



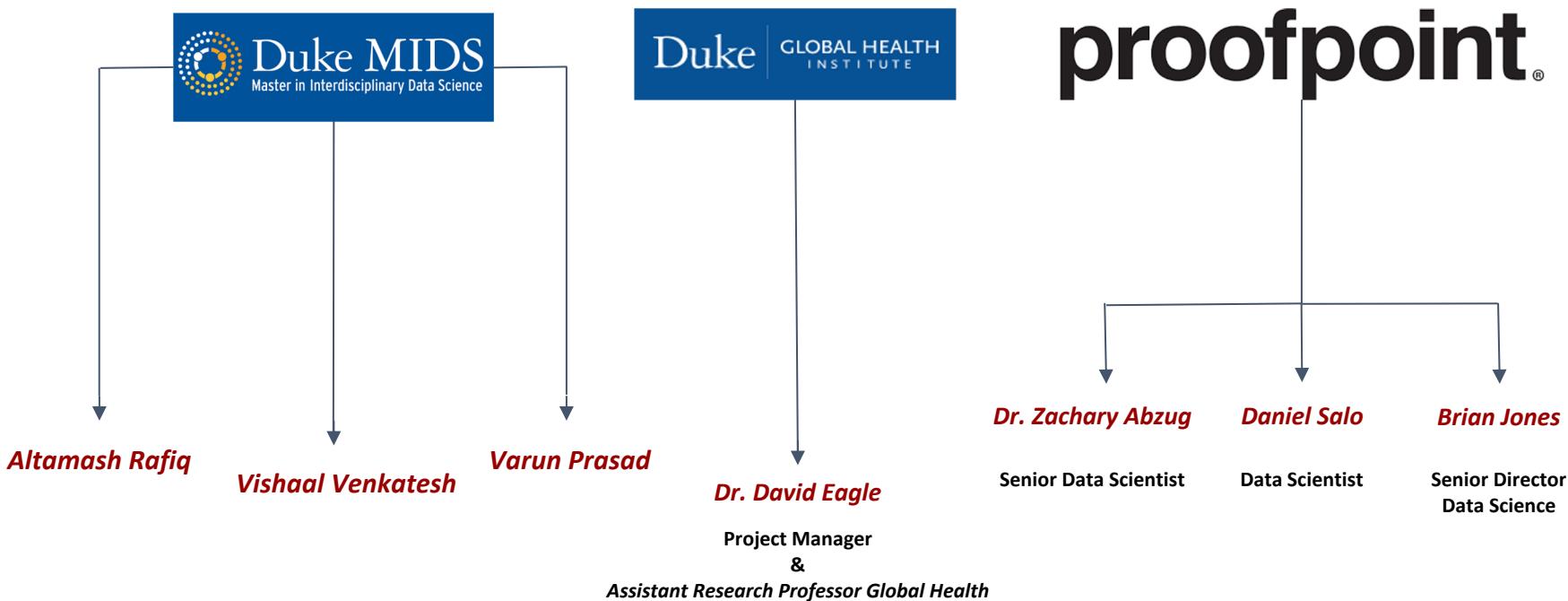
# Open-World Logo Detection & Classification

MIDS Symposium

April 9th, 2021

Duke

# The Duke Team



Duke

# Brief Problem Overview

Duke

# Project Goals/Significance

- Brand impersonation is common in phishing attacks
- Additional tool for Proofpoint to combat brand impersonation
- Curate well-annotated database of website screenshots and logos
- Develop robust models that both detect logos and identify the brand



<https://highperformanceadvocates.com/goal-person-system-person/>

Duke

Real Logo



Unfortunately the delivery of your order [COS-0077945599](#) was cancelled since the specified address of the recipient was not correct. You are recommended to complete [this form](#) and send it back with your reply to us.

Please do this within the period of one week - if we dont get your timely reply you will be paid your money back less 21% since your order was booked for Christmas.

1998 - 2013  
Costco Wholesale Corporation  
All rights reserved

*"Costco's" logo is just a bit off. This is what the Costco logo is supposed to look like.*



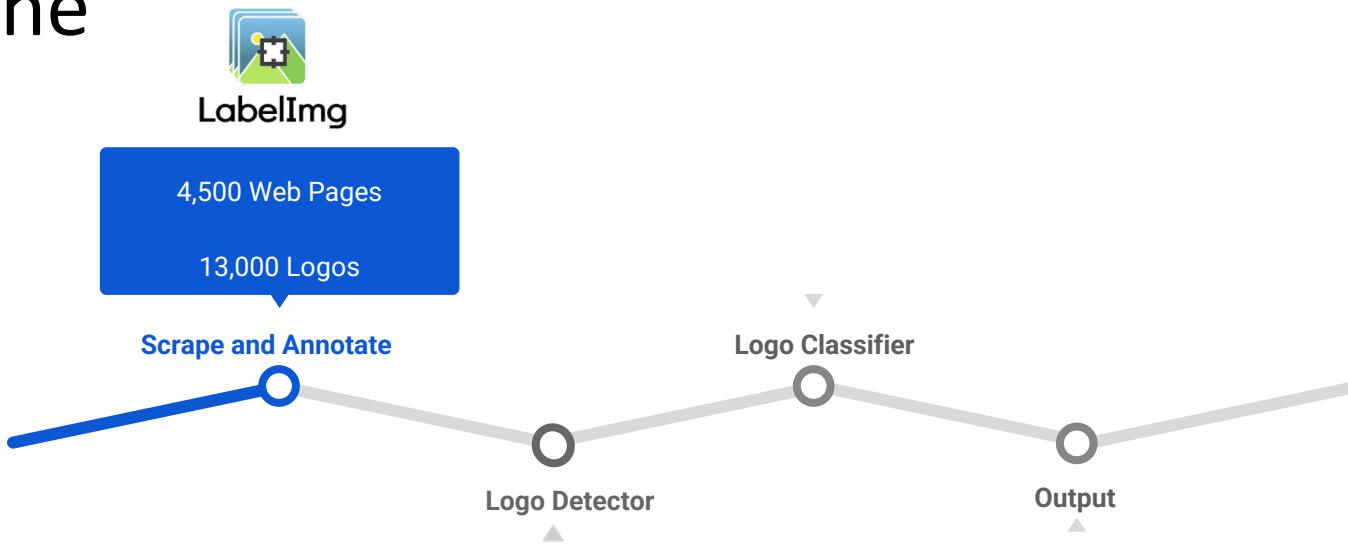
*See the difference? Subtle, no?*

Duke

# Pipeline

Duke

# Pipeline



[News](#)[Products](#)[Contact](#)

Search

[News in Focus](#)[Business & Money](#)[Science & Tech](#)[Lifestyle & Health](#)[Policy & Public Interest](#)[People & Culture](#)

# Equinix Expands Rio de Janeiro Data Center

New phase will nearly double the total capacity to meet customer demand for data center colocation

**EQUINIX**

WHERE OPPORTUNITY CONNECTS

NEWS PROVIDED BY

[Equinix, Inc. →](#)

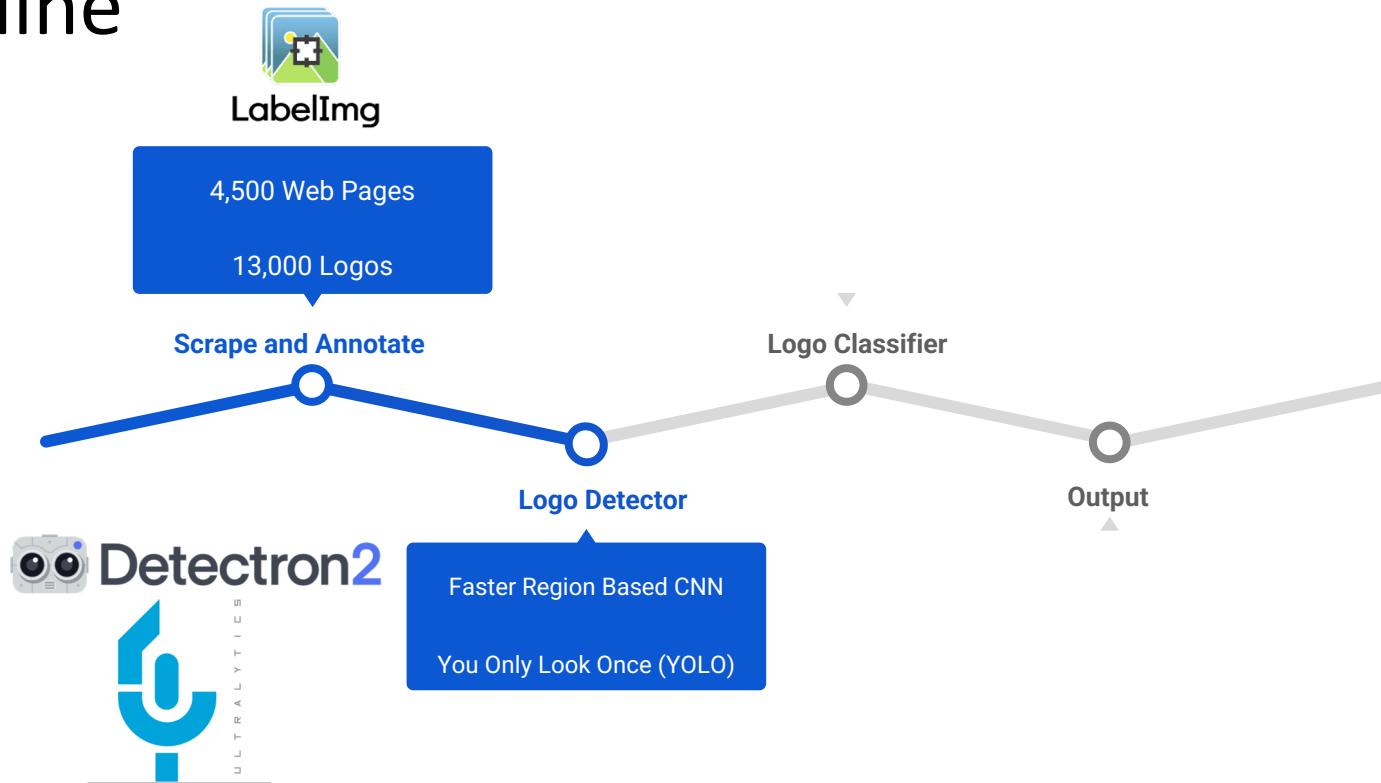
Mar 31, 2015, 07:00 ET

SHARE THIS ARTICLE



REDWOOD CITY, Calif. and RIO de JANEIRO, March 31, 2015 /PRNewswire/ -- [Equinix, Inc.](#) (Nasdaq: [EQIX](#)), the global interconnection and [data center company](#), today announced it is expanding its [Rio de Janeiro data center](#) known as RJ2. This new phase of expansion is scheduled to open in Q3 of this year and will enable Equinix to continue to meet

# Pipeline





News

Products

Contact

Search

News in Focus

Business &amp; Money

Science &amp; Tech

Lifestyle &amp; Health

Policy &amp; Public Interest

People &amp; Culture

# Equinix Expands Rio de Janeiro Data Center

New phase will nearly double the total capacity to meet customer demand for data center colocation



NEWS PROVIDED BY

[Equinix, Inc. →](#)

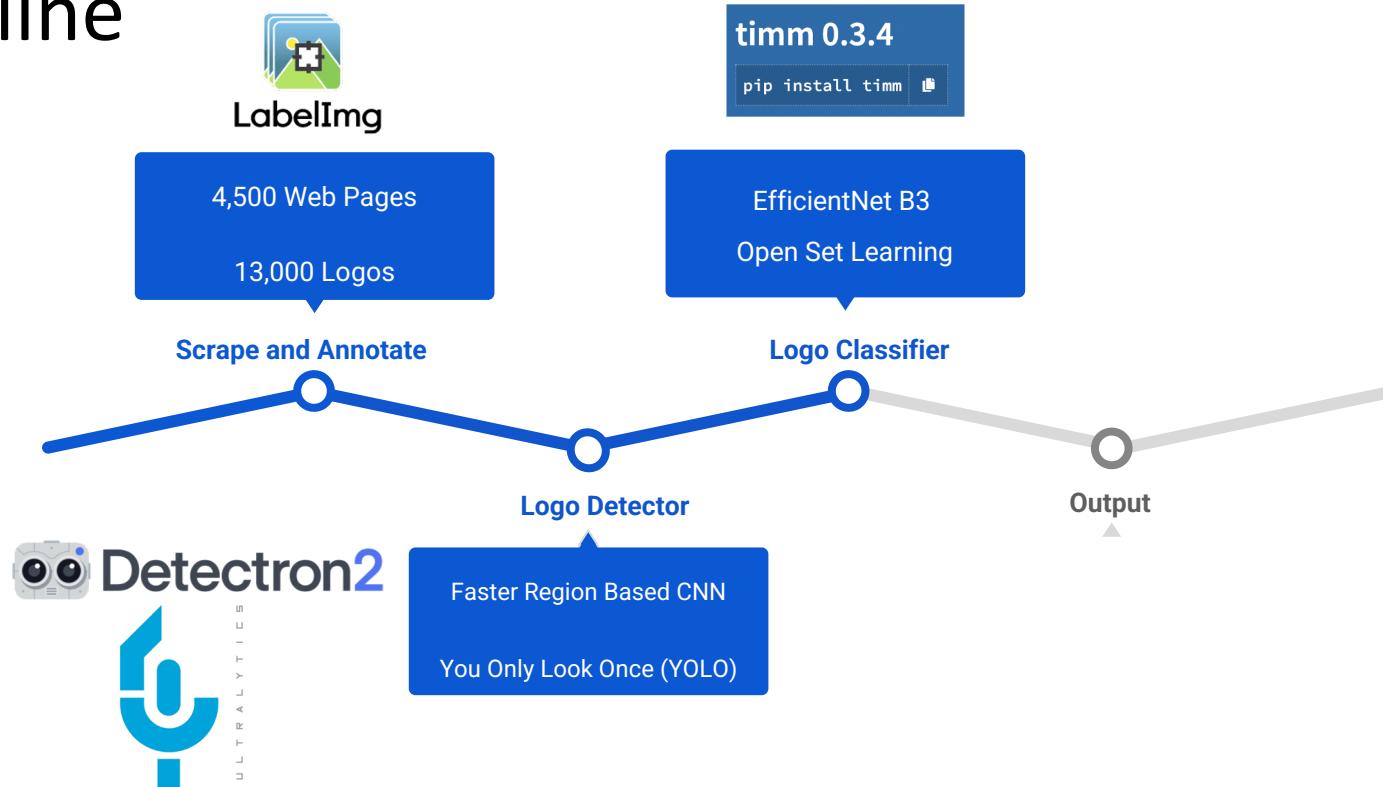
Mar 31, 2015, 07:00 ET

SHARE THIS ARTICLE



REDWOOD CITY, Calif. and RIO de JANEIRO, March 31, 2015 /PRNewswire/ -- [Equinix, Inc.](#) (Nasdaq: EQIX), the global interconnection and [data center company](#), today announced it is expanding its [Rio de Janeiro data center](#) known as RJ2. This new phase of expansion is scheduled to open in Q3 of this year and will enable Equinix to continue to meet

# Pipeline



Resources Blog Journalists

Log In Sign Up Data Privacy Send a Release

Unknown



News

Products

Contact

Search

News in Focus

Business & Money

Science & Tech

Lifestyle & Health

Policy & Public Interest

People & Culture

# Equinix Expands Rio de Janeiro Data Center

New phase will nearly double the total capacity to meet customer demand for data center colocation



NEWS PROVIDED BY

[Equinix, Inc.](#)

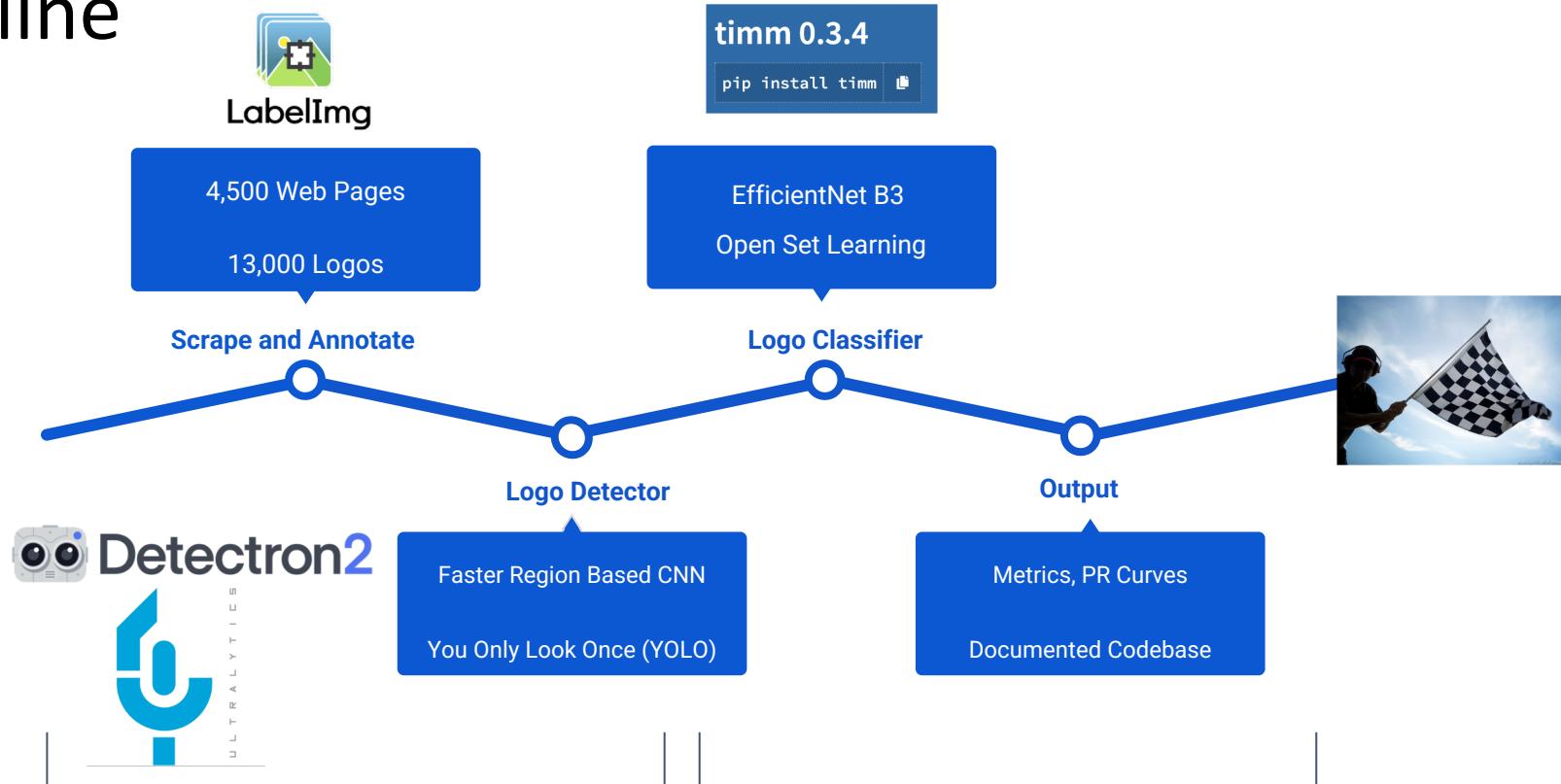
Mar 31, 2015, 07:00 ET



REDWOOD CITY, Calif. and RIO de JANEIRO, March 31, 2015 /PRNewswire/ -- Equinix, Inc. (Nasdaq: EQIX), the global interconnection and data center company, today announced it is expanding its Rio de Janeiro data center known as RJ2. This new phase of expansion is scheduled to open in Q3 of this year and will enable Equinix to continue to meet

uke

# Pipeline



Fall 2020

Spring 2021

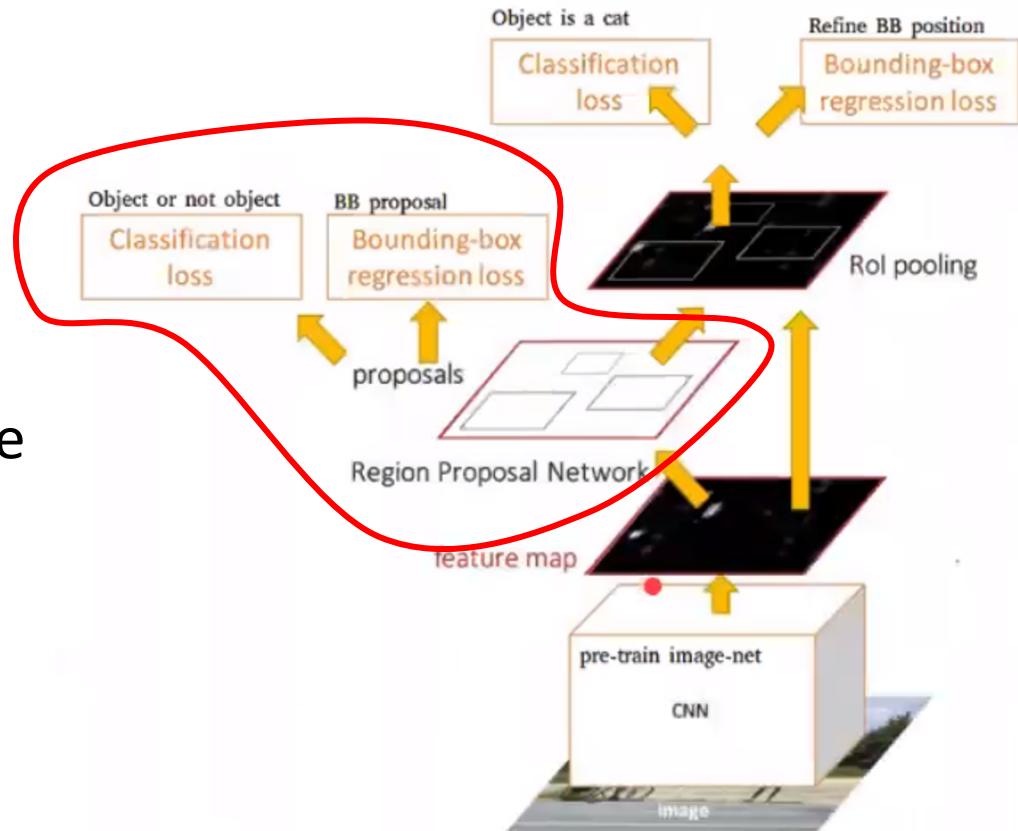
Duke

# Models

Duke

# Faster R-CNN (2016)

- Two Stage Process
- Slower but more accurate
- ResNeXt 101 + FPN

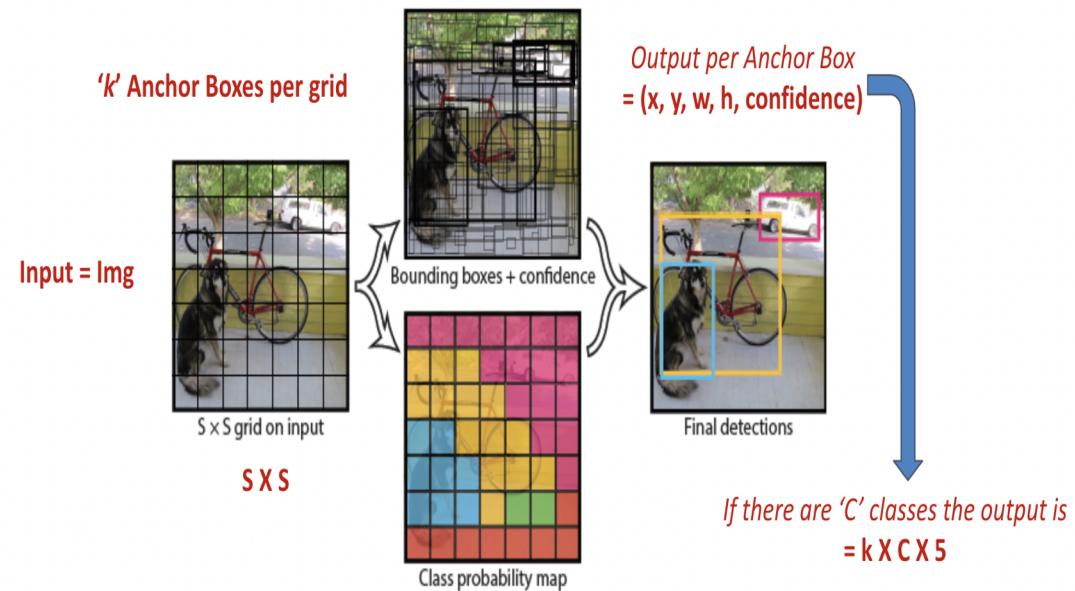


# YOLO v3

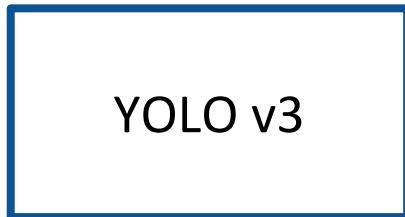
- One Stage Process

- Faster but less accurate

- DarkNet 53 + SPN



# Why Train Both YOLO and RCNN?



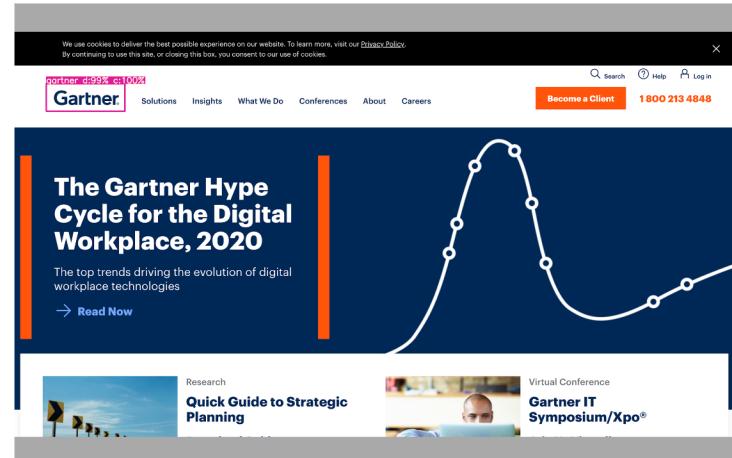
**3.4x Faster**



0.044s / image



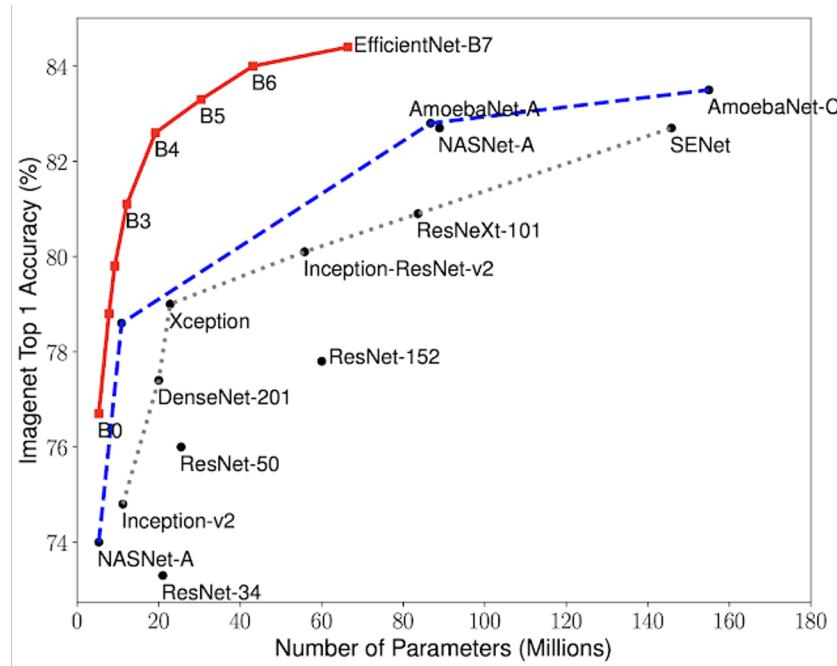
0.149s / image



\*Using Tesla V100-SXM2-16GB

Duke

# Classifier Architecture: EfficientNet



# Constructing Classifier

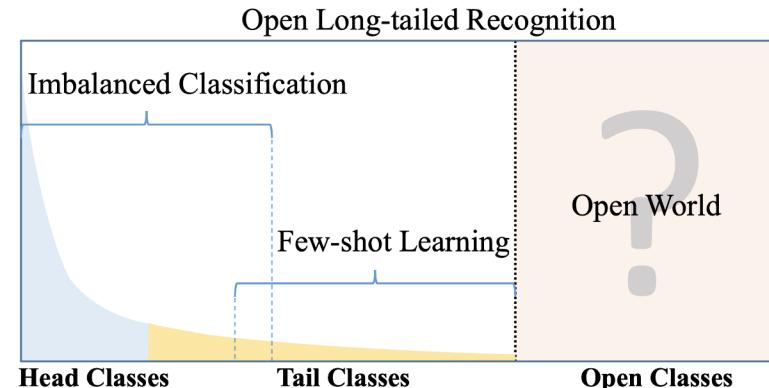
- Image Data
  - Classes (brands) from S&P 500, technology, financial, internet categories
    - Facebook, Twitter, Amazon, AMD, etc.
  - High resolution images from Bing image downloader
  - Extracted logos from our annotations
- Models
  - 1,098 Class (Brands) Model → deployment
  - 32 Class (Brands) Model → experimental
- Speed on Tesla V100
  - 0.05s per screenshot → 0.0125s per logo

# Open Set Learning

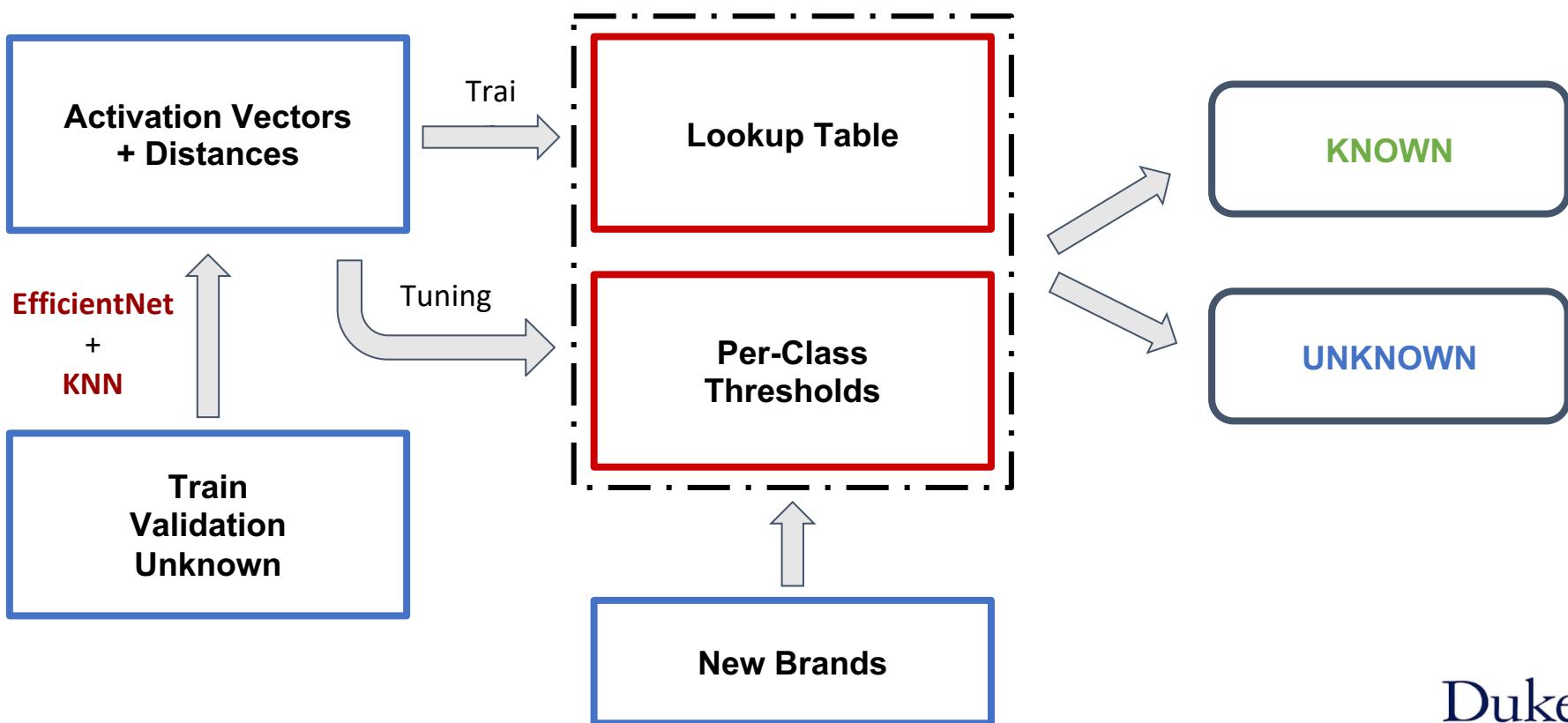
Duke

# What is Open Set Learning?

- We want our model to be able to say “This is a logo I don’t recognize.”
- Drastically reduce the chances of misclassification into known categories.



# Open Set K-Nearest Neighbors Classification



# Results

Duke



im\_smucker



PRODUCTS ▾

RECIPES ▾

ABOUT ▾



FATHER  
NATURE™  
TESTED,

*Mother Nature  
Approved.*

With real fruit as the first ingredient, it's no wonder that Smucker's® Natural Strawberry Fruit Spread is natural enough for the Nature family.

[LEARN MORE](#)

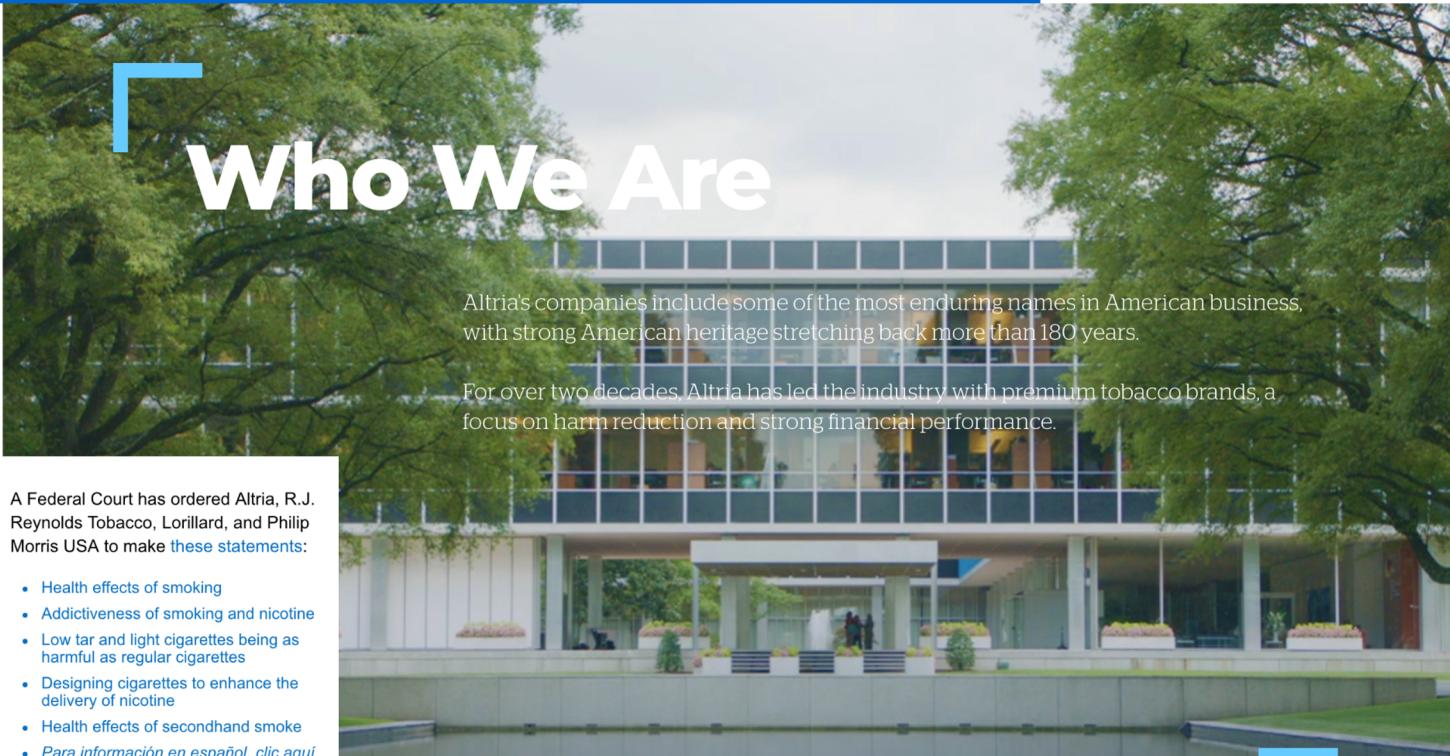
uke



# Who We Are

Altria's companies include some of the most enduring names in American business, with strong American heritage stretching back more than 180 years.

For over two decades, Altria has led the industry with premium tobacco brands, a focus on harm reduction and strong financial performance.



A Federal Court has ordered Altria, R.J. Reynolds Tobacco, Lorillard, and Philip Morris USA to make [these statements](#):

- Health effects of smoking
- Addictiveness of smoking and nicotine
- Low tar and light cigarettes being as harmful as regular cigarettes
- Designing cigarettes to enhance the delivery of nicotine
- Health effects of secondhand smoke
- *Para información en español, clic aquí*

Unknown



Products Pricing About us

CREATE A LOGO

Home

How To

Design

Logo & branding

Great Brands Logos

General

Tips

Customer Stories

File Format



# FedEx Logo: Evolution and Hidden Meaning

Roman Rogoza

Updated March 27, 2020

★ ★ ★ ★ ★ (9 votes, average: 3.56 out of 5)

Logaster / Blog / Logo & branding

The FedEx company was founded in 1971 as a packaging delivery startup. Over several decades, it has developed into a powerful logistics brand and trend setter. The company's award-winning logo became one of factors behind the mind-blowing success of FedEx.

1. [Meaning behind FedEx logo](#)
2. [Background and evolution](#)

Unknown

# LOGOSAVE

Search 300.000+ vector logos!

SEARCH

Eg: Facebook, Google, Youtube, Apple, Gmail, Instagram, Whatsapp, Snapchat, Coca Cola, Pepsi, Samsung, Chevrolet, Renault, BMW

Brand Logos ▾ [+ Advanced Search]

facebook 1.5k twitter 1.0k google\_plus 1.2k interest 140

Unknown



TAILOR BRANDS



Aloha SURF SHOP

DESIGN A LOGO IN 5 MINUTES



Logo > Category > Transport > Norfolk Southern Corp Logo Vector

## Norfolk Southern Corp Logo Vector



ADVERTISEMENT

Unkn \$5 ONLY

## DESIGN A LOGO STARTING AT \$5 ONLY

Unknown Unknown



START NOW

uke

ametek

[ABOUT US ▾](#)[PRODUCTS ▾](#)[NEWS ▾](#)[INVESTORS ▾](#)[CAREERS](#)[CONTACT US](#)

USA - English ▾



## Aerospace & Defense



### Aerospace & Defense

Aircraft components, including cockpit instruments, engine sensors, and thermal management systems, as well as maintenance, repair and overhaul services worldwide

[READ MORE >](#)

Unknown

### AMETEK AT A GLANCE

**AMETEK, Inc. is a leading global manufacturer of electronic instruments and electromechanical devices with annual sales of approximately \$5 billion.**

AMETEK has 17,000 colleagues at more than 150 operating locations, and a global network of sales, service and support locations in 30 countries around the world.

The AMETEK Growth Model combines its four growth strategies of Operational Excellence, Strategic Acquisitions, Global Expansion, and New Product Development, with a  
By continuing to use the site, you agree to our [Privacy and Cookie Policy](#).

### RECENT NEWS



AMETEK Declares  
Quarterly Dividend



AMETEK Announces  
Second Quarter Results

### STOCK INFO

#### AME (Common Stock)

Exchange: NYSE (USD)

Price: \$100.03

[Ok](#)

uke

Unknown

WORLDVECTORLOGO

ALPHABETICAL

MOST DOWNLOADED

facebook



+ ADD LOGO



For example: Facebook, Tesla or Coca Cola



## Download Eli Lilly & Co vector (SVG) logo

berkshire\_hathaway



uke

Monster Energy's Commitment to Equality: [LEARN MORE](#)

How Monster Beverage Corporation is responding to the Coronavirus Outbreak: [LEARN MORE](#)

X

Unknown



PRESS  
RELEASES

SOCIAL  
RESPONSIBILITY

EVENTS &  
PRESENTATIONS

CORPORATE  
GOVERNANCE

FINANCIAL  
INFORMATION

STOCK  
INFORMATION CONTACTS

Based in Corona, California, Monster Beverage Corporation is a holding company and conducts no operating business except through its consolidated subsidiaries. The Company's subsidiaries develop and market energy drinks, including Monster Energy® energy drinks, Monster Energy Ultra® energy drinks, Monster MAXX® maximum strength energy drinks, Java Monster® non-carbonated coffee + energy drinks, Espresso Monster® non-carbonated espresso + energy drinks, Caffé Monster® non-carbonated energy coffee drinks, Monster Rehab® non-carbonated tea + energy drinks, Muscle Monster® non-carbonated energy shakes, Monster Hydro® non-carbonated refreshment + energy drinks, Monster HydroSport Super Fuel® non-carbonated advanced hydration + energy drinks, Monster Dragon Tea® non-carbonated energy teas, Reign Total Body Fuel™ high performance energy drinks, Reign Inferno™ thermogenic fuel high performance energy drinks, NOS® energy drinks, Full Throttle® energy drinks, Burn® energy drinks, Samurai® energy drinks, Relentless® energy drinks, Mother® energy drinks, Play® and Power Play® (stylized) energy drinks, BU® energy drinks, Nalu® energy drinks, BPM® energy drinks, Gladiator® energy drinks, Ultra Energy® energy drinks, Live+® energy drinks and Predator® energy drinks.



## Latest News

4th August, 2020

26th May, 2020

uke

# Performance Analysis

Duke

# Detector

Duke

youtube

YouTube

Search

AUTOPLAY

applied\_materials

APPLIED MATERIALS

0:00 / 1:11

© Applied Materials, Inc. 2019

CC

SHARE

SAVE

...

Career Opportunities at Applied Materials

1,239 views • Apr 29, 2020

21

2

SHARE

SAVE

...

applied\_materials

Applied Materials

4.67K subscribers

SUBSCRIBE

What will you make possible today? At Applied Materials, our innovations make possible the

Up next

Maydan Technology Center Overview Video

Applied Materials

23K views • 3 years ago

Celebrating 40 Years in Japan

Applied Materials

1.7K views • 11 months ago

Inside the mind of a master procrastinator | Tim Urban

TED

31M views • 4 years ago

4th Dimension - Tesseract, 4th Dimension Made Easy - Carl...

AstronomyCorner

5.9M views • 9 years ago

10 ways to have a better conversation | Celeste Headlee

TED

10M views • 4 years ago

Making Memory Chips – Process Steps

MicronTechnology

308K views • 3 years ago

uke

youtube

YouTube

Search

AUTOPLAY

Up next

Maydan Technology Center Overview Video  
Applied Materials  
23K views • 3 years ago

Celebrating 40 Years in Japan  
Applied Materials  
1.7K views • 11 months ago

Inside the mind of a master procrastinator | Tim Urban  
TED  
31M views • 4 years ago

4th Dimension - Tesseract, 4th Dimension Made Easy - Carl...  
AstronomyCorner  
5.9M views • 9 years ago

10 ways to have a better conversation | Celeste Headlee  
TED  
10M views • 4 years ago

Making Memory Chips – Process Steps  
MicronTechnology  
308K views • 3 years ago

APPLIED MATERIALS

0:00 / 1:11

© Applied Materials, Inc. 2019

▶ ▶ 🔍 0:00 / 1:11

CC 🔍

Career Opportunities at Applied Materials

1,239 views • Apr 29, 2020

21 2 SHARE SAVE ...

applied\_materials

Applied Materials

4.67K subscribers

SUBSCRIBE

What will you make possible today? At Applied Materials, our innovations make possible the

+971 4 4224900

Contact Us

Careers

DOWNLOAD CATALOGUE

REQUEST QUOTE

English



Unknown



COMPANY ▾

PRODUCTS ▾

SERVICES ▾

SUPPORT

OUR PARTNERS



< Previous Next >

AGBL offers Next-Generation Sequencing (NGS) solutions, including both platforms and reagents, through Illumina Inc., that deliver industry-leading data quality and accuracy at an unparalleled scale. With flexible throughput and simple streamlined workflows, Illumina sequencing platforms are transforming the field of genomics.



#### Applications:

- Whole-Genome Sequencing
- Targeted DNA sequencing including sequencing panels for exome, cancer, genetic conditions, immunology and metagenomics

#### Partner Details

**Categories:** Life Sciences

**Applications:** Genomics

**More Details:** [Illumina Website](#)

Duke

+971 4 4224900

Contact Us

Careers

DOWNLOAD CATALOGUE

REQUEST QUOTE

English



Unknown



COMPANY ▾

PRODUCTS ▾

SERVICES ▾

SUPPORT

OUR PARTNERS



< Previous Next >



AGBL offers Next-Generation Sequencing (NGS) solutions, including both platforms and reagents, through Illumina Inc., that deliver industry-leading data quality and accuracy at an unparalleled scale. With flexible throughput and simple streamlined workflows, Illumina sequencing platforms are transforming the field of genomics.

#### Applications:

- Whole-Genome Sequencing
- Targeted DNA sequencing including sequencing panels for exome, cancer, genetic conditions, immunology and metagenomics

#### Partner Details

**Categories:** Life Sciences

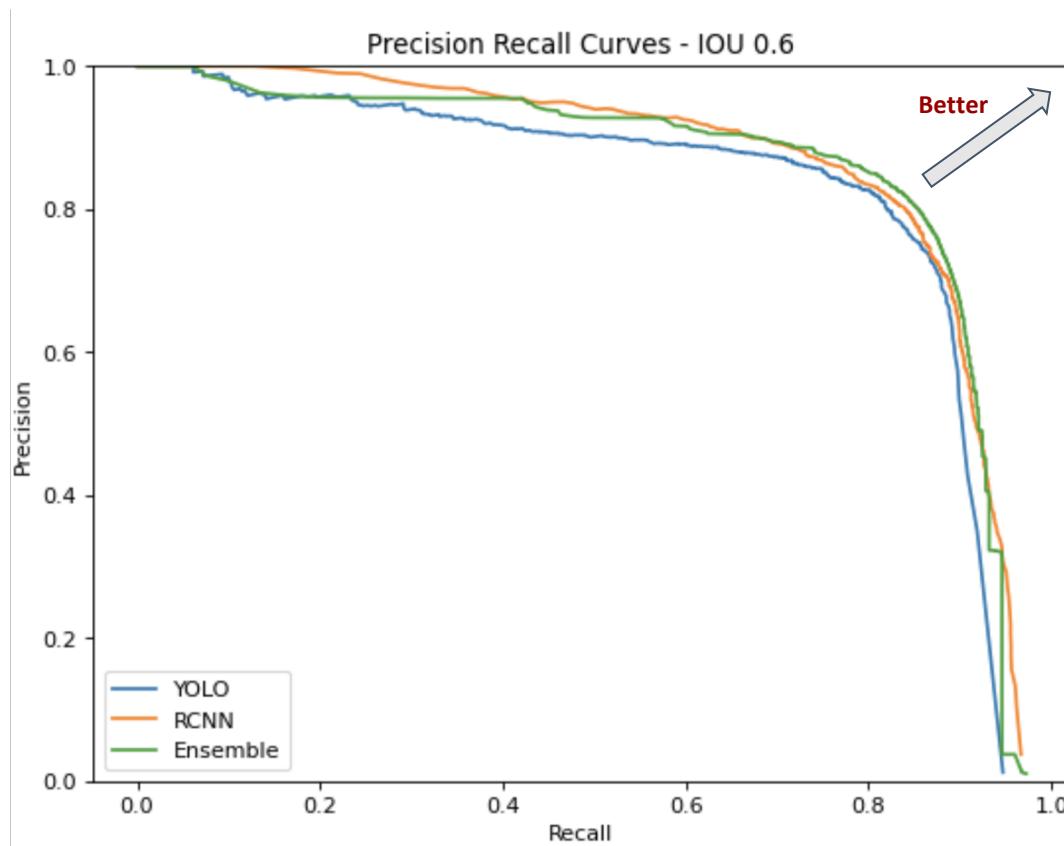
**Applications:** Genomics

**More Details:** [Illumina Website](#)

uke

# Ensembling

- Can combining the models make them better? **YES!**
- Ensembling YOLO and RCNN leads to better performance than both individually.



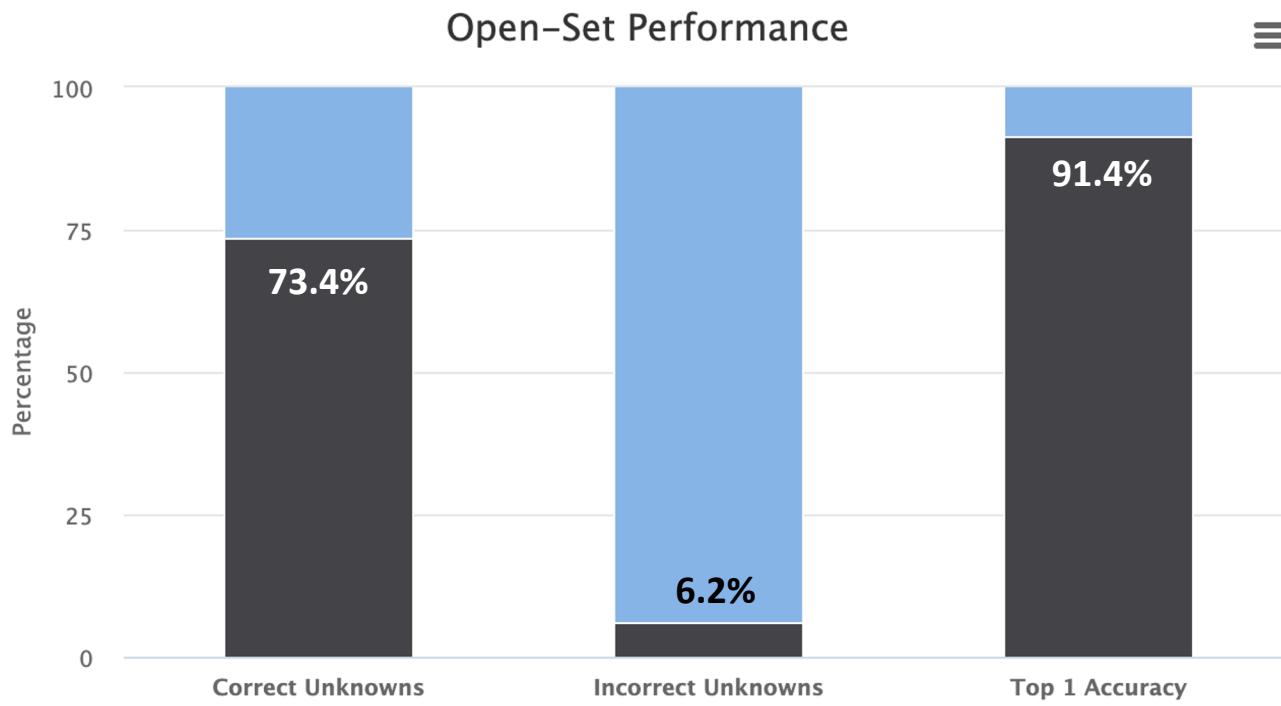
# Classifier

Duke

# Closed Set Performance - 1098 Classes

	Accuracy	Precision	Recall	Support
Val	94.4%	95.3%	94.4%	4,668
Test	94.5%	98.3%	94.5%	1,165

# Open Set Performance - 1098 Classes



# Acknowledgements



**proofpoint**<sup>®</sup>

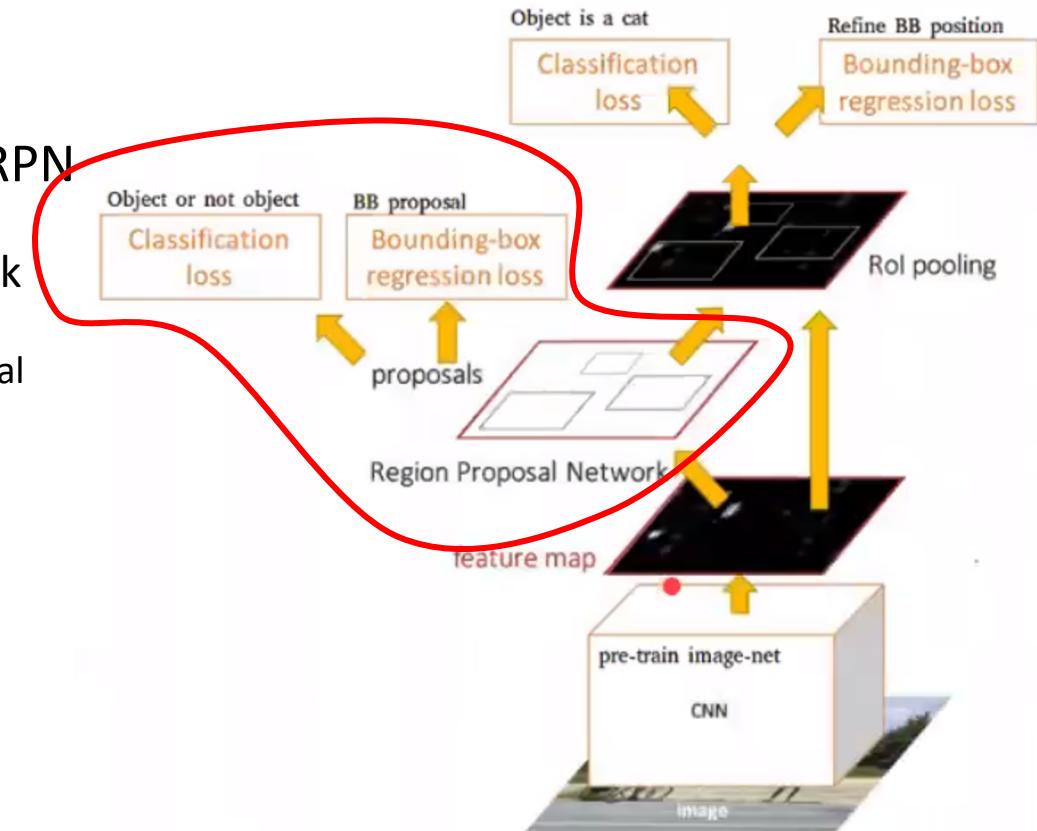
Duke

# Appendix

Duke

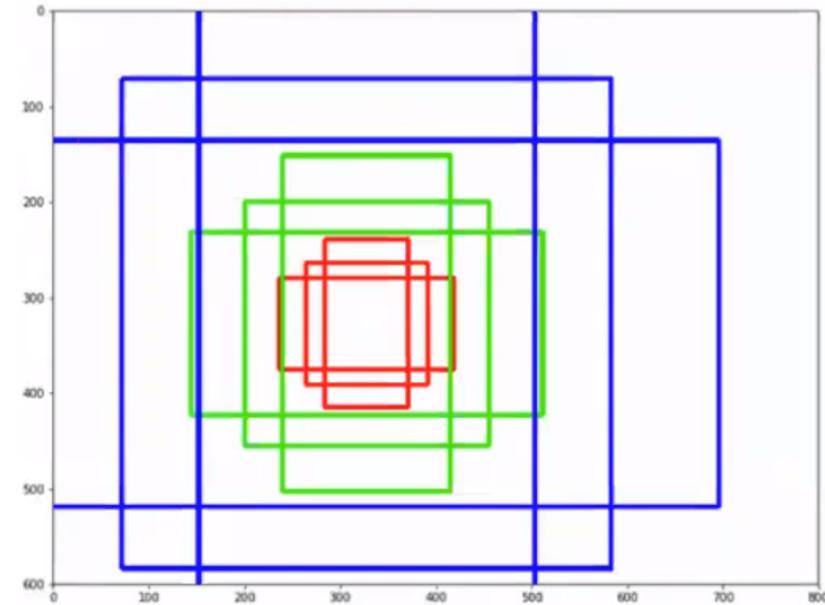
# Faster R-CNN (2016)

- Region Proposal Network (RPN)
  - **Initial Guess**
  - Fully Convolutional Network
  - Outputs :
    - Rectangular Object Proposal
    - Objectness Score
- **RPN + Fast R-CNN**



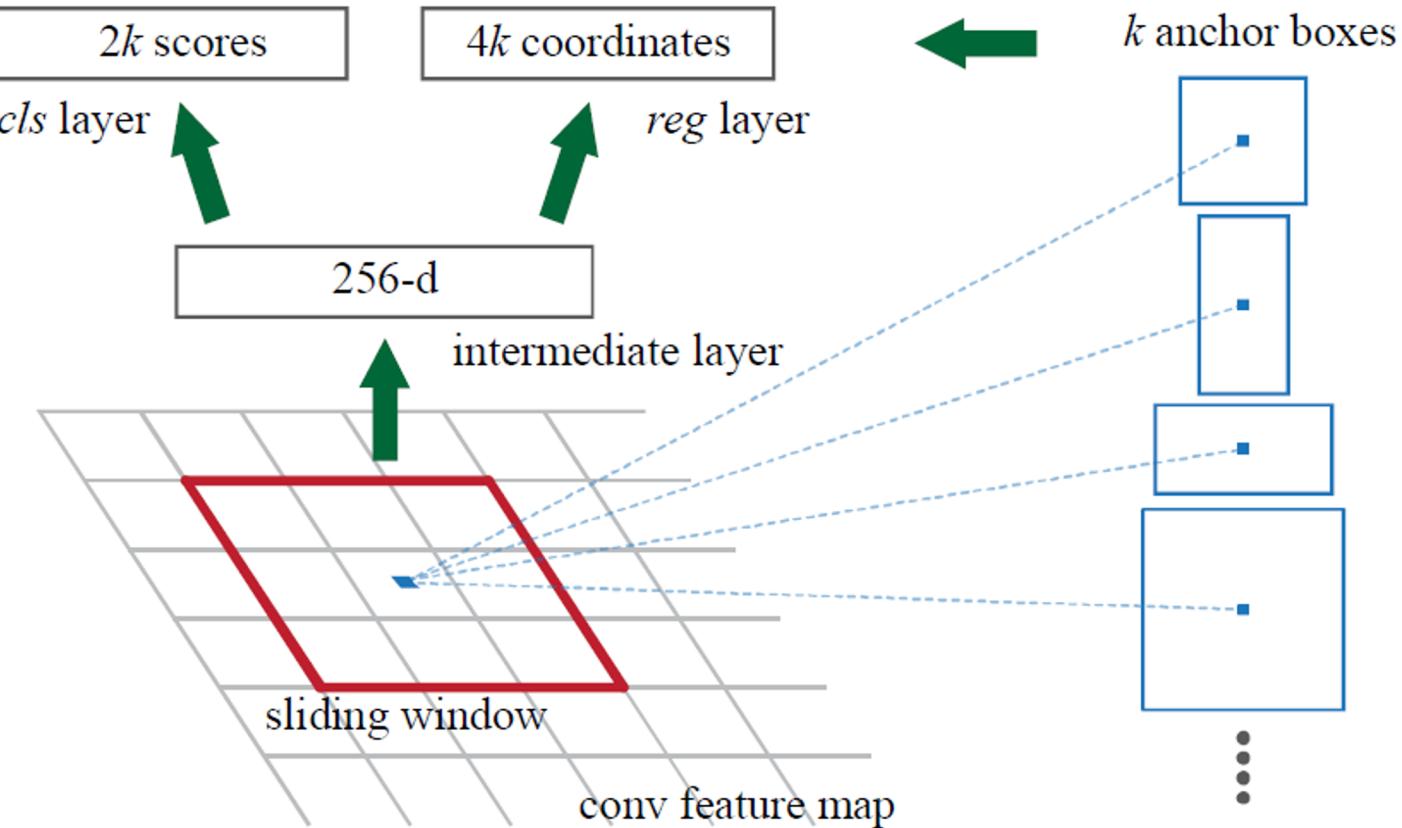
# How does RPN Work?

- Anchors
  - **Initial Initial guess** (Input to RPN)
  - Anchors are shapes and aspect ratios we place at every pixel on image
  - They are not meant to be close to the ground truth bounding box. They are just a starting point **proposal**. Hence Region Proposal Network (RPN)

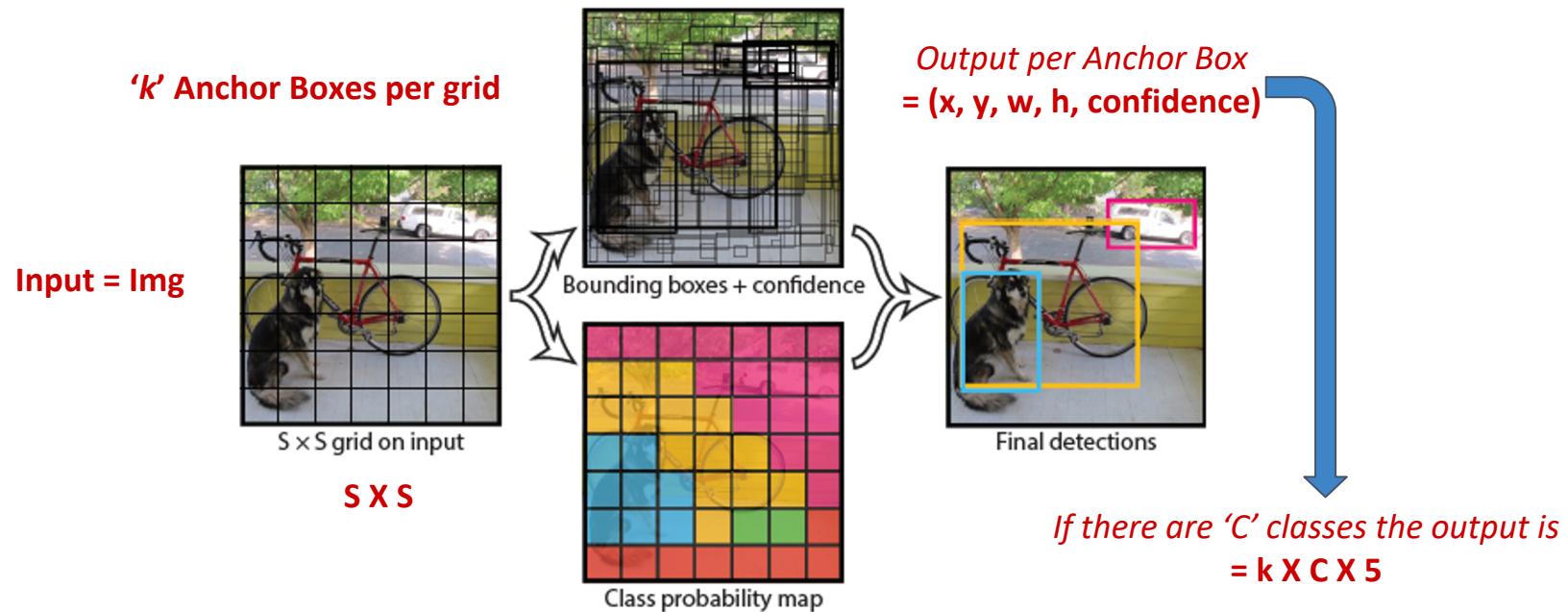


- **RPN prunes anchor boxes**

$$k = 9 \text{ anchor boxes per pixel}$$
$$\text{Total Anchor Boxes} = W * H * k$$

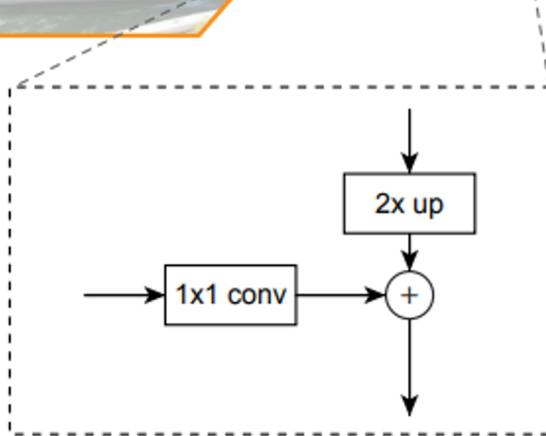
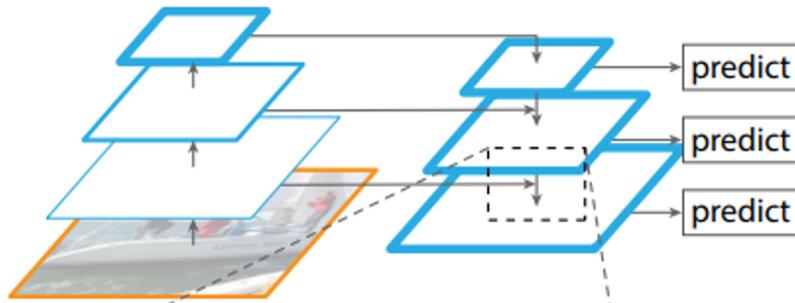


# YOLO v3



Duke

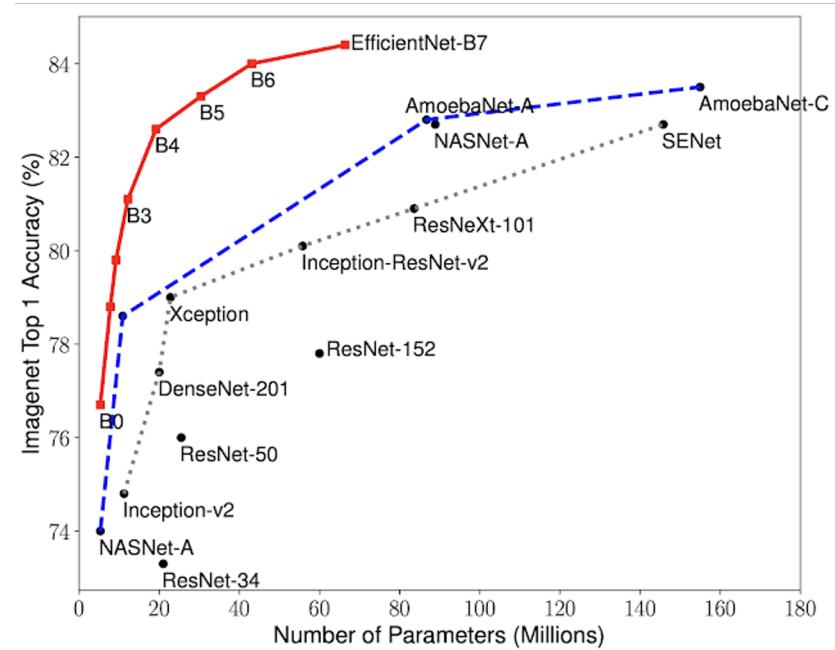
# Feature Pyramid Network (FPN)



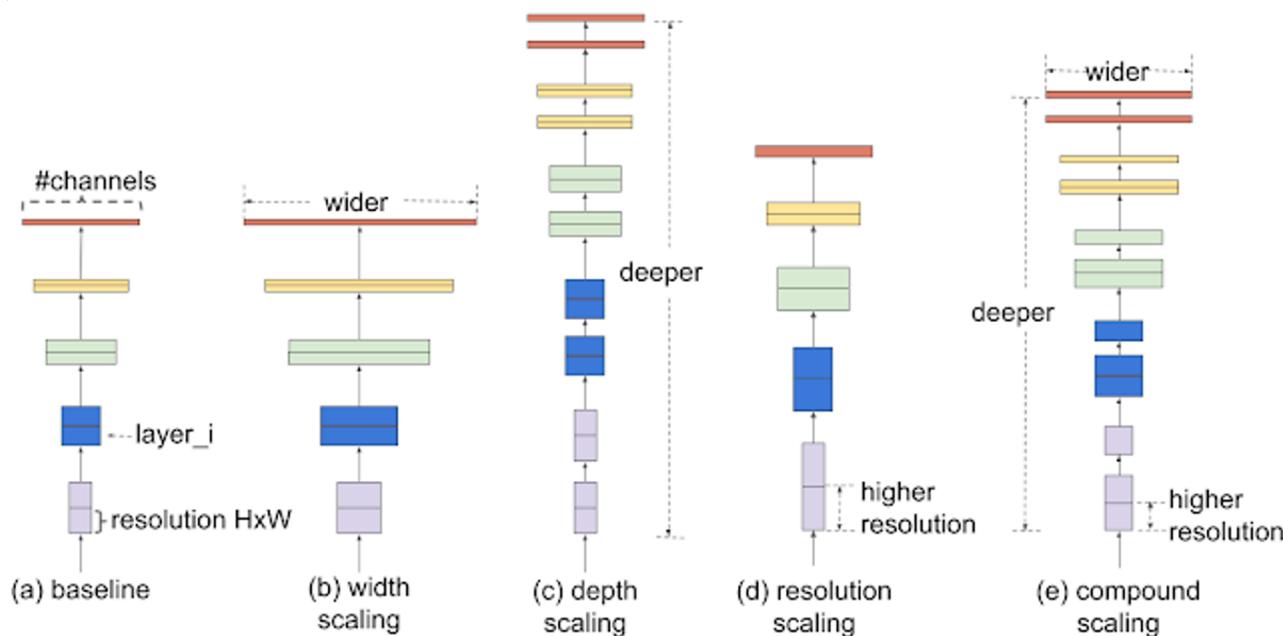
*FPN good when we have  
small and big objects in  
our images*

# EfficientNet

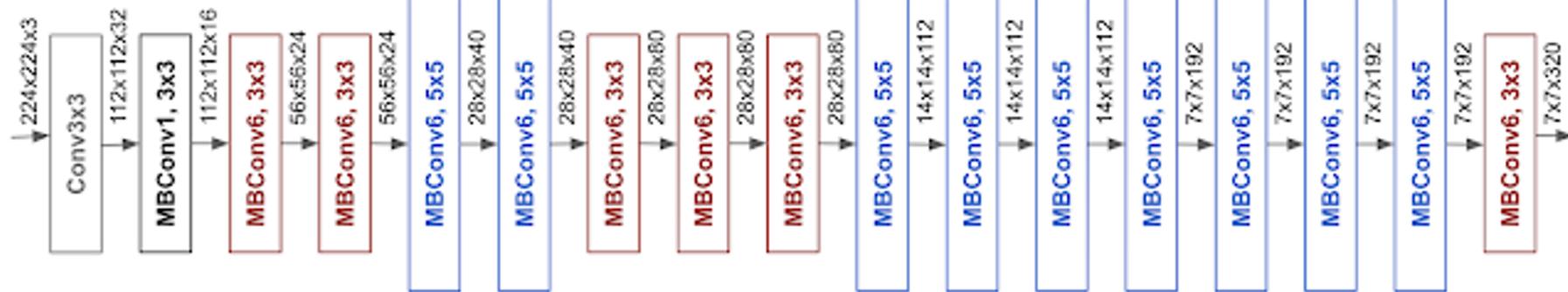
- Focus on improving scaling of CNNs
  - Depth, width, resolution
- Compound scaling method
  - Fix resource (FLOPs) and scaling coefficient
- Similar or better performance and significantly smaller than other CNN architectures



# Compound Scaling

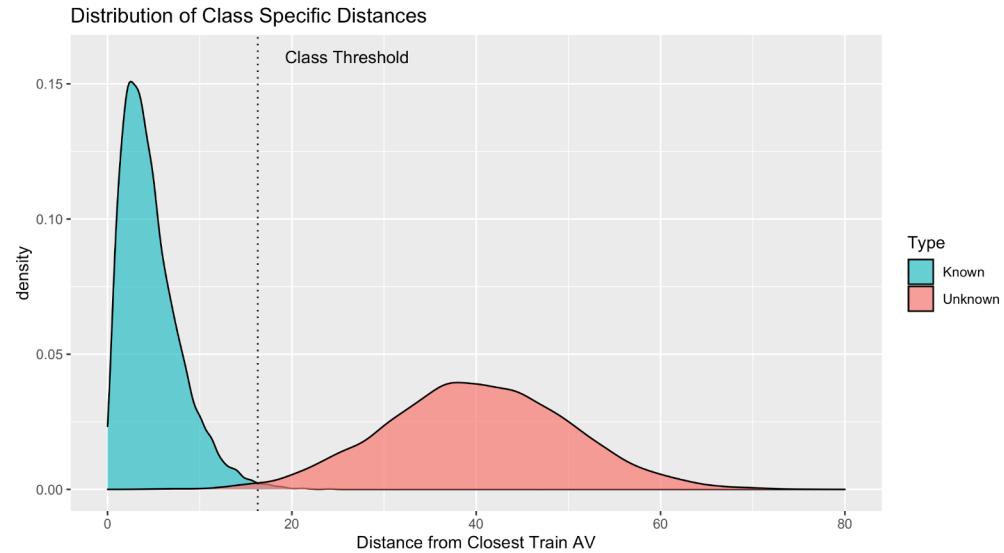


# EfficientNet Baseline Architecture

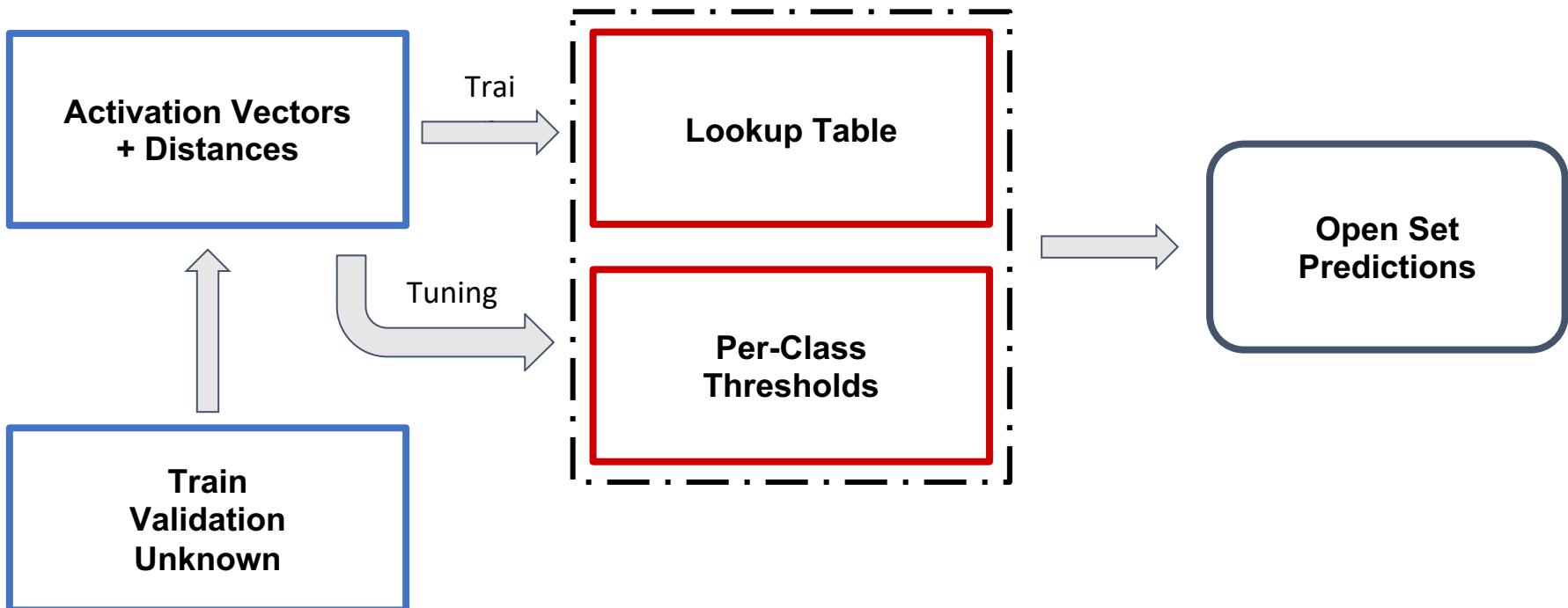


# Open Set K-Nearest Neighbors Classification

- Generate **Lookup Table of Activation Vectors**
- Generate **Per-Class Thresholds using Distances** to lookup table vectors



# Open Set K-Nearest Neighbors Architecture



# False Positives of Ensemble

Category 1

The  
*The*  
The,

Category 2

Nasdaq, Inc.  
N E W S

Category 3



Duke

# False Negatives of Ensemble

Category 1



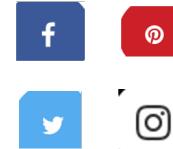
Category 2



Category 3



Category 4



Duke

# Sample Images for Classifier

Bing Downloader



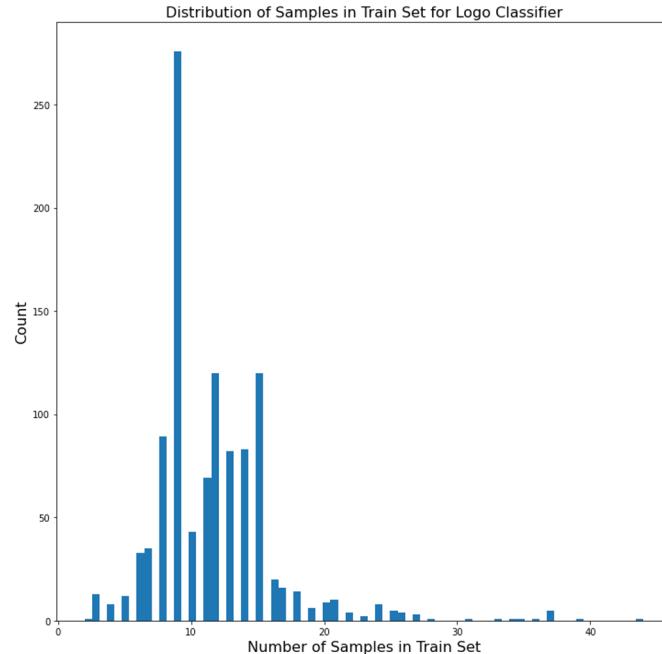
Annotation Extracted



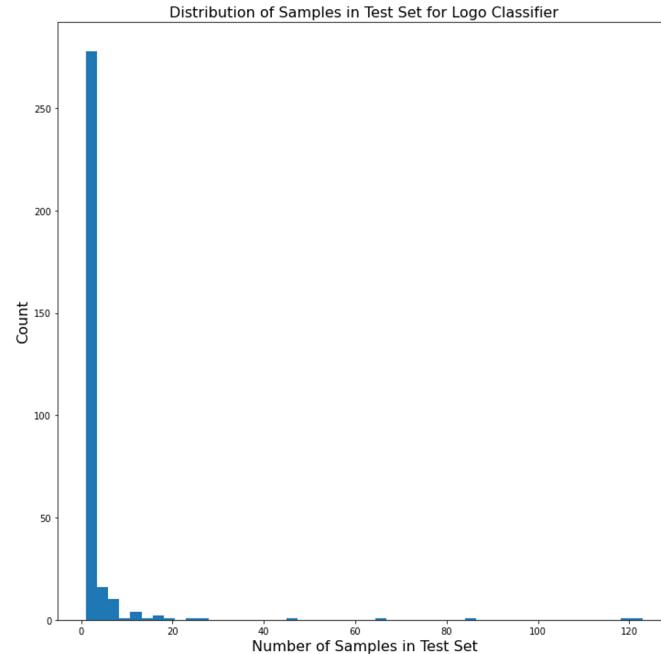
Duke

# Classifier Data Distribution

## Training Data



## Test Data



# Classifier Predictions

Correct Classifications



Incorrect Classifications



# Adding Additional Classes

	Additional Incorrect Unknowns (False Negatives)		Additional Incorrect Knowns (False Positives)	
Additional Classes	Trained Classes	New Classes	Trained Classes	New Classes
0 → 5	+1	+1	+1	+2
5 → 10	+3	+0	+1	+3
10 → 15	+6	+0	+2	+0



SPONSORED BY SQUARESPACE

Get a domain and create a website with Squarespace

START A FREE TRIAL

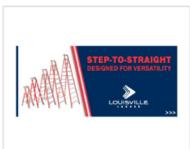
HIDE AD • AD VIA BUYSELLADS



SEARCH

## Fastenal Logo

We have found 35 Fastenal logos. Do you have a better **Fastenal** logo file and want to share it? We are working on an upload feature to allow everyone to upload logos!



uke

