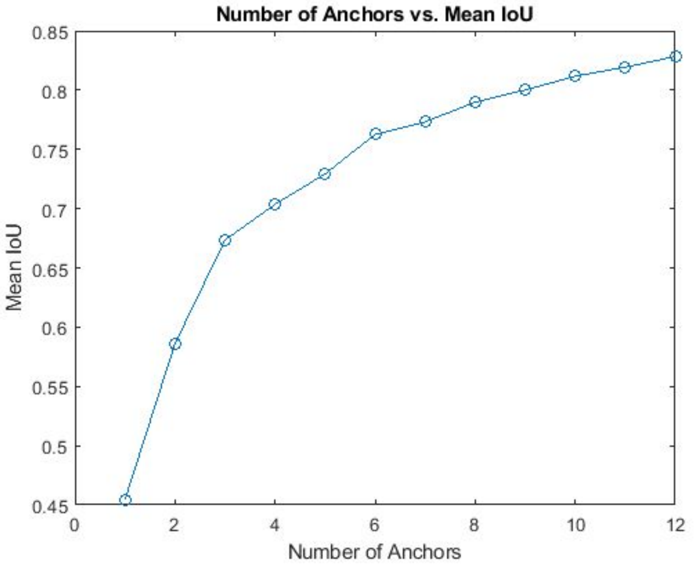



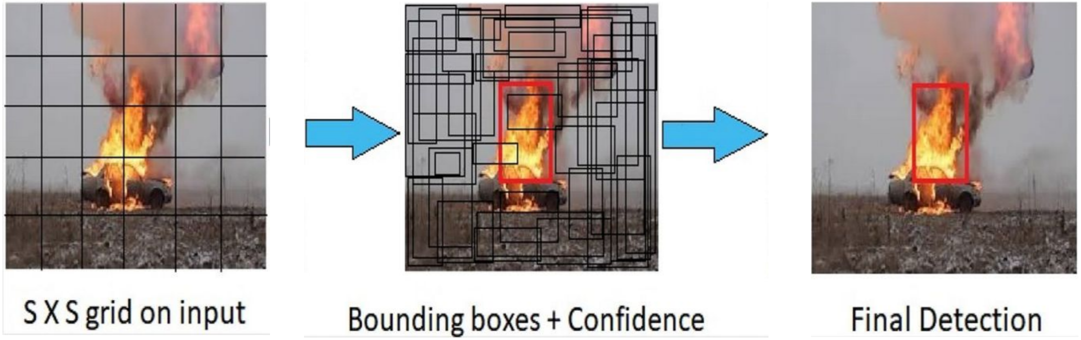
# Details on Feature Extraction Used

Intersection over Union (IOU)

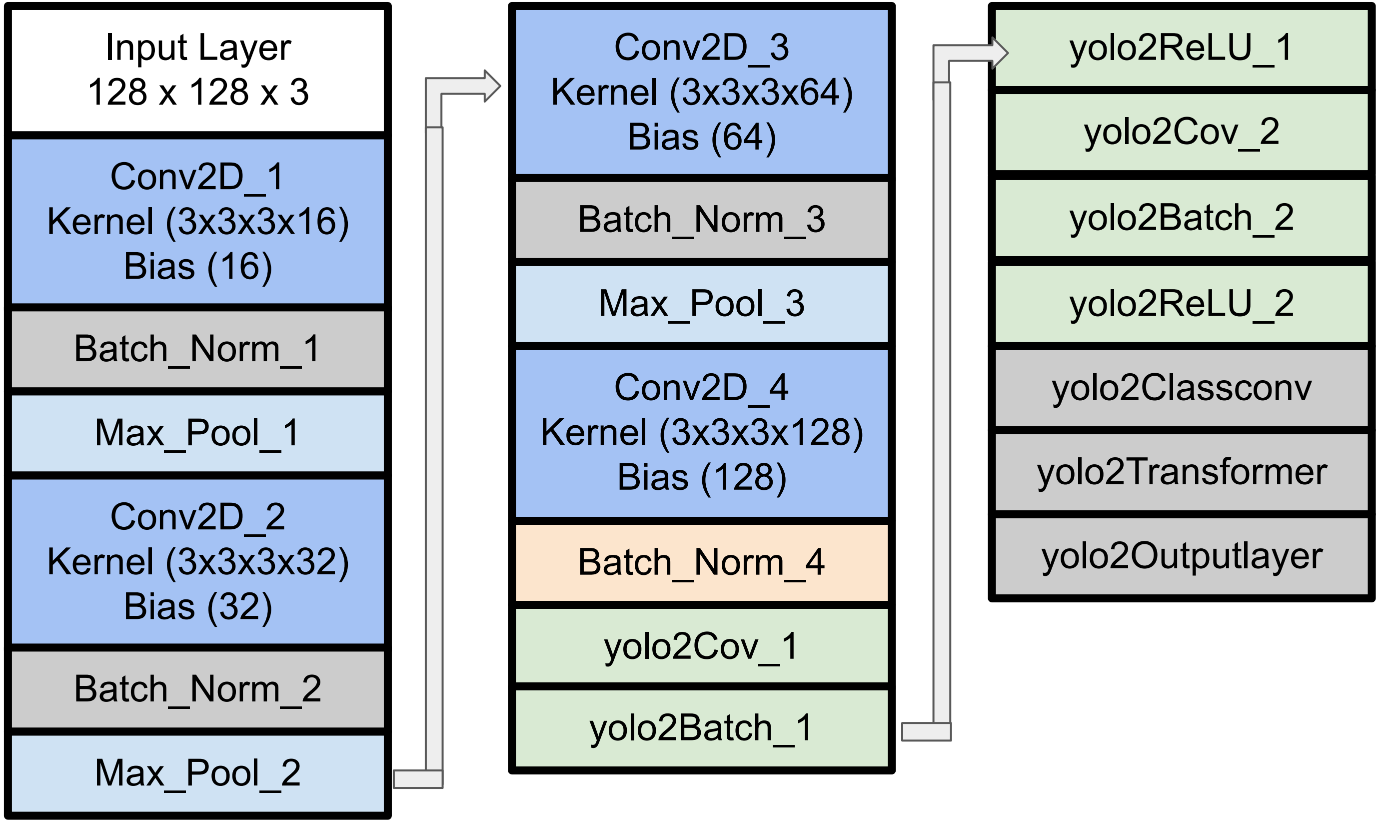
Anchor boxes and Bounding Boxes

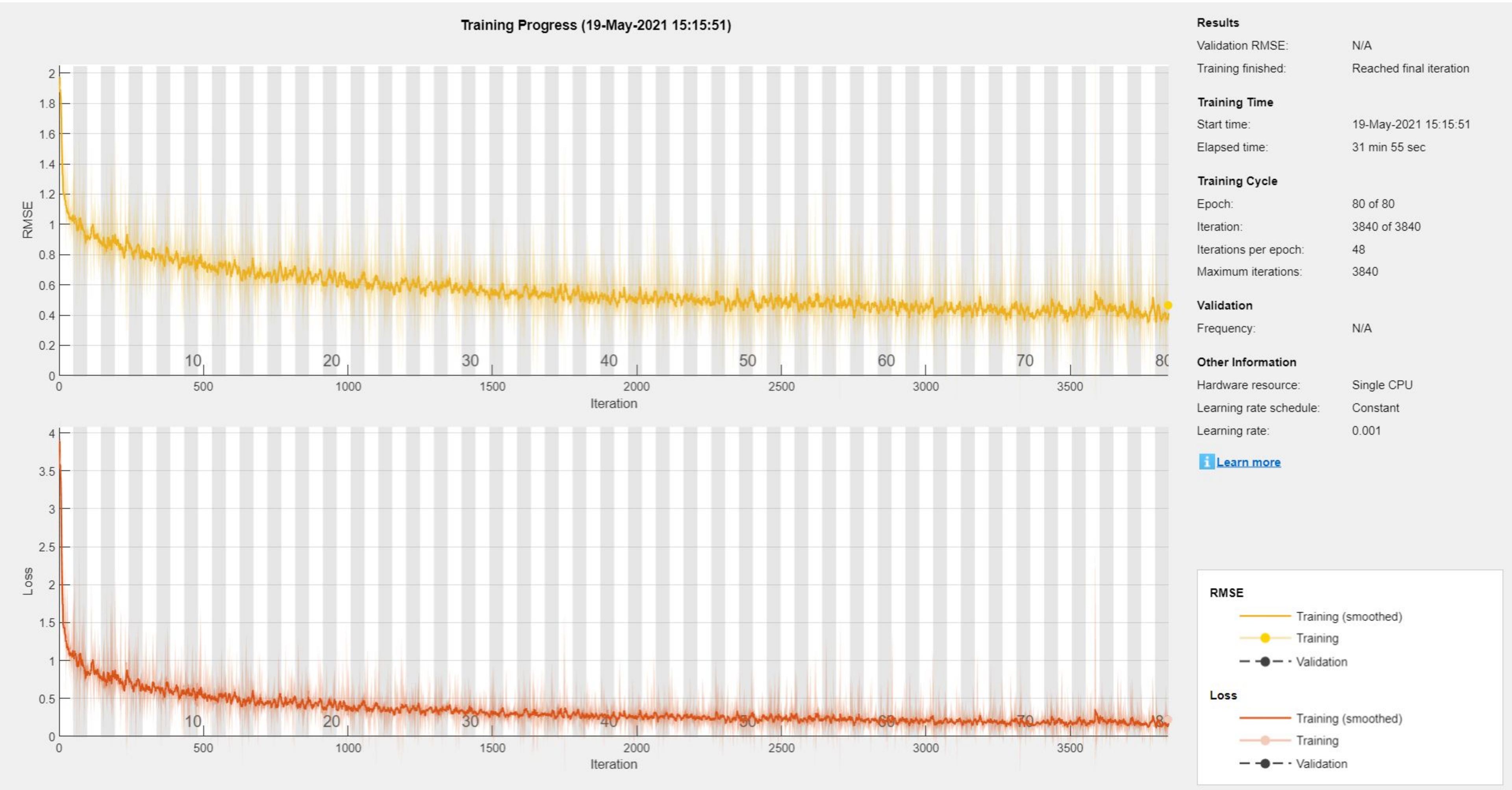


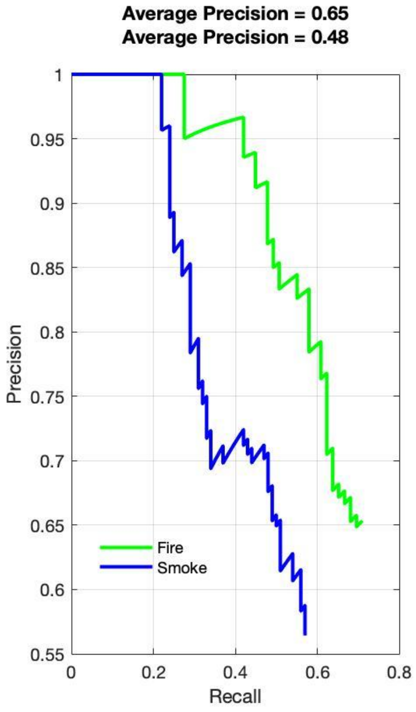
# Details on the model used - YOLOv2

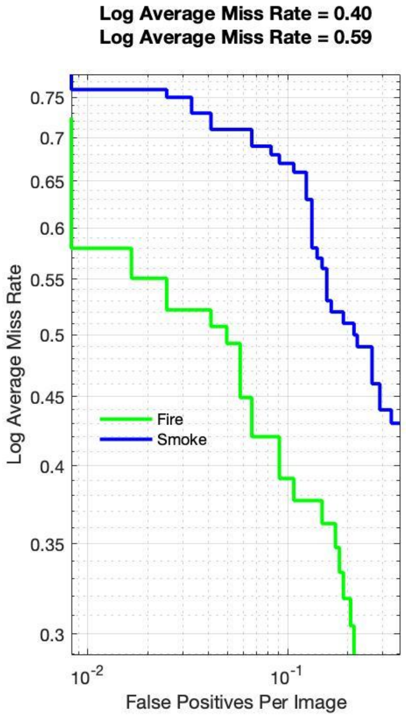



Training Progress (19-May-2021 15:15:51)
RMSE
Loss
Iteration
Results
Validation RMSE: N/A
Training finished: Reached final iteration
Training Time
Start time: 19-May-2021 15:15:51
Elapsed time: 31 min 55 sec
Training Cycle
Epoch: 80 of 80
Iteration: 3840 of 3840
Iterations per epoch: 48
Maximum iterations: 3840
Validation
Frequency: N/A
Other Information
Hardware resource: Single CPU
Learning rate schedule: Constant
Learning rate: 0.001
Learn more
RMSE
Training (smoothed)
Training
Validation
Loss
Training (smoothed)
Training
Validation

# Results and Observations

## Kaggle Dataset




## Wildfire Dataset

| | |
|---|---|
| **TP** 433 | **FP** 30 |
| **FN** 0 | **TN** 229 |

Precision = 93% ; (TP) / (TP + FP)
Recall = 100% ; (TP) / (TP + FN)
Log Average Miss Rate = 0%
False Positives Per Image = 7%

# Items to be completed before report submission

- Cross validation of hyperparameters (RandomizedSearchCV)
- Training on dataset with multiple fires
- Incorporate a 4th channel of input images (monochrome)

# References


[1] http://www.alertwildfire.org/sdge/index.html?v=7a7f1c3

[2] W. Yuanbin, "Smoke Recognition Based on Machine Vision," *2016 International Symposium on Computer, Consumer and Control (IS3C)*, 2016, pp. 668-671, doi: 10.1109/IS3C.2016.172.

[3] R. Kaabi, M. Sayadi, M. Bouchouicha, F. Fnaiech, E. Moreau and J. M. Ginoux, "Early smoke detection of forest wildfire video using deep belief network," *2018 4th International Conference on Advanced Technologies for Signal and Image Processing (ATSIP)*, 2018, pp. 1-6, doi: 10.1109/ATSIP.2018.8364446.

[4] C. Hu, P. Tang, W. Jin, Z. He and W. Li, "Real-Time Fire Detection Based on Deep Convolutional Long-Recurrent Networks and Optical Flow Method," *2018 37th Chinese Control Conference (CCC)*, 2018, pp. 9061-9066, doi: 10.23919/ChiCC.2018.8483118.

[5] Saponara, S., Elhanashi, A. & Gagliardi, A. “Real-time video fire/smoke detection based on CNN in antifire surveillance systems.” *J Real-Time Image Proc* 18, 889–900 (2021). https://doi.org/10.1007/s11554-020-01044-0

[6] Christiansen, A. “Anchor Boxes — The key to quality object detection,” *towards data science,* 2018. https://towardsdatascience.com/anchor-boxes-the-key-to-quality-object-detection-ddf9d612d4f9

[7] Avid Risk. “Why are Smoke Detectors so Important?” *Avid Risk Solutions,* 2018. https://www.avidrisk.com/smoke-detectors-important/

# Ryley: Presents Code

1. Next 5 to 10 minutes - Give a run down of your code as part of the same video.
   a. Go over the high level details of your code on say jupyter notebook/matlab live script for eg.
   b. Do a live run to generate test results - captured in this video. Do this test run only for tests that take less than say 30 seconds to generate plots.