Apache Spark 中国技术... 全员

该群属于“Apache Spark 中国技术交流社区”全员群，仅组织内部成员可以加入，如果组织外部人员收到此分享，需要先申请加入该组织。

Building AI to Play FIFA* Video Game Using Distributed TensorFlow* on Analytics Zoo

Shengsheng Huang, Shan Yu, Jason Dai

Collaborations with Shanghai Jiao Tong University

AGENDA

- Distributed TF on Apache Spark* using Analytics Zoo
- RL Platform for Playing FIFA18
- Playing FIFA18 using Imitation Learning & DRL
- Experimenting with GRF (Google Research Football*)

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What is Analytics Zoo

BigDL

Distributed, High-Performance

Deep Learning Framework

for Apache Spark

https://github.com/intel-analytics/bigdl

ANALYTICS ZOO

Unified Analytics + AI Platform

Distributed TensorFlow, Keras, PyTorch and BigDL on Apache Spark

https://github.com/intel-analytics/analytics-zoo

Accelerating Data Analytics + AI Solutions At Scale

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INTEGRATED BIG DATA ANALYTICS AND AI

SEAMLESS SCALING FROM LAPTOP TO PRODUCTION

- Easily prototype the end-to-end pipeline
- "Zero" code change from laptop to distributed cluster
- Directly access production data without data copy
- Seamlessly deployed on production big data clusters

Analytics Zoo

Unified Big Data Analytics and AI Platform

ANALYTICS ZOO

Models & Algorithms	Recommendation	Time Series	Computer Vision	NLP
ML Workflow	AutoML for Time Series	Automatic Cluster Serving		
Integrated Analytics & AI Pipelines	Distributed TensorFlow & PyTorch on Spark	RayOnSpark		
	Spark Dataframes & ML Pipelines for DL	Model Serving		

Library & Framework

- Distributions (Cloudera/Databricks/....)
- Distributed Analytics (Spark/Flink/Ray/...)
- DL Frameworks (TF/PyTorch/...)
- Python Libraries (Numpy/Pandas/...)

https://github.com/intel-analytics/analytics-zoo

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DISTRIBUTED TENSORFLOW ON SPARK IN ANALYTICS ZOO

```
#pyspark code
train_rdd = spark.hadoopFile(…).map(…)
dataset = TFDataset.from_rdd(train_rdd,…)

#tensorflow code
import tensorflow as tf
slim = tf.contrib.slim
images, labels = dataset.tensors
with slim.arg_scope(lenet.lenet_arg_scope()):
   logits, end_points = lenet.lenet(images, …)
loss = tf.reduce_mean( \
   tf.losses.sparse_softmax_cross_entropy( \
   logits=logits, labels=labels))

#distributed training on Spark
optimizer = TFOptimizer.from_loss(loss, Adam(…))
optimizer.optimize(end_trigger=MaxEpoch(5))
```

Write TensorFlow code inline in PySpark program

MORE INFORMATION ON ANALYTICS ZOO

- Project website
  - https://github.com/intel-analytics/analytics-zoo
  - https://github.com/intel-analytics/bigdl
- Tutorials
  - CVPR 2018: https://jason-dai.github.io/cvpr2018/
  - AAAI 2019: https://jason-dai.github.io/aaai2019/
- "BigDL: A Distributed Deep Learning Framework for Big Data"
  - *In proceedings of ACM Symposium on Cloud Computing 2019 (SOCC'19)*
- Use cases
  - *Azure, CERN, MasterCard, Office Depot, Tencent, Midea, etc.*
  - https://analytics-zoo.github.io/master/#powered-by/

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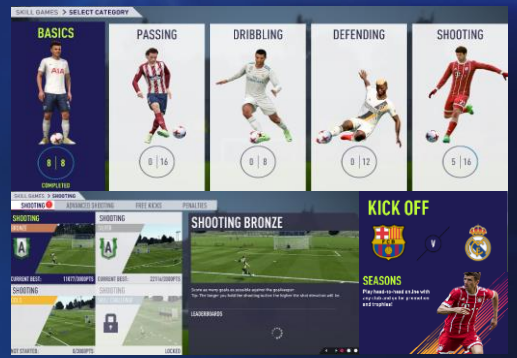
WHY FIFA18?

What is FIFA18*?

- **A real-time 3D soccer simulation video game by Electronic Arts***

Why FIFA18?

- **It's fun ☺**
- **It's challenging**
  - **Complex (esp. full-court game) and non-deterministic**
  - **Large action space (16 basic keys w/ combinations)**
- **Many modes available**
  - **Full-court, mini-games, skill games, etc.**



SHOOTING BRONZE: OUR EXPERIMENT ENVIRONMENT

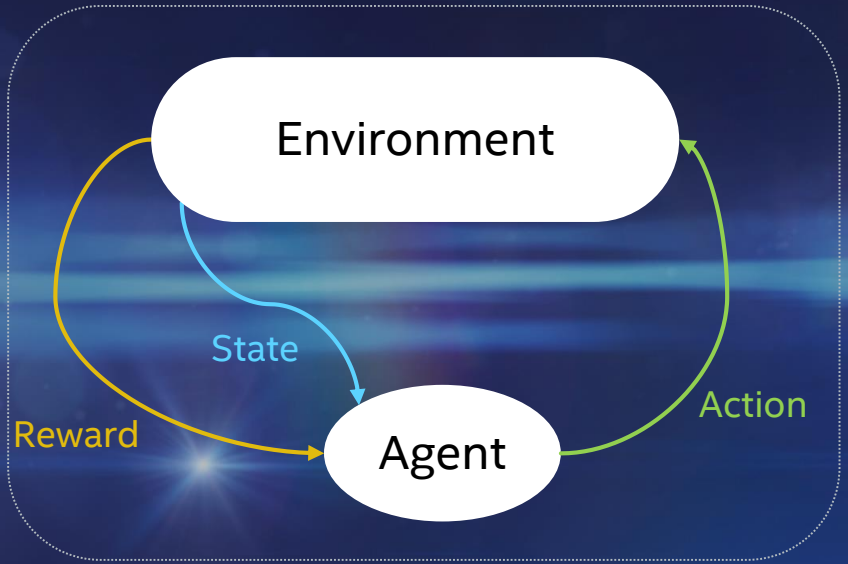
Shooting is one of the mini-games in FIFA18,
Bronze is the easiest level

Game mode
- Player & goalkeeper 1v1
- Goal: get higher score in 44s

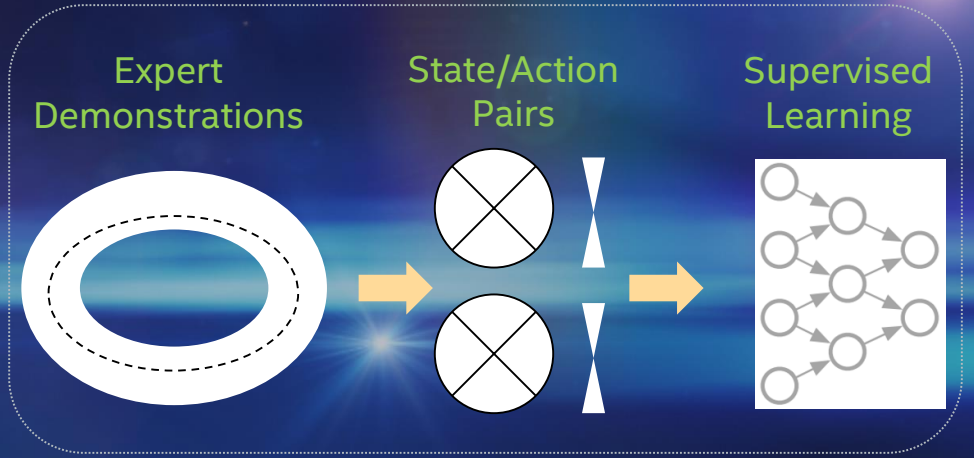
Evaluation
- Single shoot: score ≤ 200 for miss; 200<score<1200 for goal
- Accumulated scores after the game

Keyboard control
- A/S/W/D: left/right/up/down
- Space: shoot

REINFORCEMENT LEARNING



Sequential Decision Making



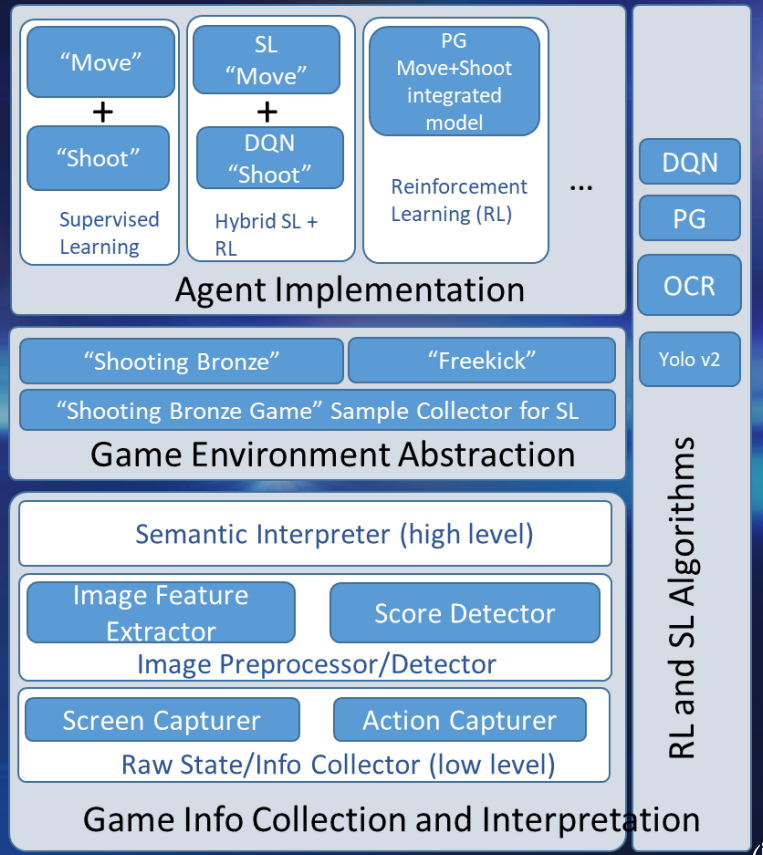
Imitation Learning

RL PLATFORM FOR PLAYING FIFA18

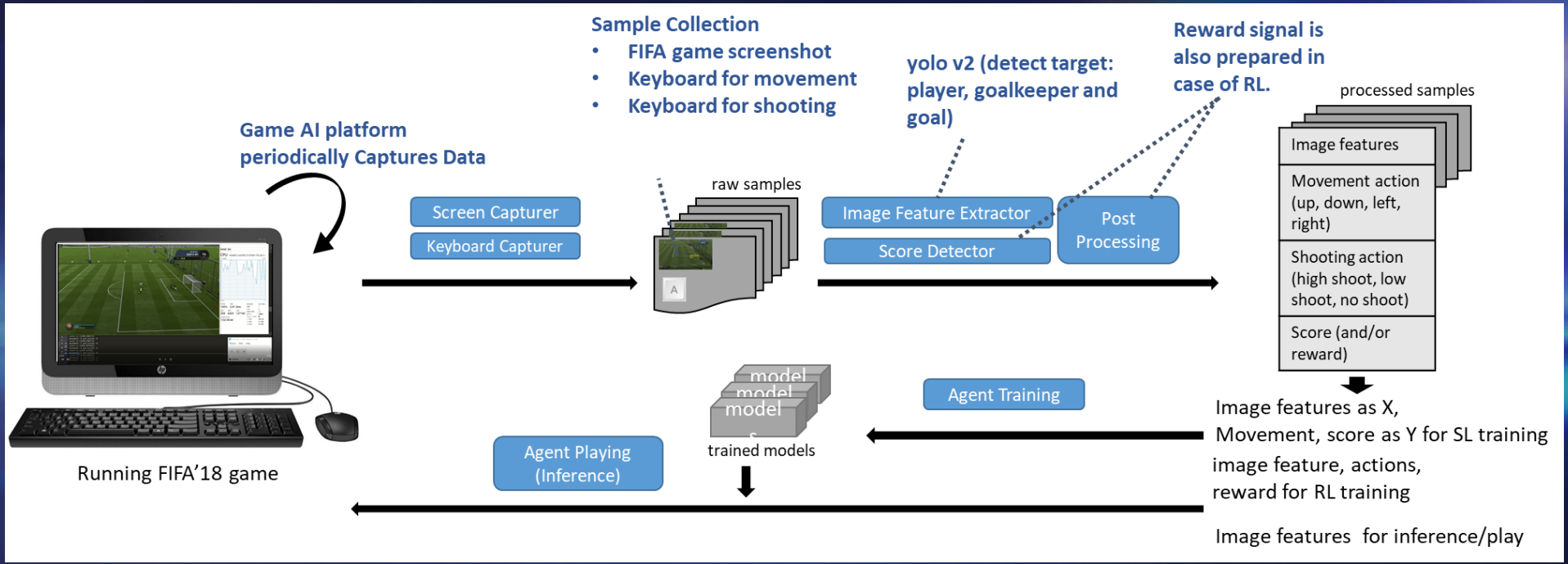
Experiment platform for RL agents and algorithms for FIFA18

Major components

- Game info collection & Interpretation
- Game Environment Abstraction
- Agent Implementation
  - Imitation learning / supervised learning (SL)
  - Reinforcement learning (RL)
  - Hybrid (SL+RL)



END-TO-END WORKFLOW



ANALYTICS ZOO

tfpark: Distributed TensorFlow on Spark

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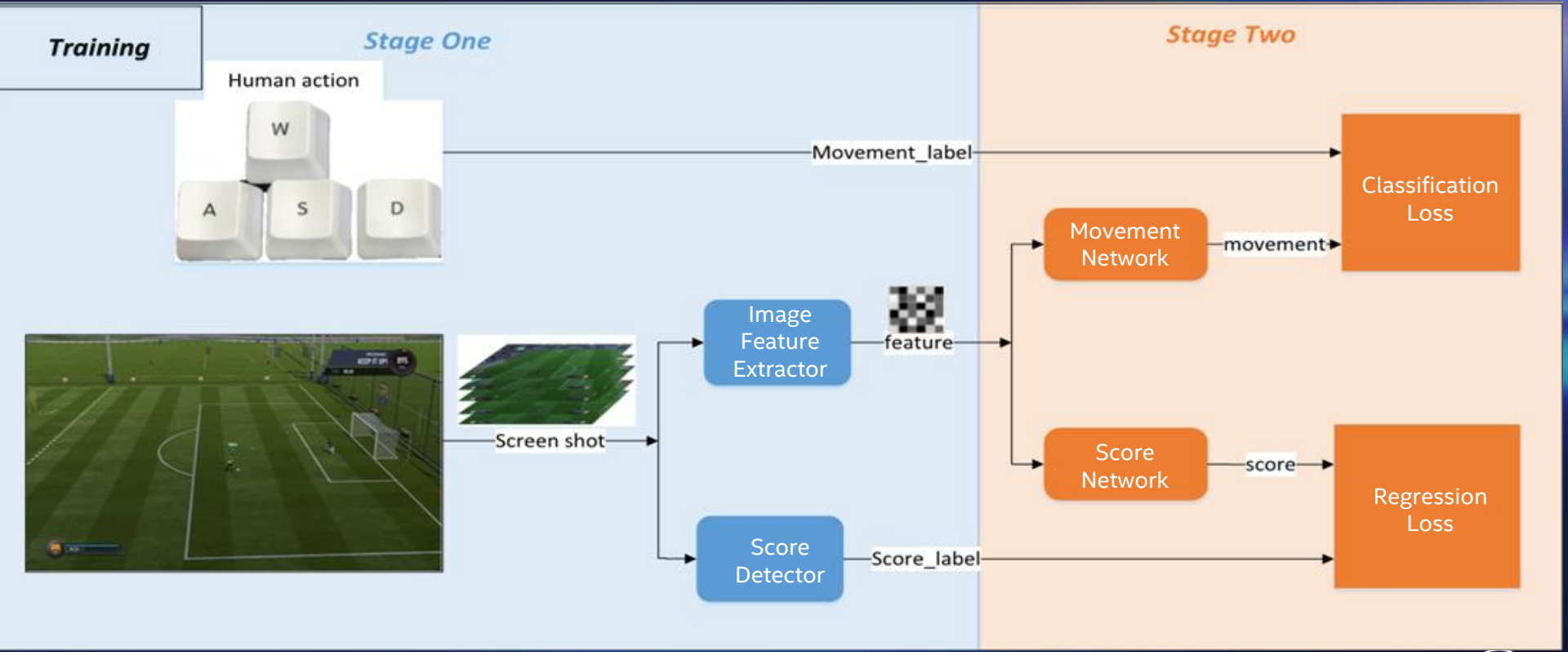
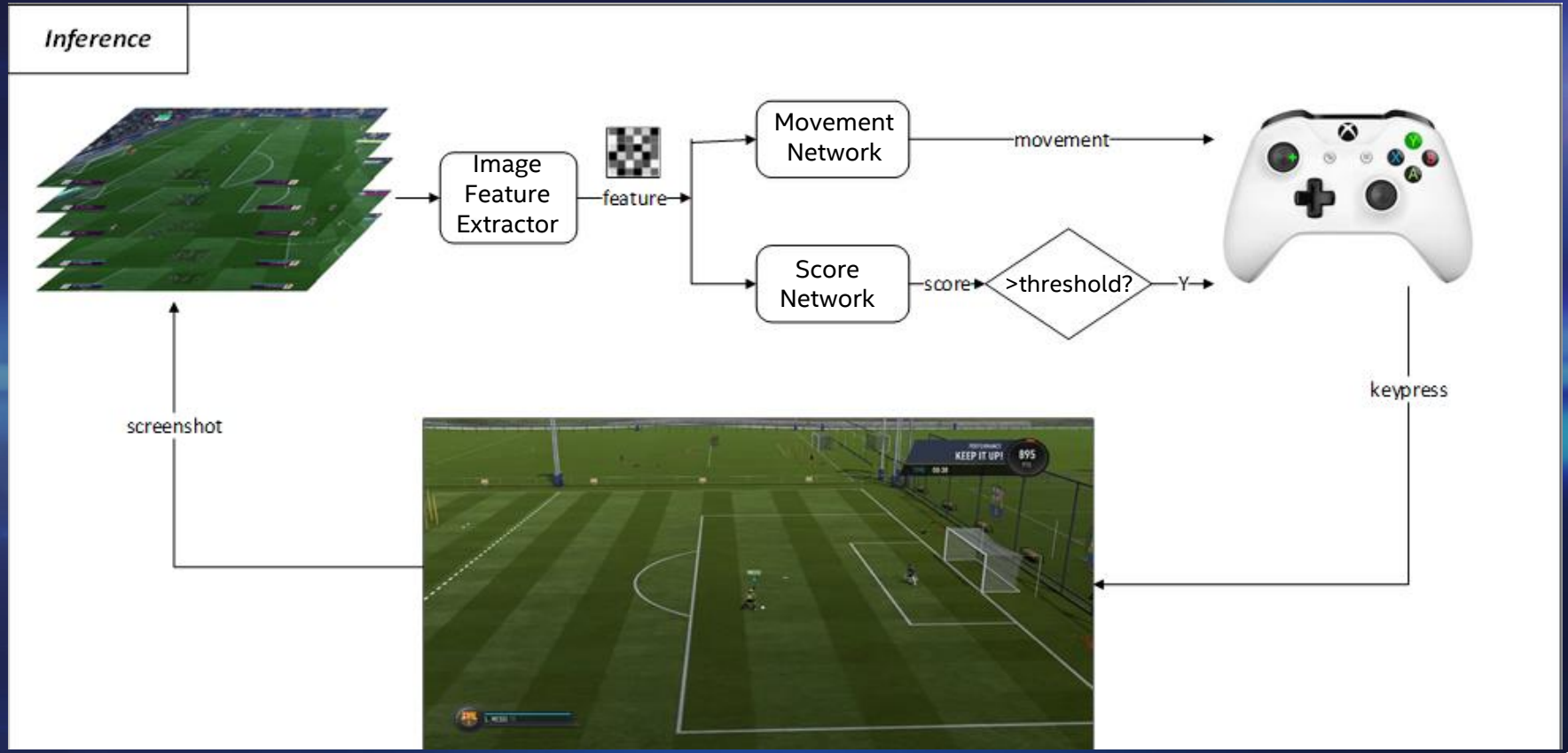
TRAINING THE AGENT USING IMITATION LEARNING



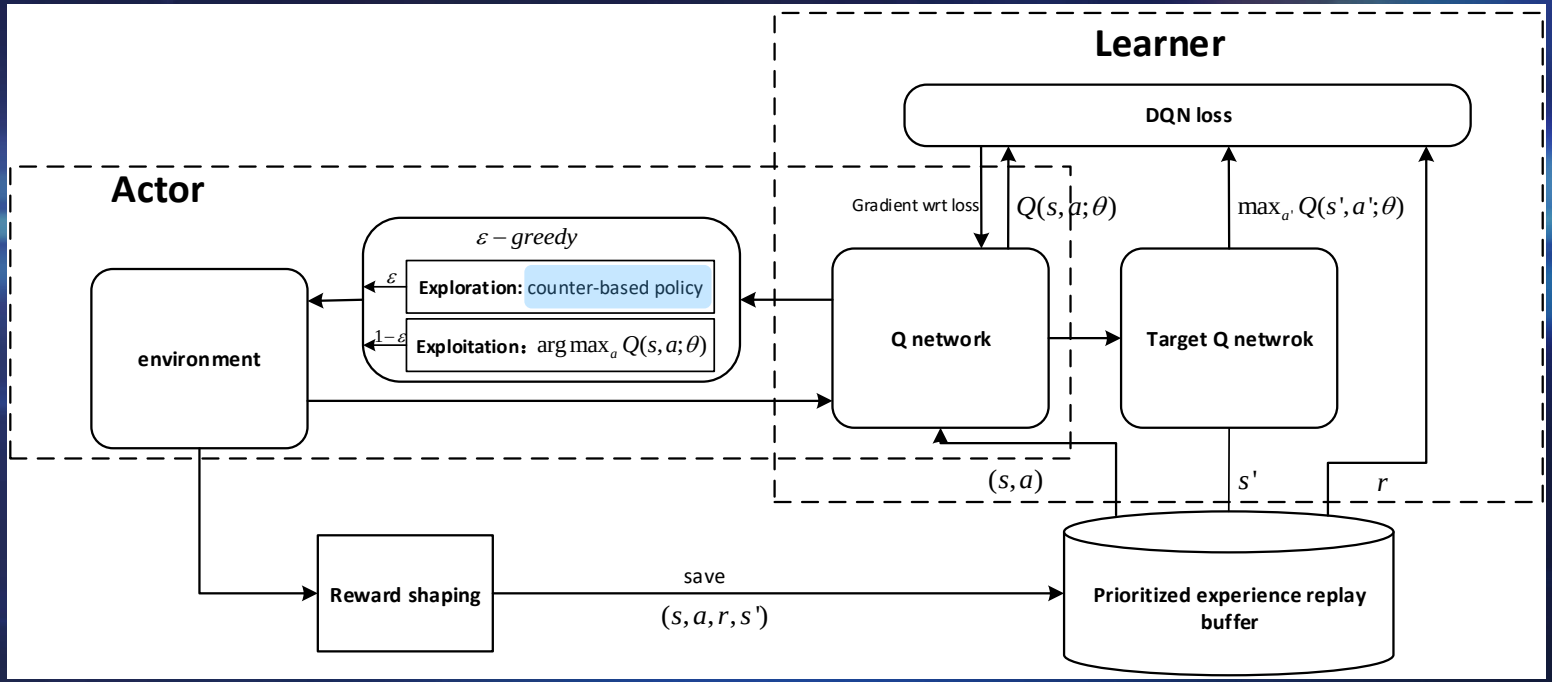
GAME PLAYING (INFERENCE) FOR IMITATION LEARNING



HYBRID APPROACH FOR TRAINING AGENT

Movement network: trained with Imitation Learning

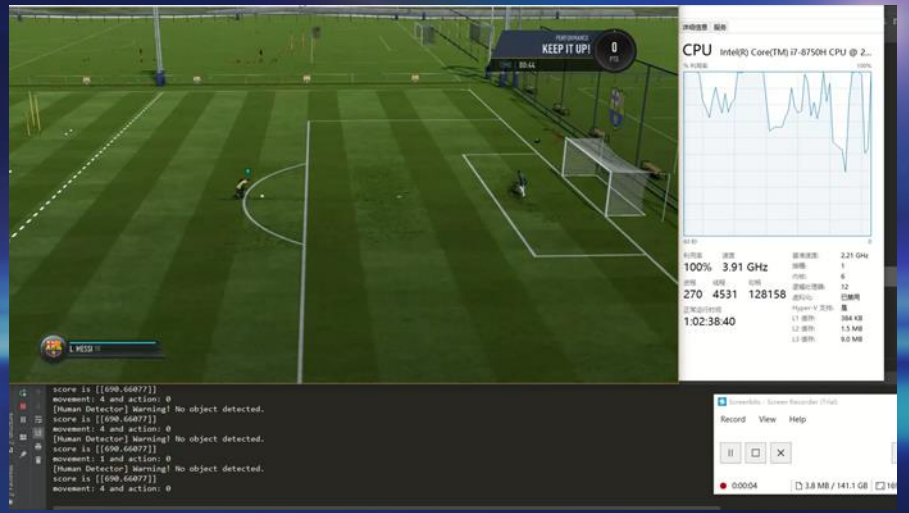
Shoot network: Double DQN



DEMO

https://drive.google.com/file/d/13dBsGOiGbCYOS5TgVAI95Qd-YszAHTW6/view

Human (demonstrator)



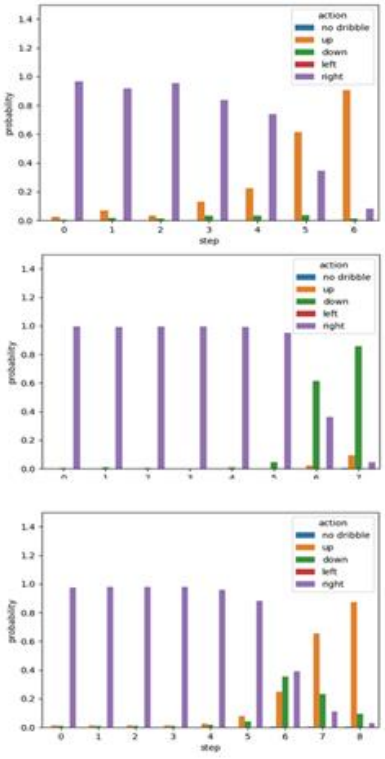
https://drive.google.com/file/d/1JVZjlDSyX8YtUy6qOuGRD_VN4RSZw0U8/view

Imitation Learning (better score than demonstrator)

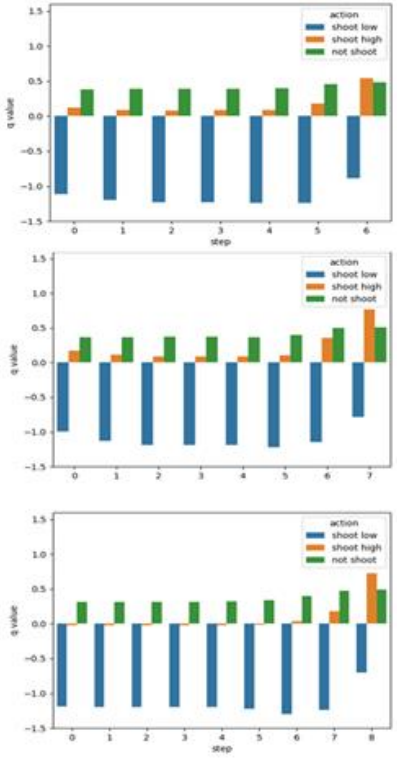
TYPICAL TRAJECTORY ANALYSIS (HYBRID)

Typical Trajectories

Movement Policy (SL)



Shoot Q-Value (RL)



RESULTS

		Score	Goal Ratio	Convergence speed
Human	beginner	5846.69	50%	-
	master	10112.78	92%	-
	demonstrator	7284.98	84.96%	-
Agent	Imitation Learning	10345.18	92.54%	-
	RL (Policy Gradient)	5606.31	40.25%	1069.5 epochs
	Hybrid	10514.43	95.59%	749.6 epochs

For more complete information about performance and benchmark results, visit www.intel.com/benchmarks.

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GOOGLE RESEARCH FOOTBALL (GRF)

An open source RL environment for playing soccer from Google Brain

- https://github.com/google-research/football

A great RL environment for playing soccer

- More state and reward info & controls
- Customizable scenarios, players, rewards and observations, etc.
- More useful features such as accelerated speed, self-play, multi-agent, etc.
- Easy to dump traces and replay

Transfer between FIFA18 and GRF?

Google Research Football: A Novel Reinforcement Learning Environment (https://arxiv.org/abs/1907.11180)

EARLY EXPERIMENTS ON GRF

https://drive.google.com/file/d/1bNO5rpUhCeCZY9zPGgVCzgUlqH9QF39n/view

Trained using PPO in OpenAI* baseline

FUTURE WORK

Ray* support in Analytics Zoo
- E.g., *RayOnSpark*

Support for *Google Research Football*
- *E.g., transfer between GRF and FIFA?*

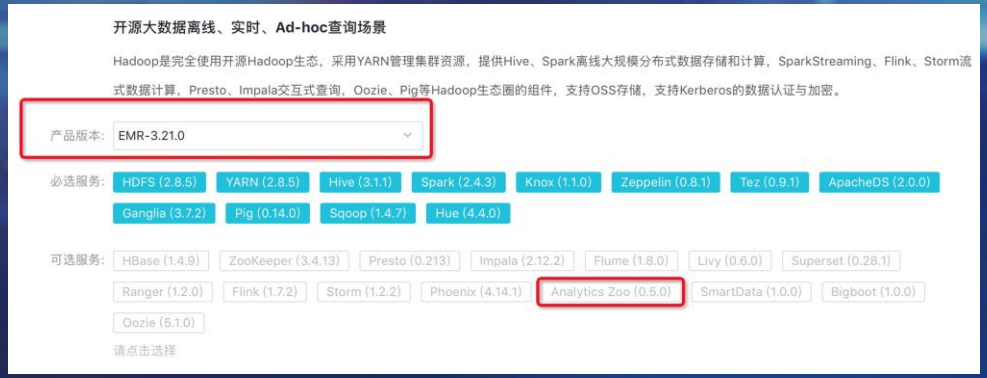
Additional algorithms/models and scenarios
- E.g., *full-court* game

https://medium.com/riselab/rayonspark-running-emerging-ai-applications-on-big-data-clusters-with-ray-and-analytics-zoo-923e0136ed6a

Analytics Zoo on Ali E-MR

ANALYTICS ZOO + Alibaba Cloud aliyun.com

Analytics Zoo is already out-of-box on Ali EMR:



* Version upgrade for Analytics Zoo is on-going.

For more information and support, contact Wesley:

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DingTalk:

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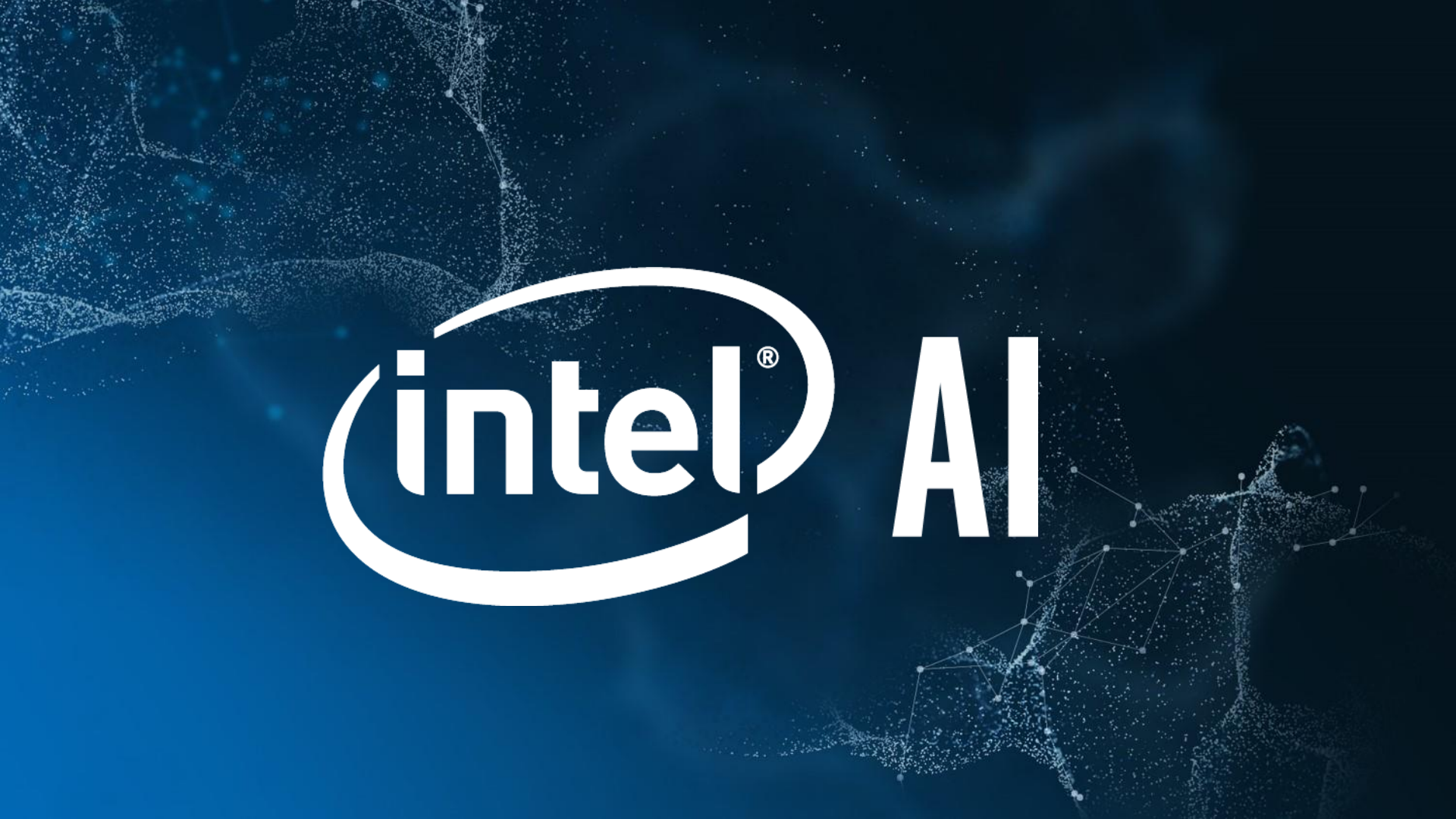
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