Google AI

The 2nd YouTube-8M Large-Scale Video Understanding Workshop

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ECCV 2018

Organizers

General Chairs

Paul Natsev

Rahul Sukthankar

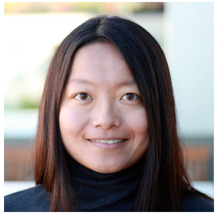
Program Chairs

Joonseok Lee

George Toderici

kaggle

Julia Elliott

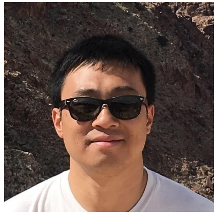

Wendy Kan

Sohier Dane

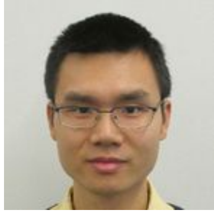
Walter Reade

Challenge Organizers

Sami Abu-El-Haija


Ke Chen

Nisarg Kothari


Hanhan Li

Sobhan Naderi Parizi

Balakrishnan Varadarajan

Joe Ng

Javier Snaider

Agenda (Morning)

Time	Content	Presenter
9:00 - 9:05	Opening Remarks	Paul Natsev
9:05 - 9:30	**Overview of 2018 YouTube-8M Dataset & Challenge**	Joonseok Lee, Walter Reade
Session 1		
9:30 - 10:00	**Invited Talk 1**: Human action recognition and the Kinetics dataset	Andrew Zisserman
10:00 - 10:30	**Invited Talk 2**: Segmental Spatio-Temporal Networks for Discovering the Language of Surgery	Rene Vidal
10:30 - 10:45	*Coffee Break*	
Session 2		
10:45 - 12:00	**Oral Session 1** ● Building a Size Constrained Predictive Model for Video Classification ● Temporal Attention Mechanism with Conditional Inference for Large-Scale Multi-Label Video Classification ● Label Denoising with Large Ensembles of Heterogeneous Neural Networks ● NeXtVLAD: An Efficient Neural Network to Aggregate Frame-level Features for Large-scale Video Classification ● Non-local NetVLAD Encoding for Video Classification	● Next top GB model (#1) ● KANU (#5) ● Samsung AI Moscow (#2) ● PhoenixLin (#3) ● YT8M-T (#4)
12:00 - 1:00	*Lunch on your own*	

Agenda (Afternoon)

Time	Content	Presenter
Session 3		
1:00 - 1:30	**Invited Talk 3**: Learning video representations for physical interactions and language-based retrieval	Josef Sivic
1:30 - 2:00	**Invited Talk 4**: Towards Video Understanding at Scale	Manohar Paluri
2:00 - 2:30	**Context-Gated DBoF Models for YouTube-8M**	Paul Natsev
2:30 - 3:45	**Poster Session**	Participants
3:45 - 4:00	*Coffee Break*	
Session 4		
4:00 - 4:45	**Oral Session 2** ● Learnable Pooling Methods for Video Classification ● Training compact deep learning models for video classification using circulant matrices ● Axon AI's Solution to the 2nd YouTube-8M Video Understanding Challenge	● Deep Topology ● Alexandre Araujo (#36) ● Axon AI (#17)
4:45 - 5:00	Closing and Award Ceremony	Paul Natsev

Introduction

Joonseok Lee (joonseok@google)

What is Video Understanding?

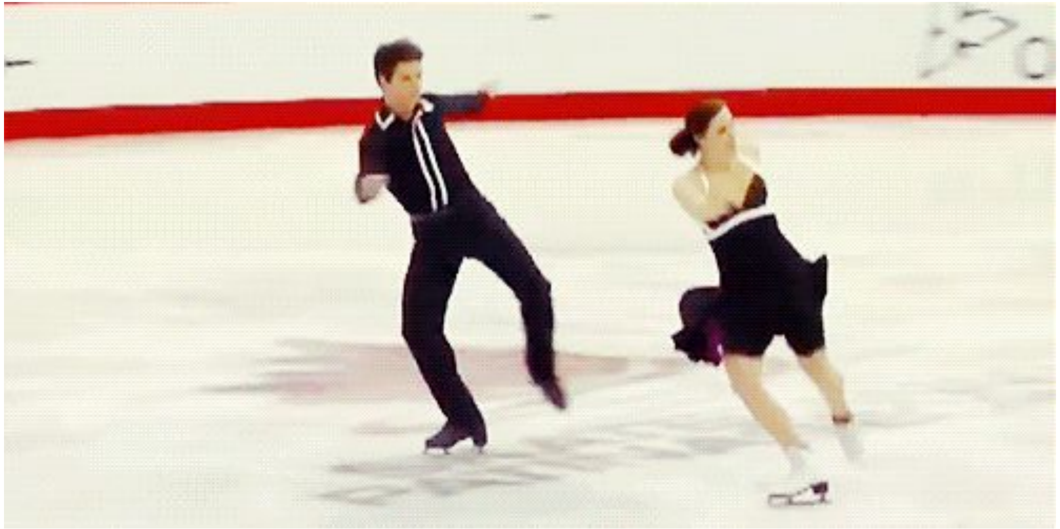
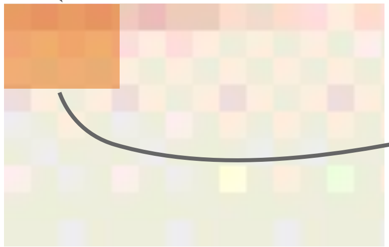


Figure skating   Winter sports   Ice rink   Pair skating

What is Video Understanding?



{(238, 204, 187), (238, 187, 187), …
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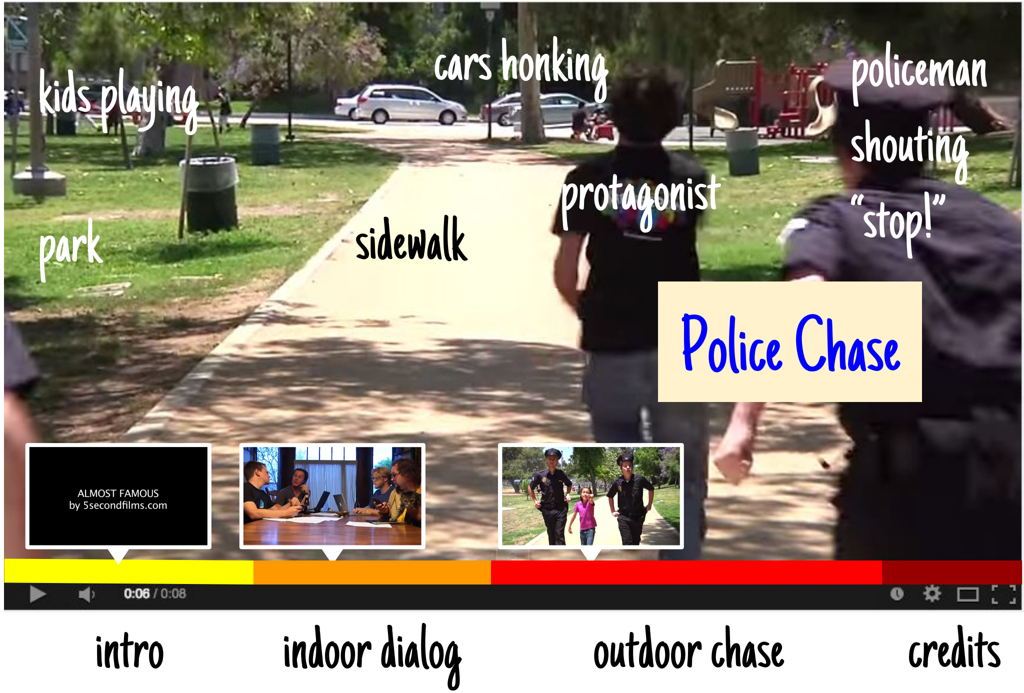
Figure skating
Winter sports
Ice rink
Pair skating

The Multiple Shades of Video Understanding



Describing the **content:**
what is visible/audible?

Inferring the **central topics:**
what is the story about?

Describing the **structure & style:**
how is the story told?

Inferring **creator / viewer intent:**

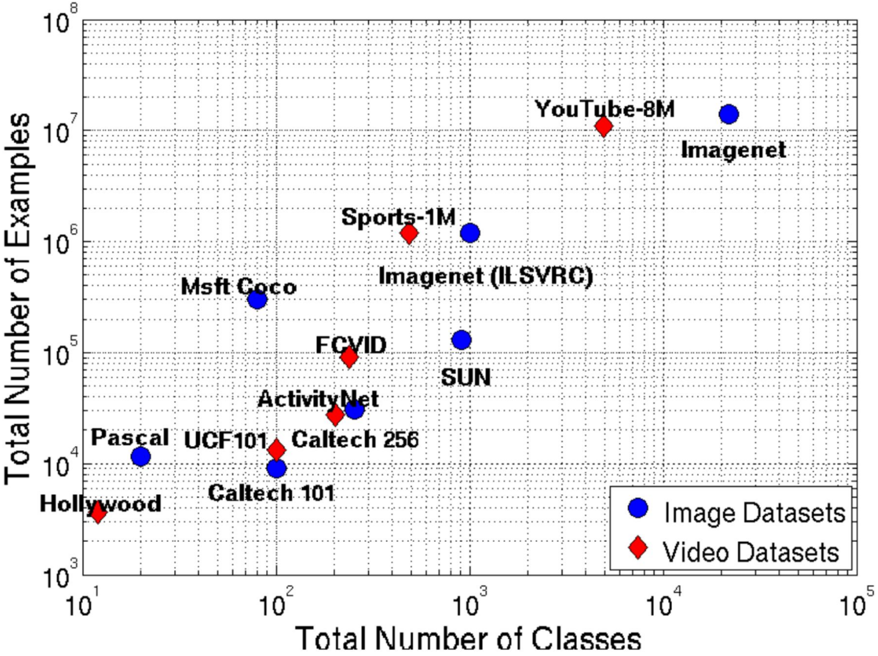
- **why capture** this video?
- **why watch** this video?

YouTube-8M: Primary Motives

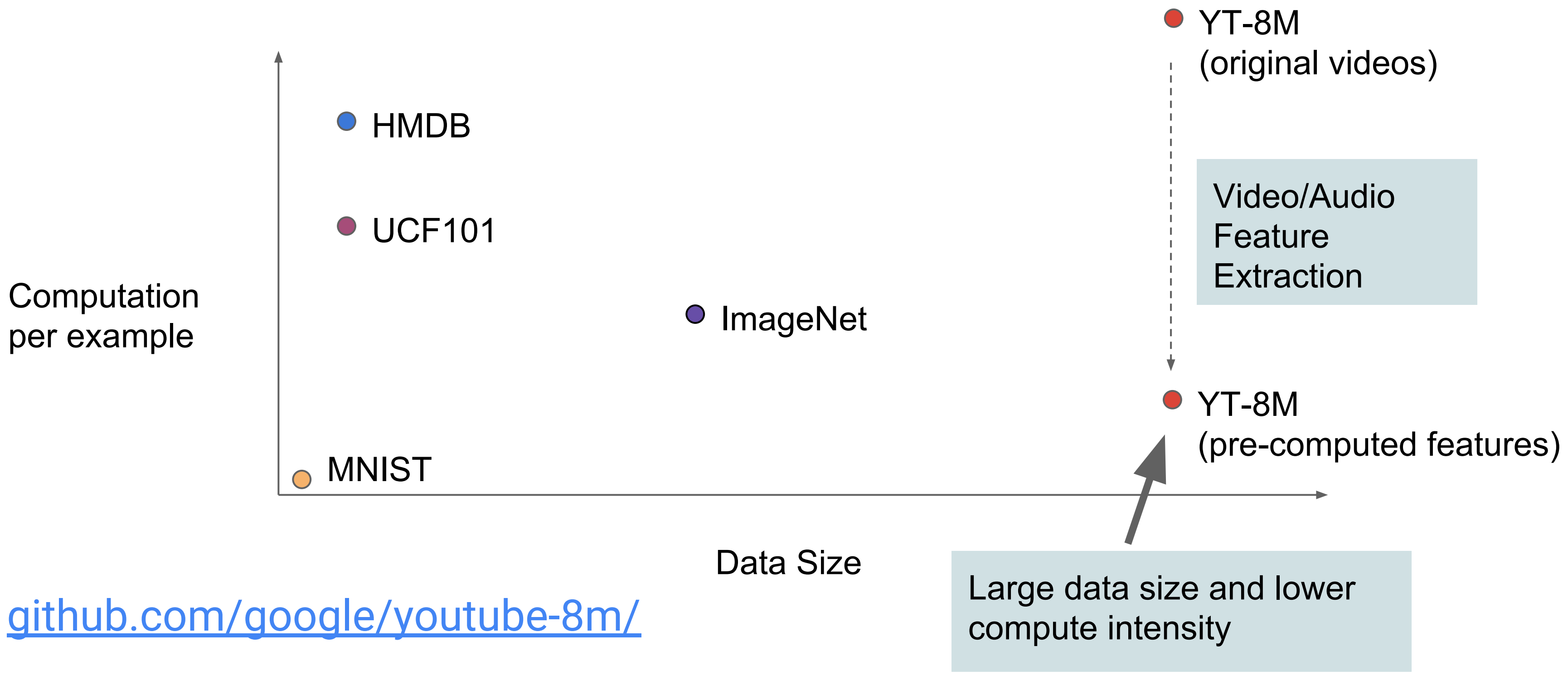
- Help advance the state-of-the-art in Video Understanding
  - By providing a large, free, realistic, labeled video dataset
  - Hoping that we can collaborate with the research community to reach better-than-human performance on Video Classification, similar to Image Classification tasks.
- Establishing a representative sample of YouTube
  - The YouTube corpus is HUGE - slow to train on
  - It is faster for us to continuously test our ideas on a smaller yet representative dataset.

Challenges in Creating Video Dataset

- File sizes are larger than images.
  - More expensive to download, store, and train from.
- Video labels are more expensive to obtain.
  - Requiring annotators to watch the video and listen to audio stream.
- Therefore, existing video datasets tend to be small.



YouTube-8M: TensorFlow Framework Design



YT-8M
(original videos)

HMDB

UCF101

Video/Audio
Feature
Extraction

Computation
per example

ImageNet

YT-8M
(pre-computed features)

MNIST

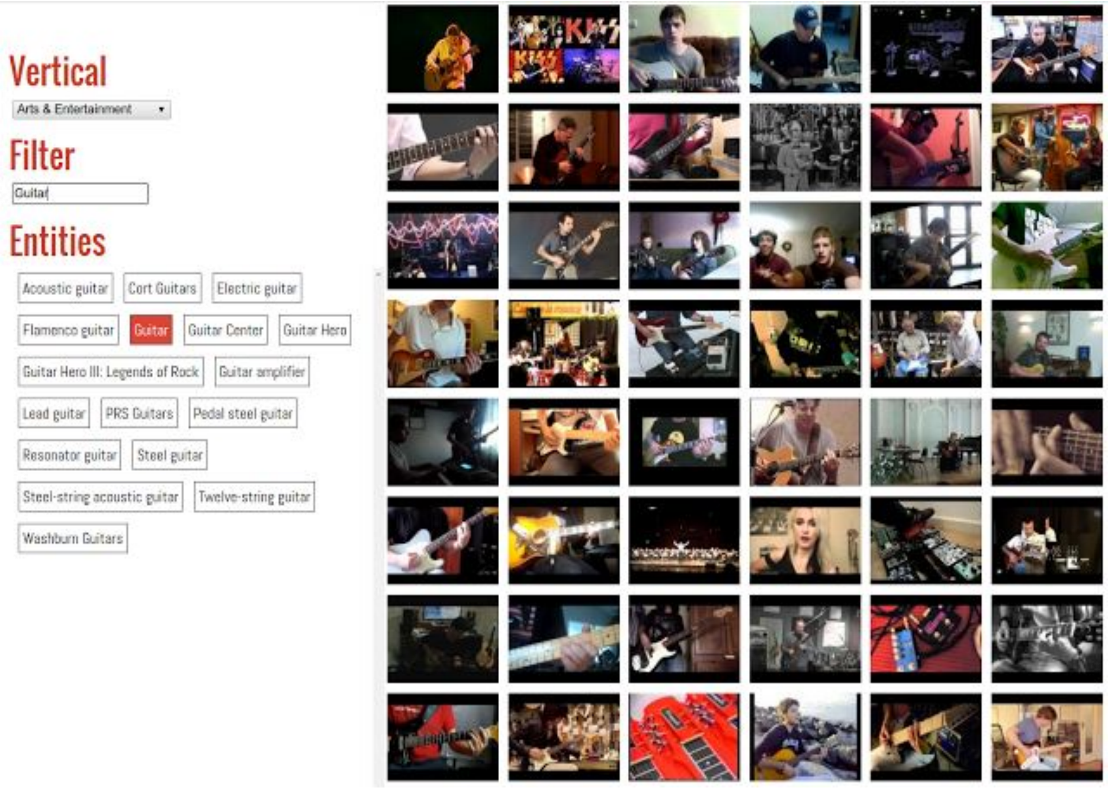
Data Size

Large data size and lower compute intensity

github.com/google/youtube-8m/

YouTube-8M: The Dataset (v3)

- 6.1M videos
- 350,000 hours
- 2.6B audio/visual features
- 3,862 classes
- 3.0 labels/video



Vertical

Arts & Entertainment ▾

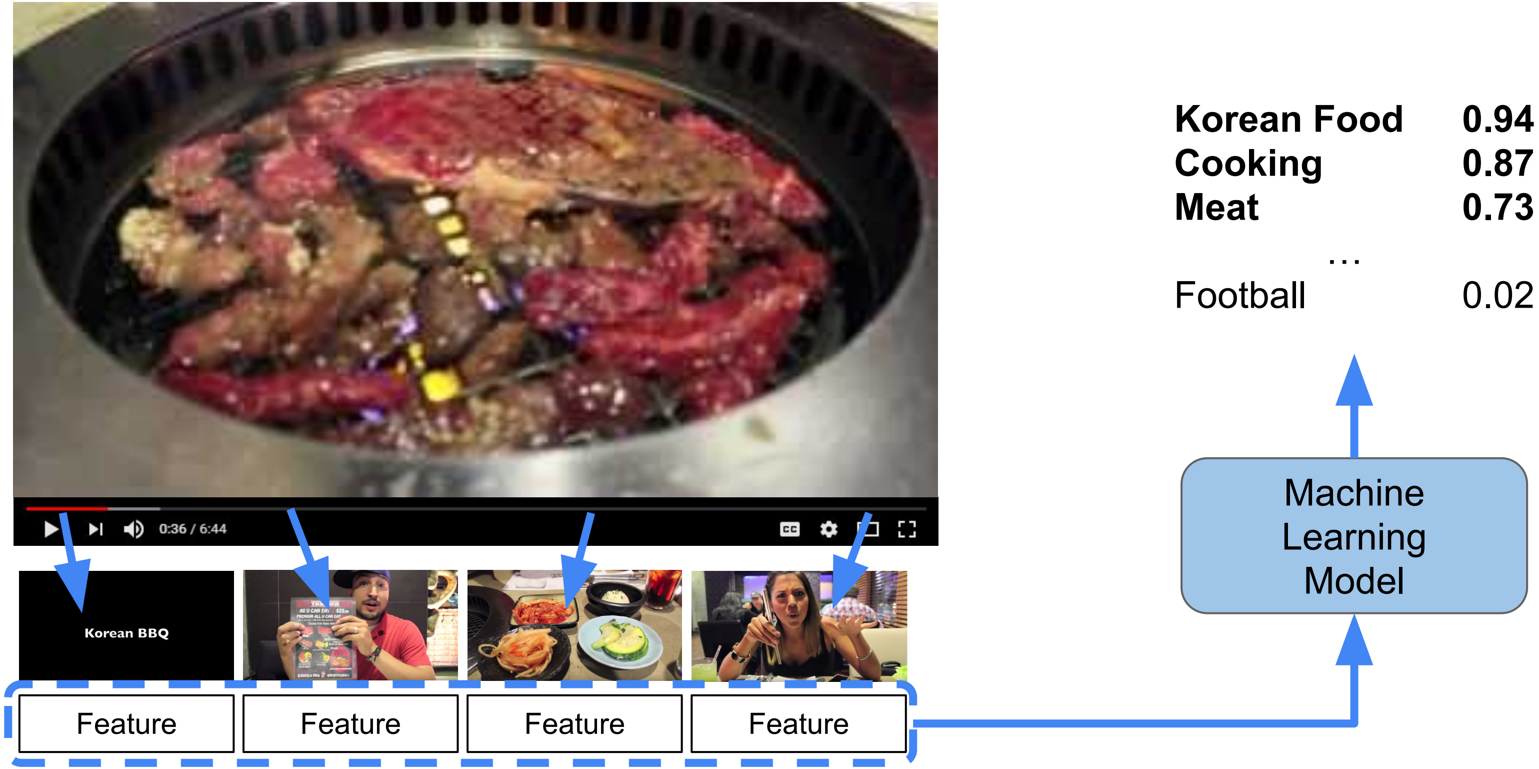
Filter

Guitar

Entities

2018 YouTube-8M Challenge

YouTube-8M Classification Challenge Task



Feature

Feature

Feature

Feature

Machine Learning Model

Korean Food	**0.94**
Cooking	**0.87**
Meat	**0.73**
…	
Football	0.02

YouTube-8M Classification Challenge Task

- Input:
  - A sequence of frame-level audio-visual features, extracted at 1 fps
  - Each video has [120, 300] frame-level features
  - Visual Inception-V3 bottleneck features extracted from pixels (PCA-ed to **1024D**)
  - Audio Resnet-ish bottleneck features extracted from audio spectrograms (**128D**)
- Target:
  - Video topics from a 3,862 Knowledge Graph entity vocabulary
  - The target topics cover the **main themes** in the video (vs. object detection, scene parsing, etc.)
  - Each video has 3.0 ground truth labels on average
- New in 2018: **Model size must be < 1GB**.
- Goal: Predict target video topics from the sequence of frame-level features

Last Year’s Leaderboard

Rank	Team Name	Best Performance (GAP)		# models in ensemble
		Single model	Ensembled	
1	**WILLOW**	**0.8300**	**0.8496**	25
2	**monkeytyping**	0.8179	0.8458	74
3	**offline**	0.8275	0.8454	57
4	**FDT**	0.8178	0.8419	38
5	**You8M**	0.8225	0.8418	33
6	**Rankyou**	0.8246	0.8408	22
7	**Yeti**	0.8254	0.8396	21
8	**SNUVL X SKT**	0.8200	0.8389	22
9	**LanzanRamen**	—	0.8372	—
10	**Samartian**	0.8139	0.8366	36

Scores in GAP; higher values are better.

Gray scores mean that it’s not published, but we got to know it by contacting them.

Approaches Overview

- Temporal aggregation
  - (Variants of) NetVLAD: most widely used.
  - LSTM/GRU
  - Attention model
- Architecture
  - WILLOW architecture (2017 Winner): most widely used.
  - ResNet

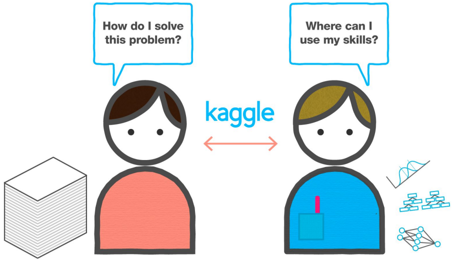
Approaches Overview

- Ensembles
  - Top performers are still taking advantage of ensembling.
  - # of models decreased: mostly around 3 - 6 models.
    - Heaviest ensemble model combined 115 models.
- Distillation
  - Most top performers distilled from larger, ensembled teacher model.
- Quantization
  - float16 is used instead of full 4 bytes float.

Kaggle Overview and Community View of Competition

Walter Reade (inversion@kaggle)

Kaggle Background



- Well-Known for Machine Learning Contests
    - Connect talent to business
    - Diverse methods of approaching the problem
    - Find upper limit of signal in the data

- Rapidly Becoming the Place To Do Data Science Projects
    - Find and upload high-quality datasets
    - Build models in the cloud (Kernels)
    - Connect with the Community (world's largest)
    - Faster Data Science Education

"No one beginning a new data project should start from a blinking cursor"

YT8M: A Unique Competition

- Large dataset
    - 1.7 TB was the largest dataset on Kaggle when 1st competition launched
    - (TSA Passenger Screening took 1st place with ~6 TB)
- Strong baseline starter code to help level the playing field
    - Runs on Google Cloud ML Engine
    - TensorFlow
- Google Cloud Credits
    - Free GCP credit ($300 x 200) provided by Kaggle
- Strong and high quality participants

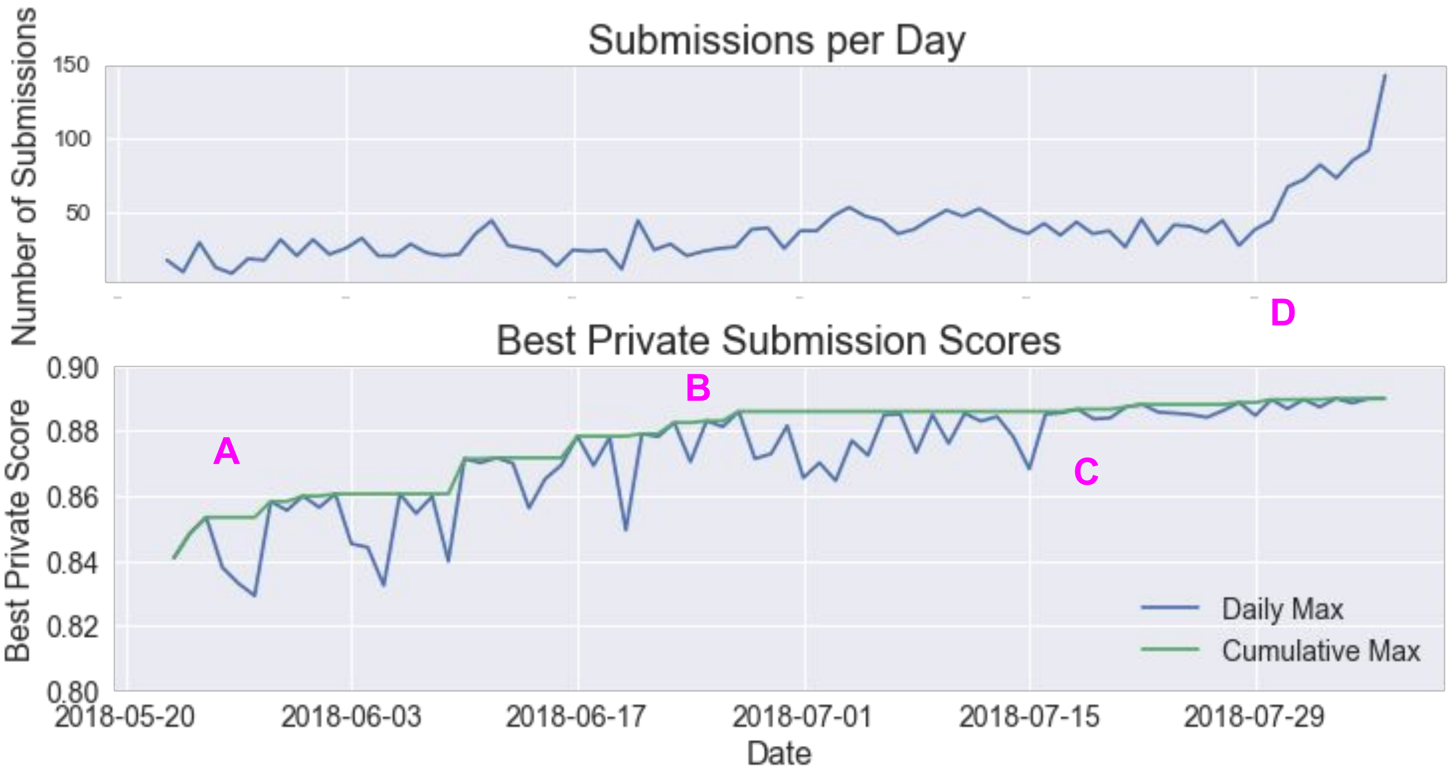
Where were the participants from?

- 394 teams
- 531 competitors
  - 106 - First Kaggle competition
  - 61 - Also participated in 1st competition
- Participants from 40+ countries

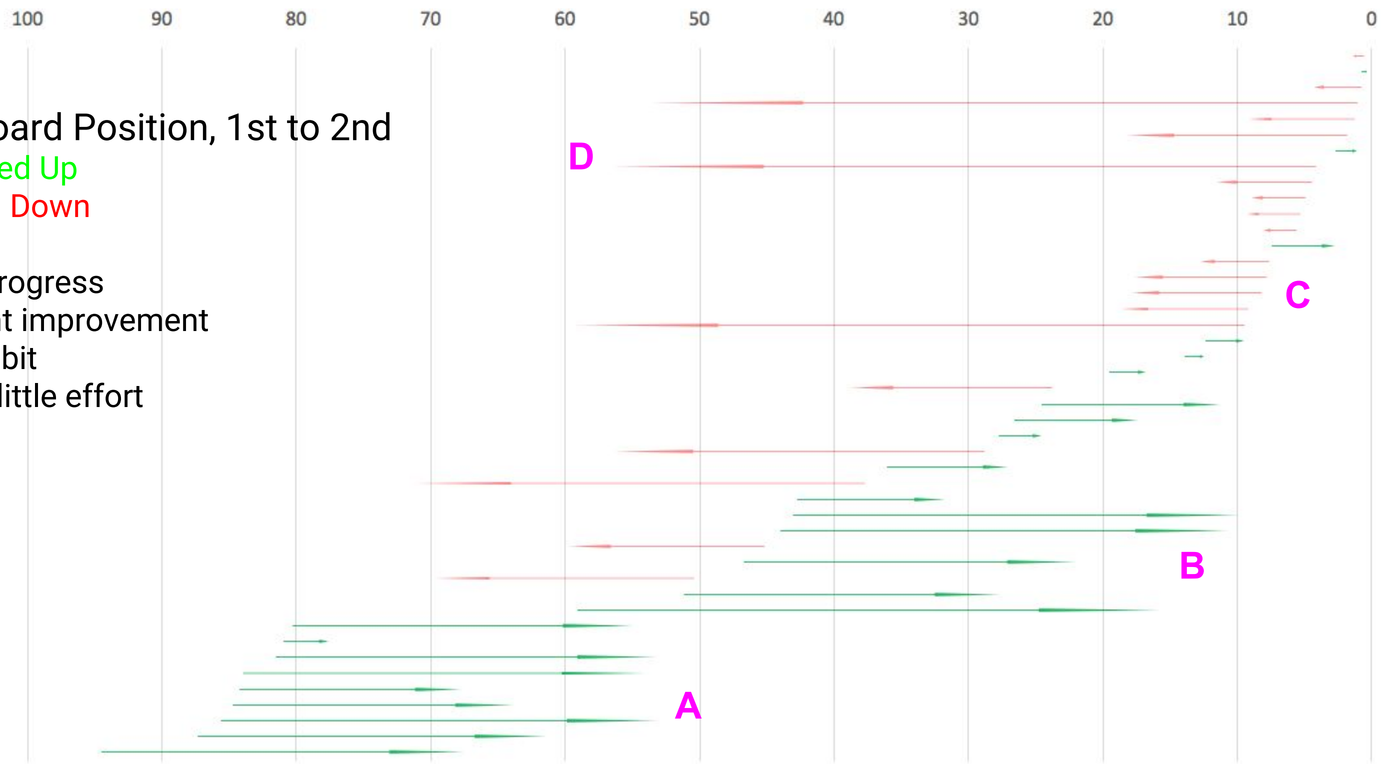
- Total of 3,805 submissions
  - Relatively low ~10 subs/team
  - Median Competition ~15

Country	#Competitors
US	136
CN	69
IN	56
RU	30
KR	25
JP	19
FR	15
CA	15
GB	14
TW	10
SG	9
HK	9
BY	8
UA	8
DE	7
PL	6
AU	5
GR	4

Competition Progression



How did returning competitors do?



% Leaderboard Position, 1st to 2nd

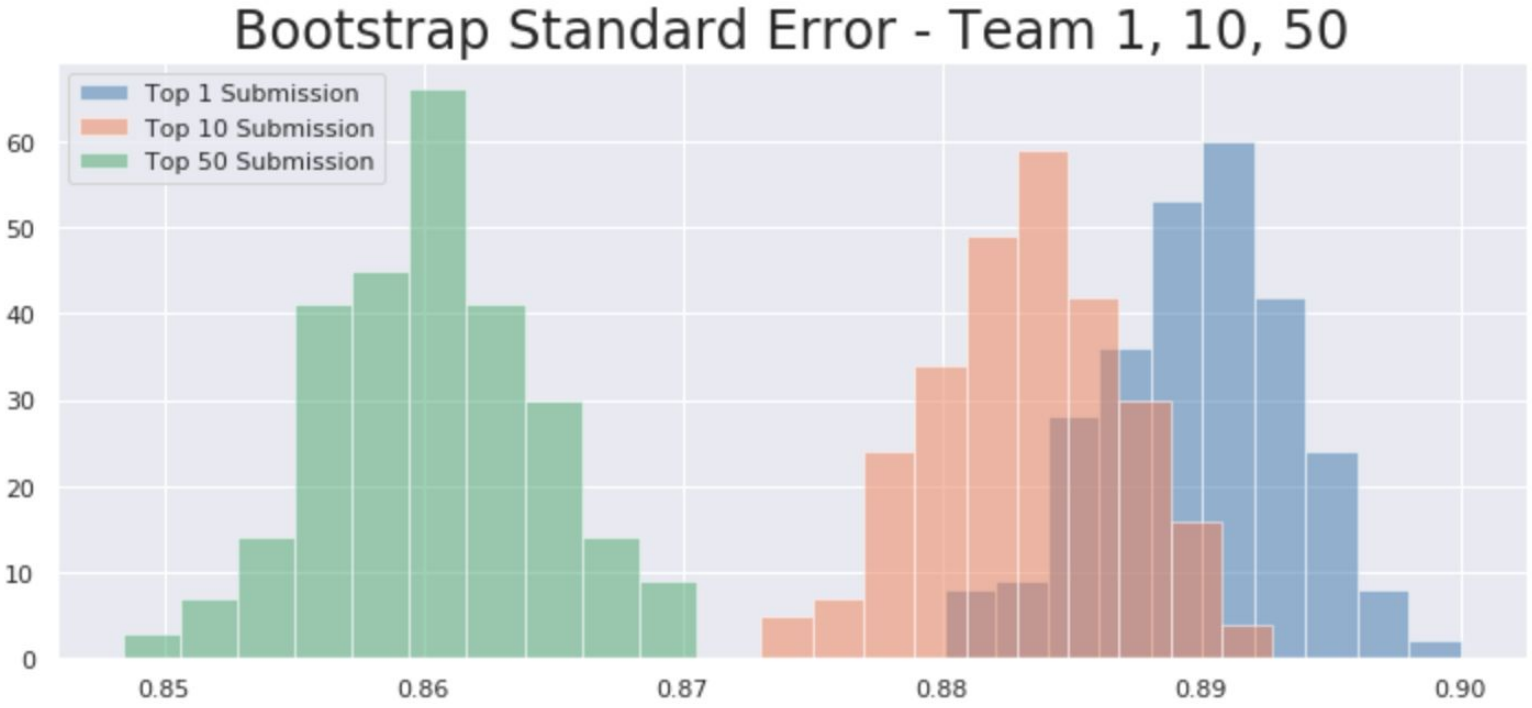
Green = Moved Up

Red = Moved Down

A - Modest progress
B - Significant improvement
C - Slipped a bit
D - Probably little effort

Out of Top 10 Teams, 1, 4, and 8 had returning competitors!

Separation Between Models



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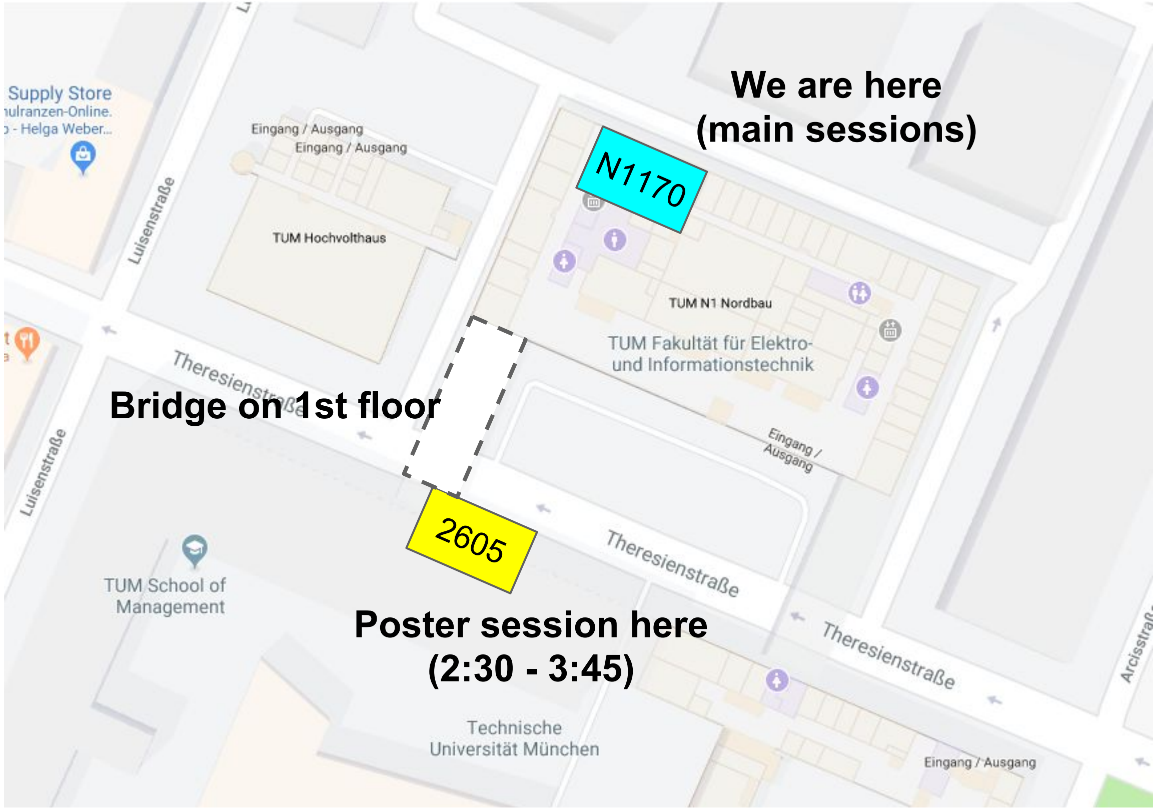
Poster Session Location



Room **2605** (+upstairs)
in Building 6 (Theresianum)
across the street.

Please set up your poster at the designated board **during/after** lunch hour.

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Thank you for your attention.