SOSCON
Unity ML-Agents

Unity Technologies Korea | Lead Evangelist | Jihyun Oh

Hanyang University | Automotive Engineering | Kyushik Min

2018.10.17

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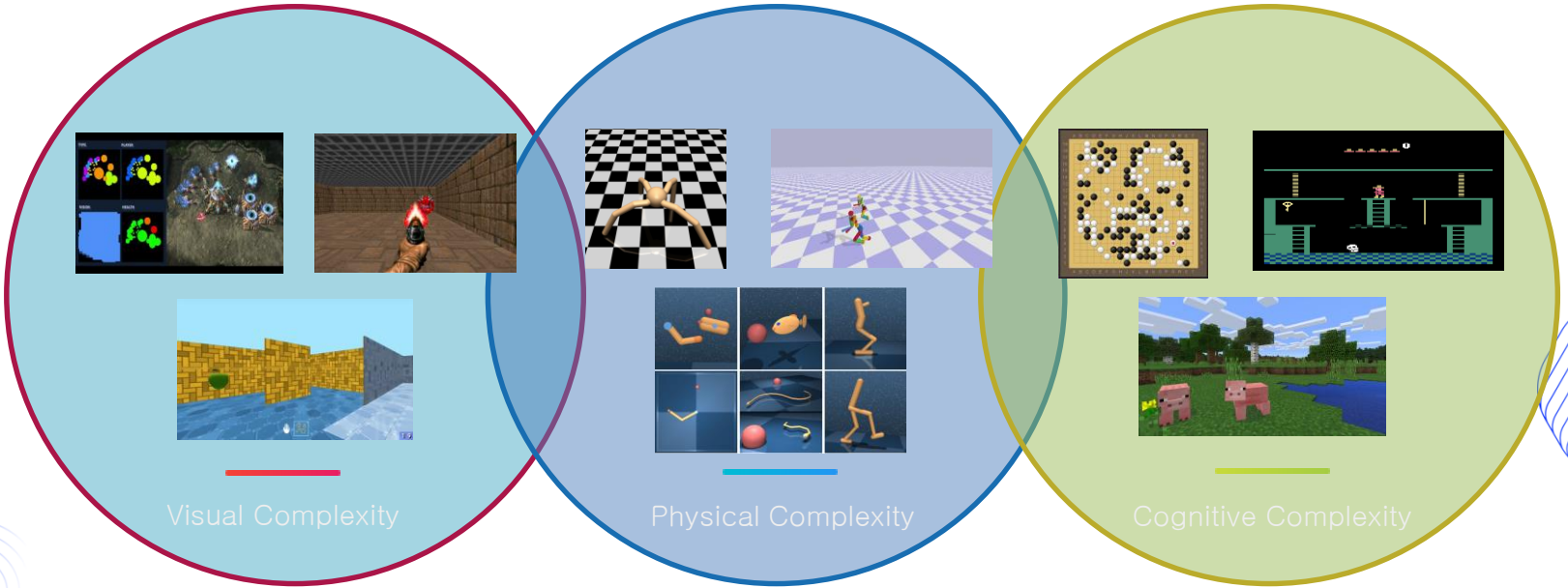
SAMSUNG OPEN SOURCE CONFERENCE 2018

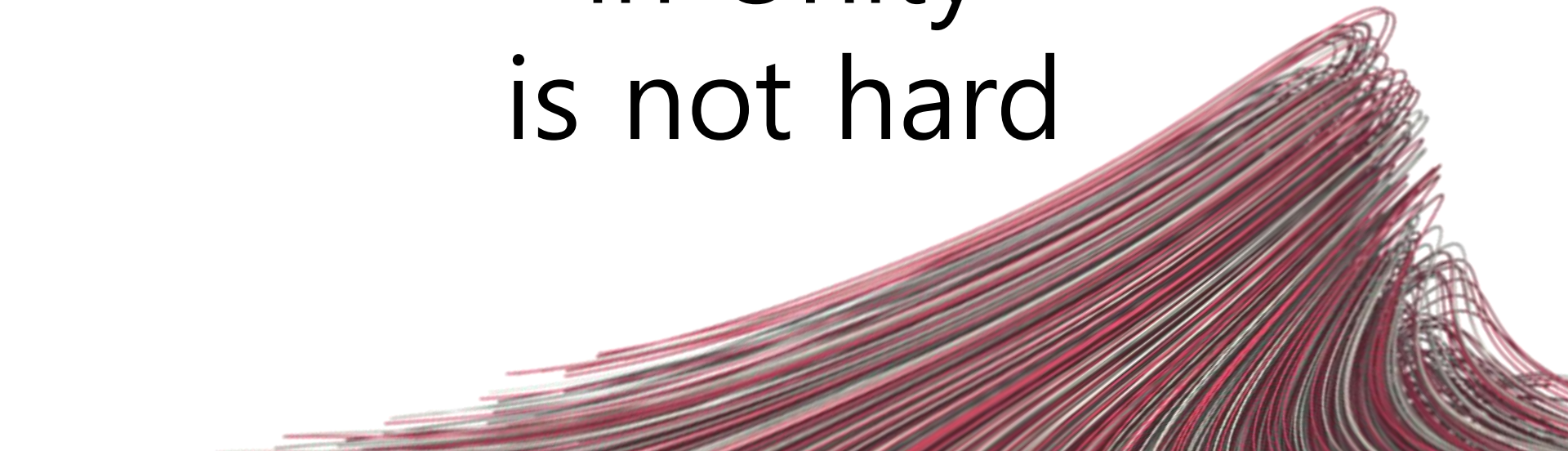
Unity ML-Agents

ML Training Environment Requirements



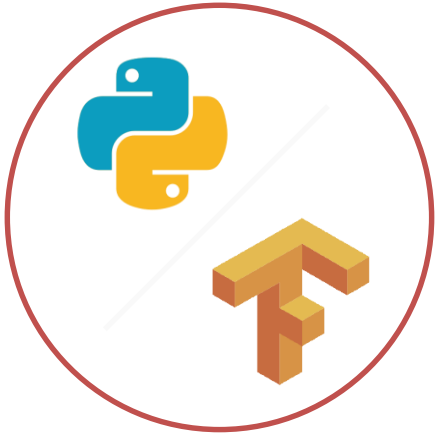
The Unity Ecosystem

Making environments in Unity is not hard



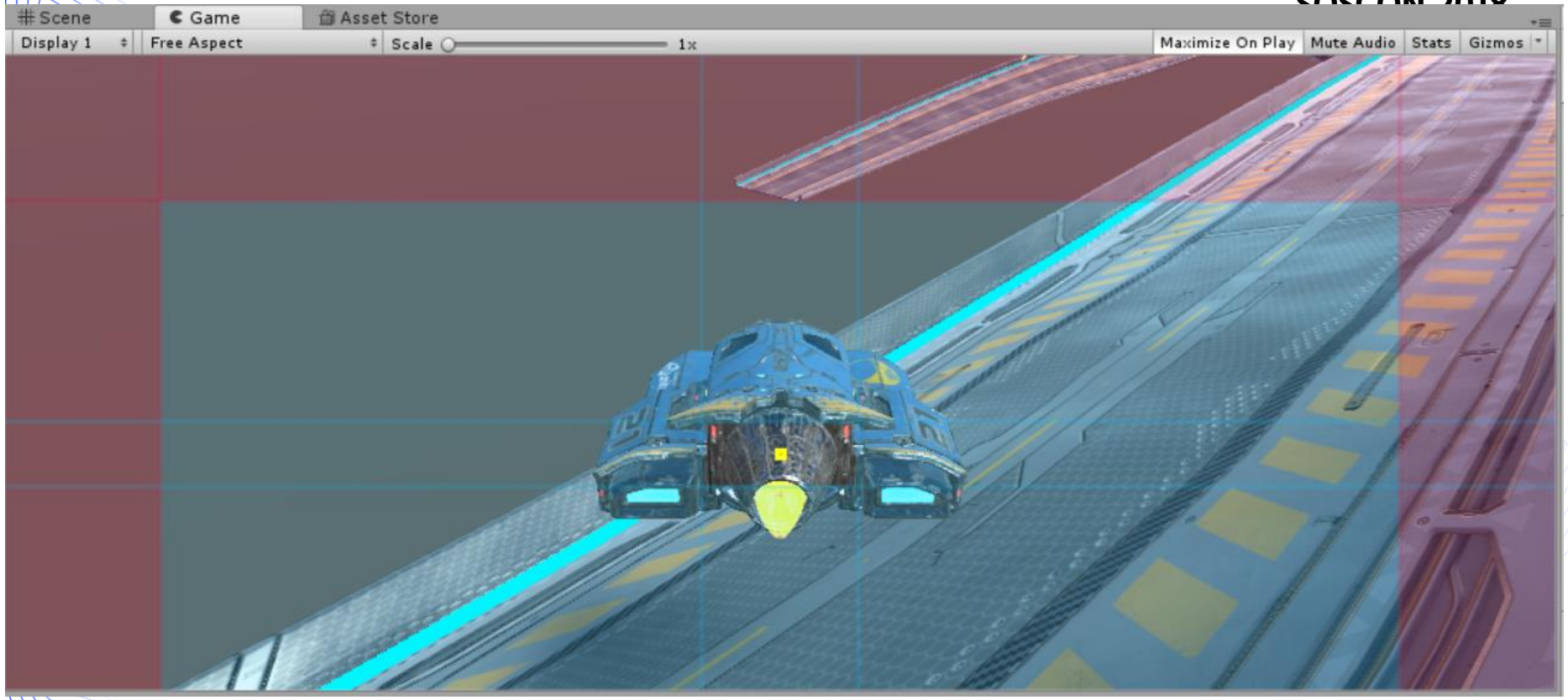
Unity ML-Agents Workflow

Create Environment



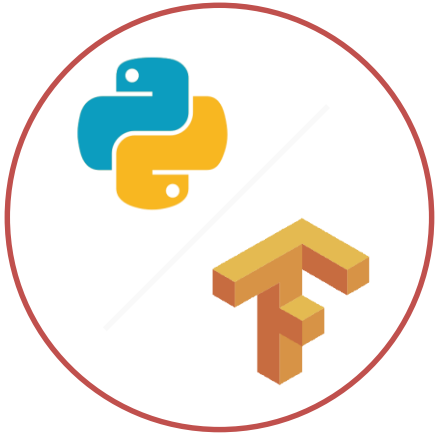
Train Agents

Embed Agents


Scene
Game
Asset Store
Display 1
Free Aspect
Scale
1x
Maximize On Play
Mute Audio
Stats
Gizmos

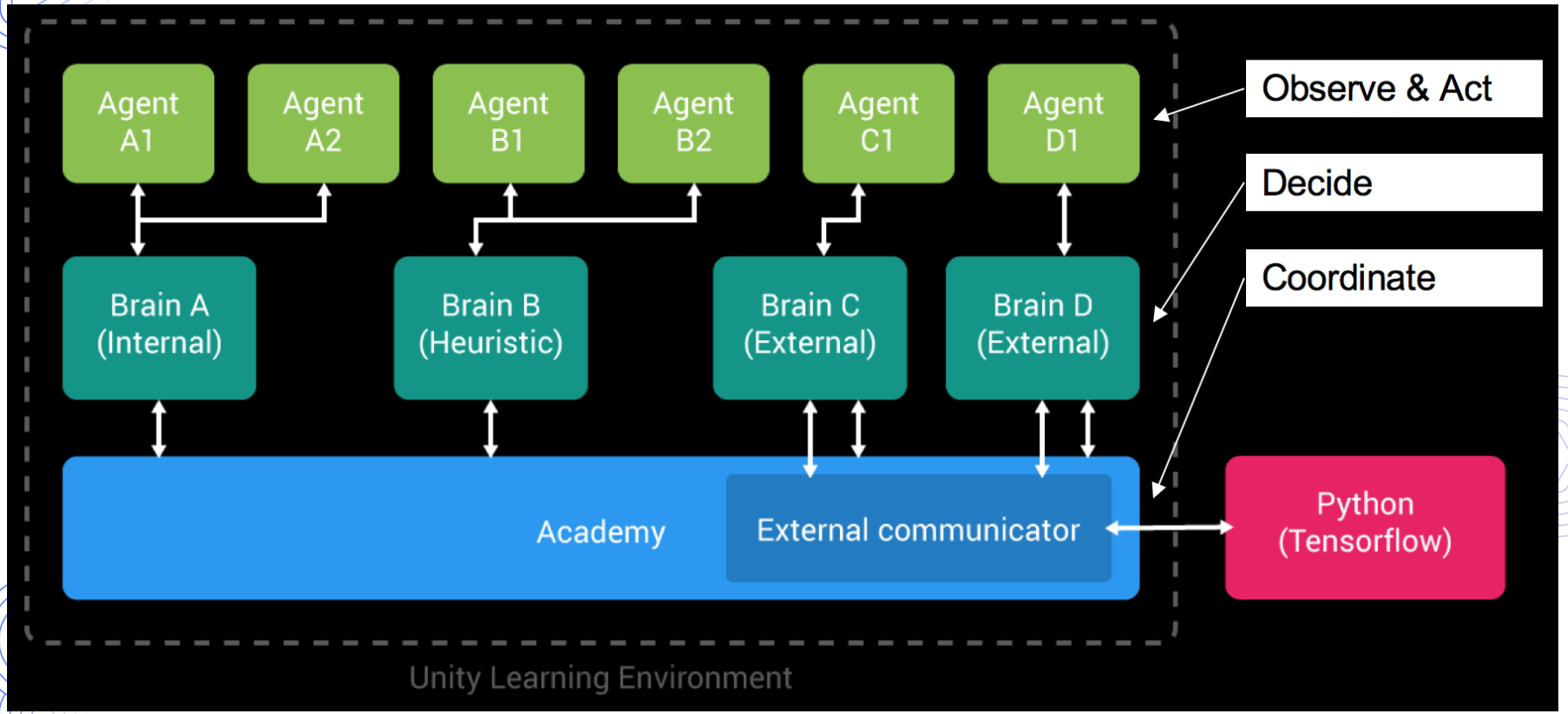
Unity ML-Agents Workflow

Create Environment

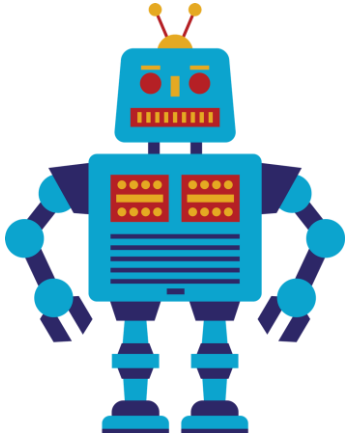


Train Agents

Embed Agents


Agent A1
Agent A2
Agent B1
Agent B2
Agent C1
Agent D1
Observe & Act
Decide
Coordinate
Brain A (Internal)
Brain B (Heuristic)
Brain C (External)
Brain D (External)
Academy
External communicator
Python (Tensorflow)
Unity Learning Environment

Imitation Learning



Collect demonstrations from a teacher

Learn policy via imitation

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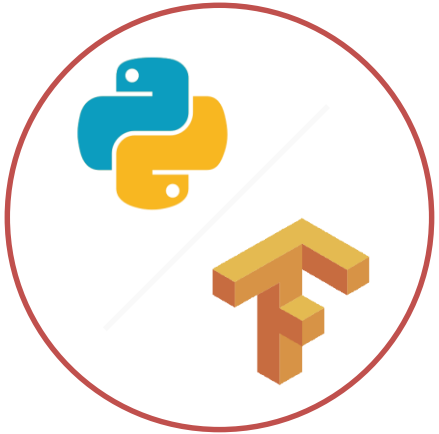
unity
INFO:unityagents:{'--curriculum': 'None',
'--docker-target-name': 'Empty',
'--help': False,
'--keep-checkpoints': '5',
'--lesson': '0',
'--load': False,
'--no-graphics': False,
'--run-id': 'MyRacer',
'--save-freq': '50000',
'--seed': '-1',
'--slow': True,
'--train': True,
'--worker-id': '0',
'<env>': None}
INFO:unityagents:Start training by pressing the Play button in the Unity Editor.
INFO:unityagents:
'Academy' started successfully!
Unity Academy name: Academy
Number of Brains: 2
Number of External Brains : 1
Lesson number : 0
Reset Parameters :
Unity brain name: ExpertRacerBrain
Number of Visual Observations (per agent): 0
Vector Observation space type: continuous
Vector Observation space size (per agent): 20
Number of stacked Vector Observation: 3
Vector Action space type: continuous
Vector Action space size (per agent): 1
Vector Action descriptions:


HUMAN
00:31.5
MACHINE

Unity ML-Agents Workflow

Create Environment



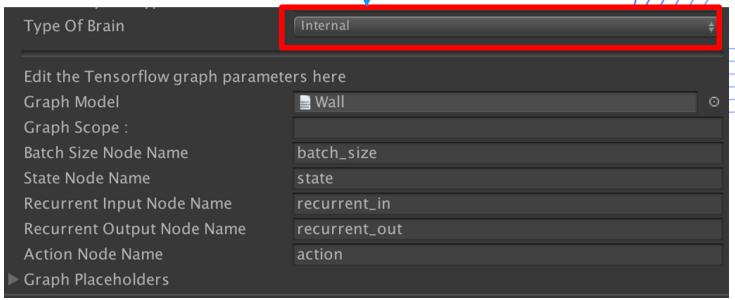
Train Agents

Embed Agents

Embed Agents (Unity)

- Simply import a *.bytes* file (traine d brain) into Unity project
- Set corresponding brain compone nt to “Internal” mode.
- Support for Mac, Windows, Linux, iOS, and Android.

Wall.bytes




File Edit Assets GameObject Component Cinemachine Window Help
Pivot Global
Collab Account Layers Layout
Hierarchy
Create
Complete*
Environment
GameManager
Cameras
Ship Player
Ship ML
Academy
ExpertRacerBrain
StudentRacerBrain
AgentMonitorCanvas
Scene Game Asset Store
Display 1 Free Aspect Scale 1x
Maximize On Play Mute Audio Stats Gizmos
HUMAN
00:34.6
MACHINE
Project Console
Clear Collapse Clear on Play Error Pause Editor
Inspector
ExpertRacerBrain
Static
Tag Untagged Layer Default
Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
Brain (Script)
Brain Parameters
Vector Observation
Space Type Continuous
Space Size 20
Stacked Vectors 3
Visual Observation
Vector Action
Space Type Continuous
Space Size 1
Action Descriptions
Brain Type Internal
Broadcast
Edit the Tensorflow graph parameters here
Graph Model 4 Minutes
Graph Scope
Batch Size Node Nar batch_size
Vector Observation I vector_observation
Recurrent Input Nod recurrent_in
Recurrent Output No recurrent_out
Action Node Name action
Graph Placeholders
Add Component

Virtual Environments for Autonomous Vehicles Development

Why Virtual Environments ?


01/26/2013 14:42:59
Создано в пробной версии программы "ВидеоМАСТЕР"
В полной версии этой надписи не будет. VIDEO-CONVERTER.RU


42 km/h
2013/02/12 17:12:00

Why Simulate?

Simulation can get autonomous systems
ready for unforeseen scenarios and edge conditio
ns
in a fast and cost effective way.

unity Asset Store 3D 2D Add-Ons Audio Templates Tools VFX

All Assets Type here to search assets Plus/Pro Learn Game Development Impressive New Assets Shop On Old Store

Home > Unity Technologies > Real World Simulation

UNITY TECHNOLOGIES

Real World Simulation (80)

Share

Assets designed to power real world simulation.

SAMUEL ABYAN
Road Signs Pack
★★★★★ (4)
$9

VIS GAMES
Highway Construction Set
★★★★☆ (29)
$20

DEFUSE STUDIOS
Realistic Grass Vol. 1
★★★☆☆ (5)
$9.99

EVOLTE
Texture Creator
★★★★☆ (7)
$5

VEA GAMES
Landscape Auto Material
★★★★☆ (33)
$99

TANUKI DIGITAL
TENKOKU Dynamic Sky
★★★★★ (171)
$65

JD CREATIVE MACHINE
Civil Construction Pack - Roads, Highways ...
★★★★☆ (5)
$34.95

MIKAEL GUSTAFSSON
Stylized Jungle Pack
★★★★★ (54)
$9.99

PROCEDURAL WORLDS
Gaia
★★★★★ (933)
$67

REBOUND GAMES
Simple Waypoint System
★★★★★ (471)
$15

RIVERMILL STUDIOS
Car Water Spray Trails
(not enough ratings)
$15

RIVERMILL STUDIOS
Car Exhaust Effect
★★★★☆ (4)
$5

MEHDI RABIEE
Driver (Traffic System)
★★★★☆ (32)

AGLOBEX
Urban Traffic System 2018.2
★★★★☆ (9)

Feedback

3D > Vehicles > Land

GAME-READY STUDIO
Next-Gen Tank
(not enough ratings)
~~$0.99~~ $0.79 Plus/Pro

3D > Vehicles > Land

UNLOCK GAME ASSETS
Unlock economy car #05
(not enough ratings)
$5

3D > Vehicles > Land

GAME-READY STUDIO
Old Rusted Car
(not enough ratings)
~~$0.99~~ $0.79 Plus/Pro

3D > Vehicles > Land

CACTUSCREATIVES PVT. LTD.
Car
★★★★☆ (84)
FREE

3D > Vehicles > Land

SYNTY STUDIOS
Simple Trains - Cartoon A...
★★★★★ (16)
~~$11.99~~ $9.59 Plus/Pro

3D > Vehicles > Land

TESTMOBILE
UAA - City Vehicles - Sout...
(not enough ratings)
$3

3D > Vehicles > Land

TESTMOBILE
UAA - City Vehicles - Gran...
(not enough ratings)
$4

3D > Vehicles > Land

PRO 3D MODELS
Low-poly Civilian vehicle #5
★★★★★ (6)
FREE

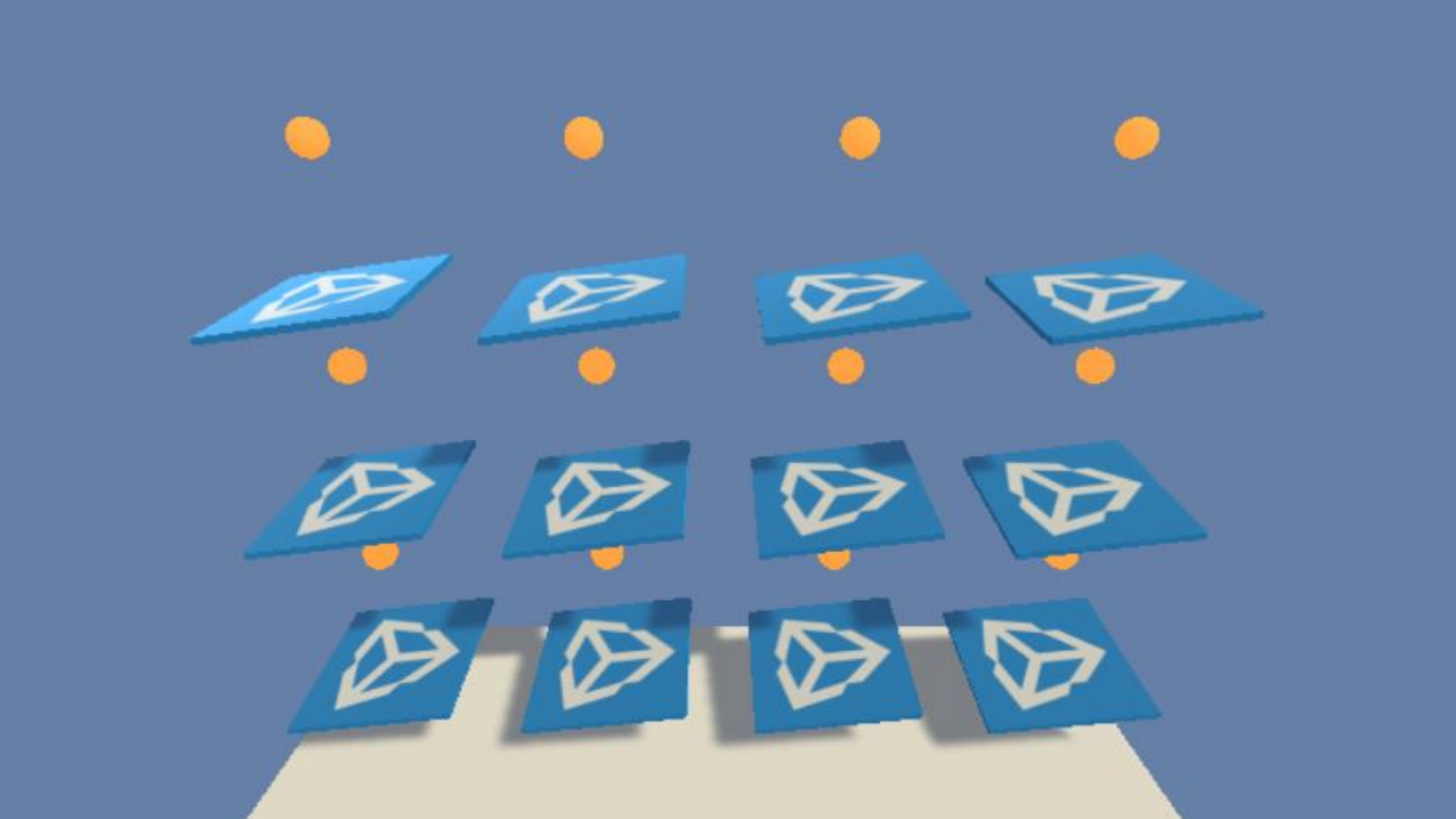
3D > Vehicles > Land

SICS GAMES
Complete Vehicle Pack V2
★★★★★ (20)
~~$30~~ $24 Plus/Pro

3D > Vehicles > Land

UNLOCK GAME ASSETS
Unlock sport utility vehicl...
★★★★★ (6)
$5

Reinforcement Learning



https://github.com/Unity-Technologies/ml-agents

Unity ML-Agents Toolkit (Beta)

The Unity Machine Learning Agents Toolkit (ML-Agents) is an open-source Unity plugin that enables games and simulations to serve as environments for training intelligent agents. Agents can be trained using reinforcement learning, imitation learning, neuroevolution, or other machine learning methods through a simple-to-use Python API. We also provide implementations (based on TensorFlow) of state-of-the-art algorithms to enable game developers and hobbyists to easily train intelligent agents for 2D, 3D and VR/AR games. These trained agents can be used for multiple purposes, including controlling NPC behavior (in a variety of settings such as multi-agent and adversarial), automated testing of game builds and evaluating different game design decisions pre-release. The ML-Agents toolkit is mutually beneficial for both game developers and AI researchers as it provides a central platform where advances in AI can be evaluated on Unity's rich environments and then made accessible to the wider research and game developer communities.

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Unity ML-Agents

How I met Unity

Hanyang University | Automotive Engineering | Kyushik Min

2018.10.17

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Contents

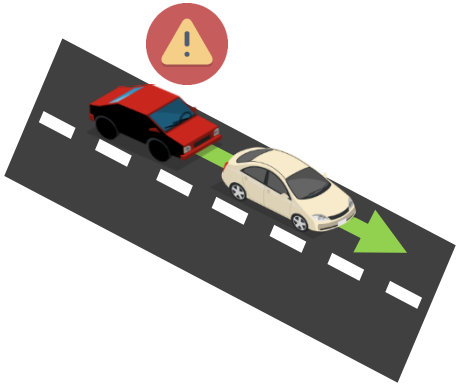
Self Introduction

Kyushik Min

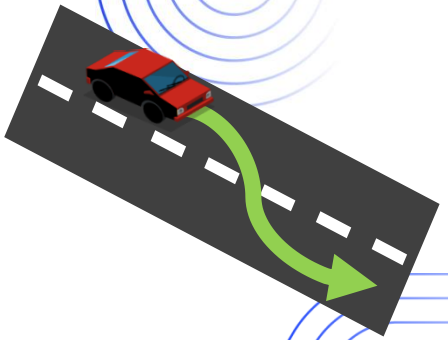
- Hanyang University MMC Lab. PhD candidate
- Operator of Reinforcement Learning Korea (Facebook)
- Machine Learning Camp Jeju 2017 Participant
- Modu Lab. Deep Learning Intensive Course
- Seminar Lecturer at Fast Campus
- Online Lecture Instructor of Programmers

Self Introduction

Self Driving Car

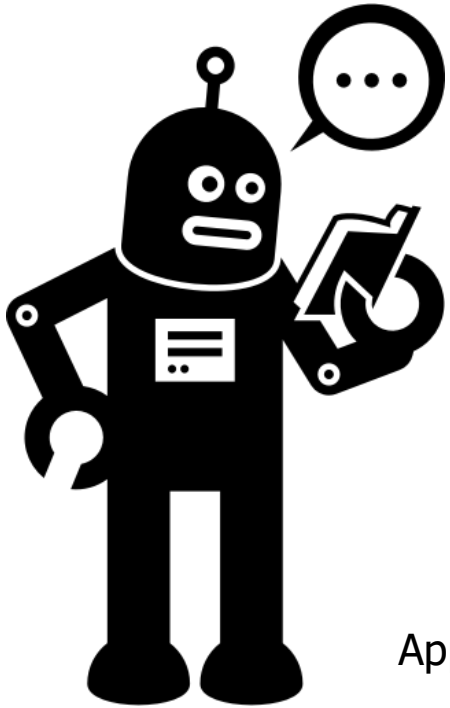


Driver Assistance System (DAS)



Vehicle Control

Self Introduction



Machine Learning

Deep Learning

Reinforcement Learning (RL)

Applying Deep Learning and RL to Self Driving Car

How I Met Unity

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How I met Unity

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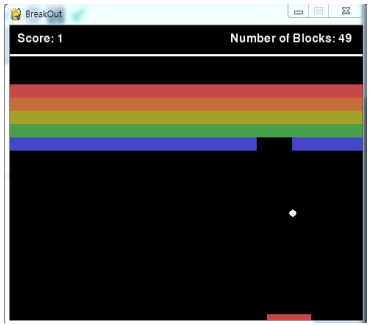
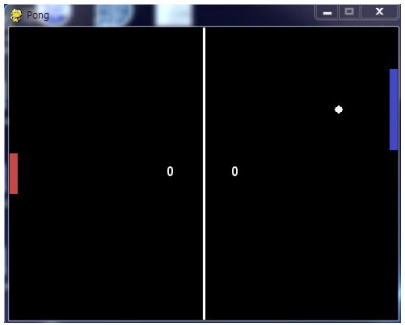
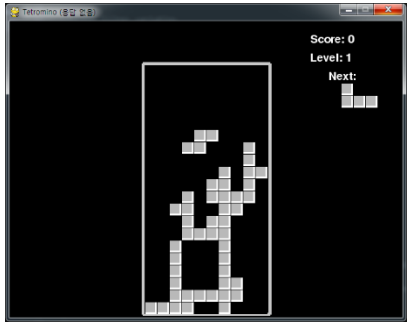


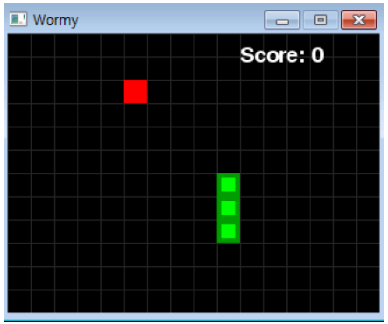
Breakout



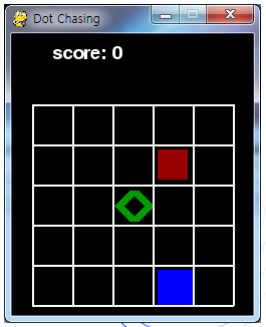
Pong



Tetris



Wormy



Gridworld

https://github.com/Kyushik/DRL

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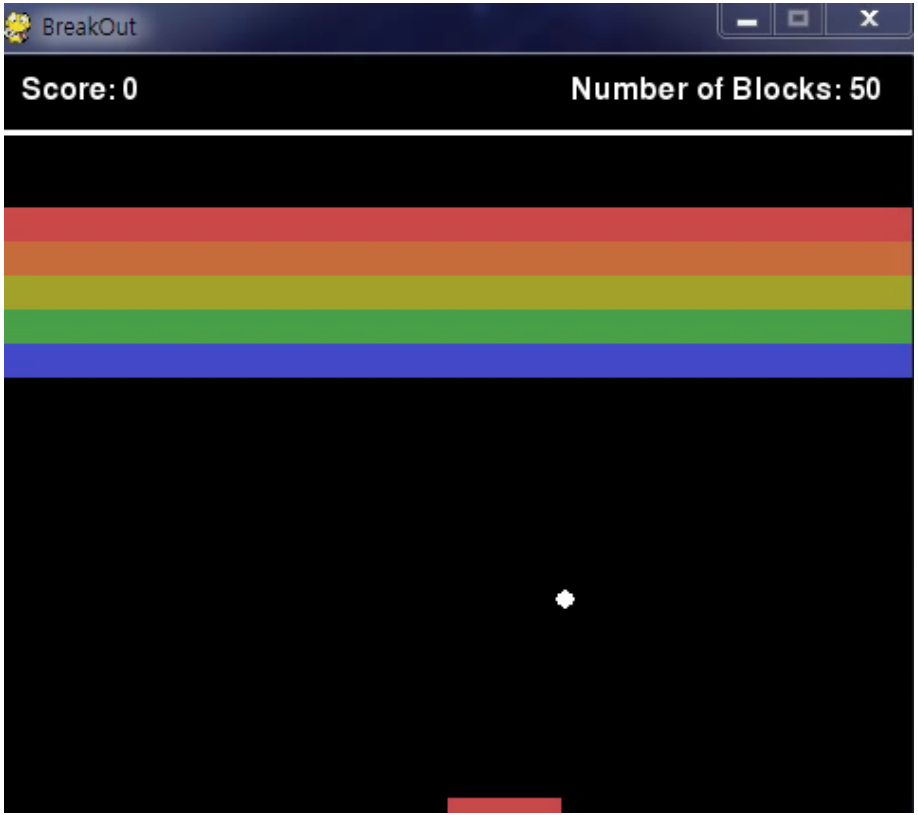
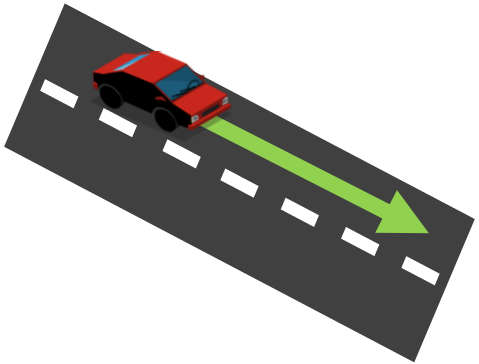



MACHINE
LEARNING
CAMP JEJU
2017

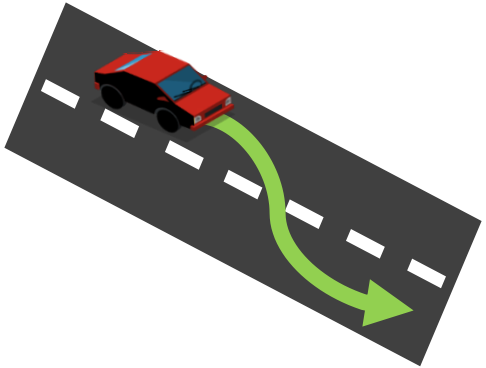
How I met Unity

Project Proposal

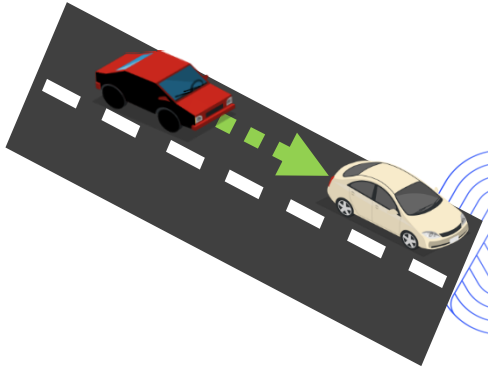
- Goal: Making Agent, which drives fast with minimum unnecessary lane change



Lane Keeping



Lane Change

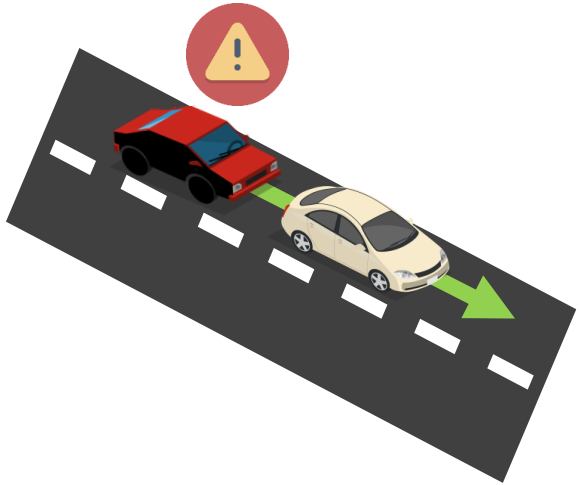


Cruise Control

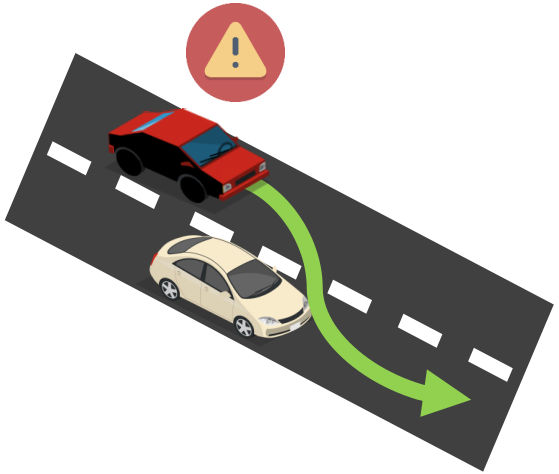
Proper choice of these functions can implement self driving car => Reinforcement Learning

How I met Unity

Project Proposal



Emergency Braking



Lane Change Prevention

Action selection of RL is unpredictable => Applying collision avoidance system

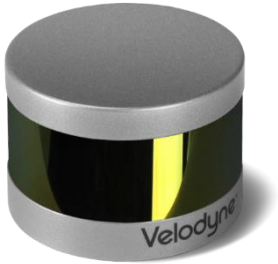
How I met Unity

Project Proposal

Add Vehicle Sensors!!

Vision

LIDAR



RADAR

- DRL algorithms are already implemented!! (DQN, DDQN, PER, Dueling DQN)
- But there is no simulator, which satisfy these conditions!!

How I met Unity

Project Proposal

Making Simulator for the Project

- Making simulator without pygame
  - In the case of Pygame, it is hard to make 3D game
  - Sensor making or collision check are hard to implement

How I met Unity

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ML Camp Jeju 2017 Application Result: ACCEPT 받은편지함 x

MLCamp Jeju <mlcampjeju@mlcampjeju.com>
mks0813에게

17. 5. 11.

영어 › 한국어 메일 번역 영어 번역 안함 ×

Dear, Kyushik Min

(If you have received a reject email from us, please discard it. You are ACCEPTED!)

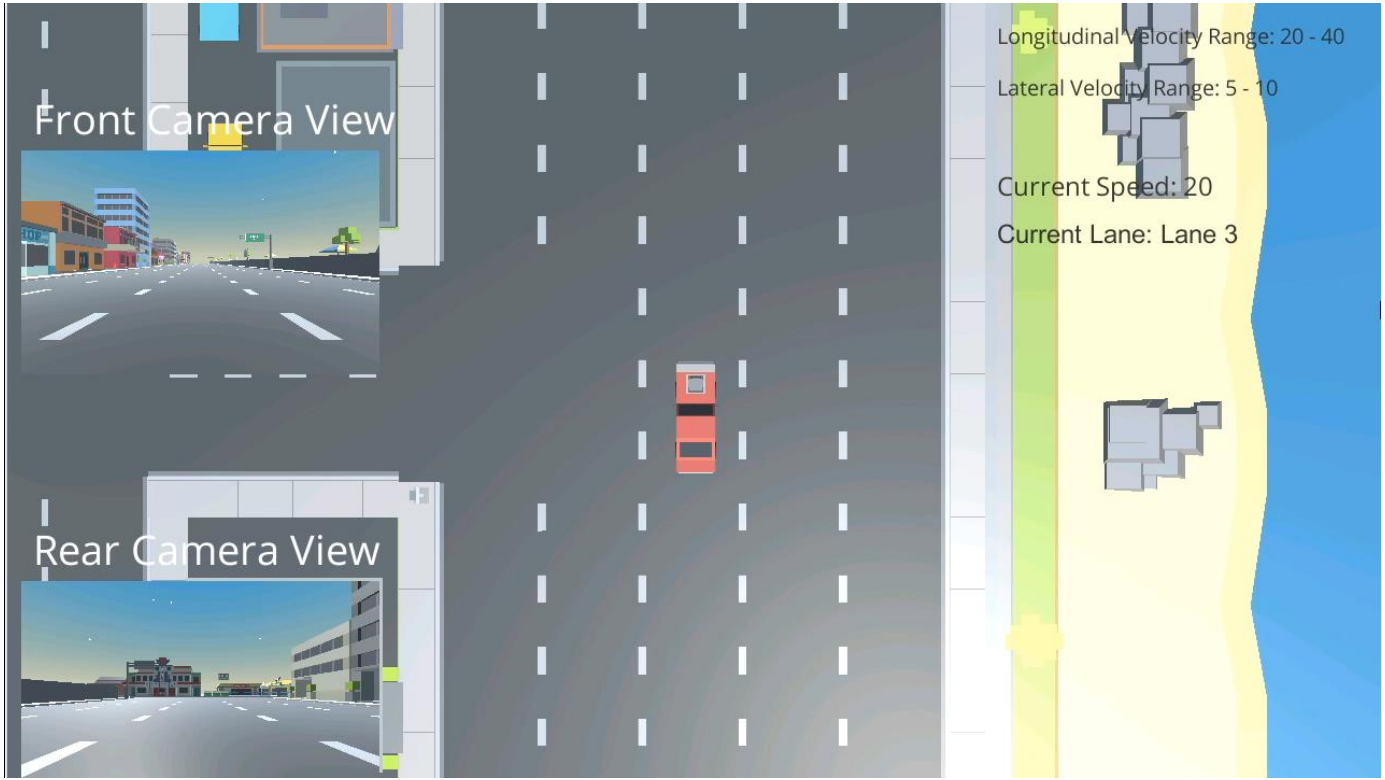
We are very pleased to inform you that you have been selected as a participant of the ML Camp Jeju 2017 (http://github.com/TensorFlowKR/MLJejuCamp) in Jeju, the most beautiful island in Korea. Congratulations!

This year, the competition was really strong: we received a total of 633 applications and only 20 were selected. The committee carefully reviewed every proposal, CV, and reference implementations, and made final decisions as a whole.

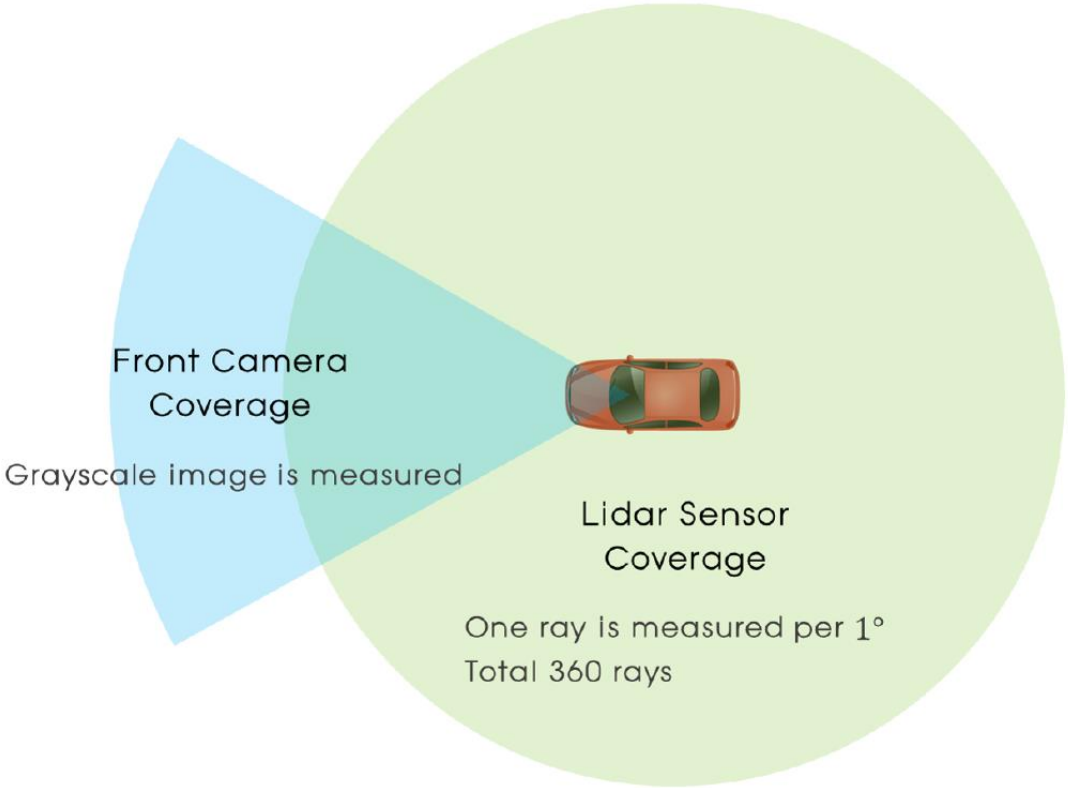
Once again, we really congratulate you for being selected as one of the 20 participants of this camp.

To complete the process to attend as a final participant, please carefully read and fill out the attached form and send us <mljejucamp@googlegroups.com> back a signed photo copy ASAP (no later than May 15, 11:59PM AoE). If we do not receive the signed copy by May 15, 11:59PM AoE, we will CANCEL your acceptance.

How I met Unity



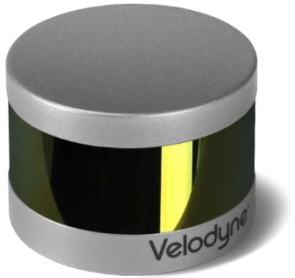
Sensor configuration



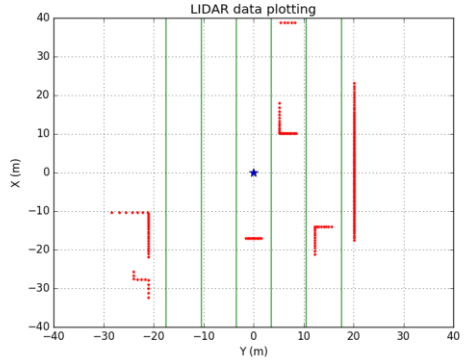
How I met Unity

Sensor configuration

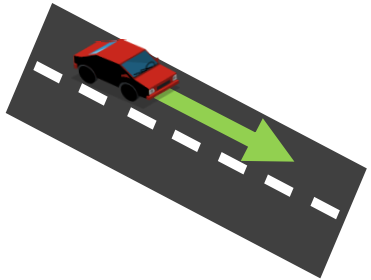
Vision



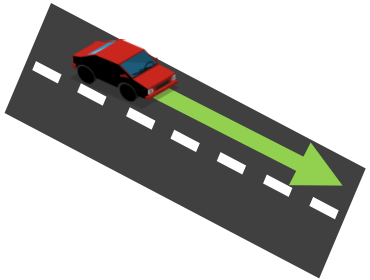
LIDAR



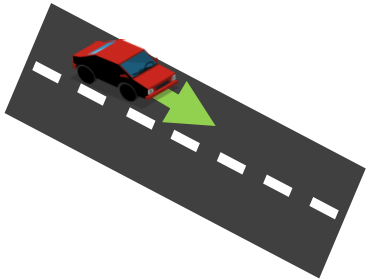
Actions



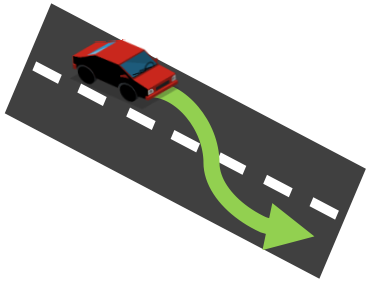
Keep current state



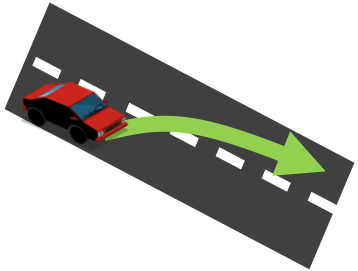
Acceleration



Deceleration



Lane change (Right)

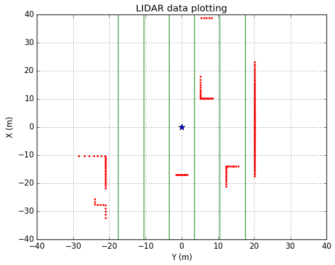


Lane Change (Left)

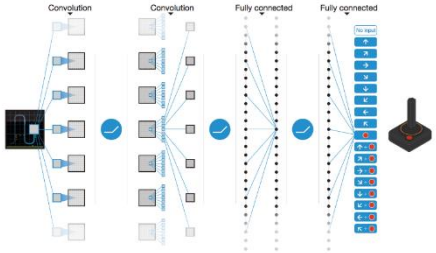
How I met Unity

Project Overview

Front Camera

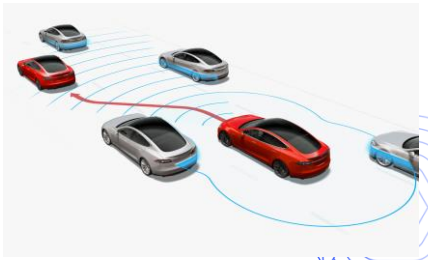


Sensor Data



DRL Algorithm

DAS



Vehicle Control

How I met Unity

Communication between Unity and python

Deep Learning Libraries

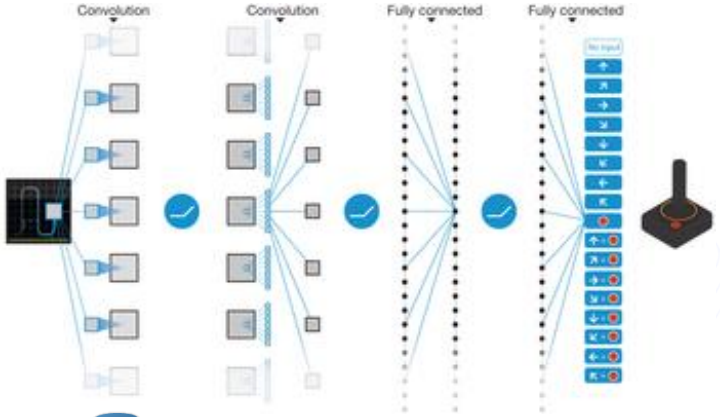
How I met Unity

Communication between Unity and python

Camera Image
Sensor Data
Reward
Terminal

Socket

Action

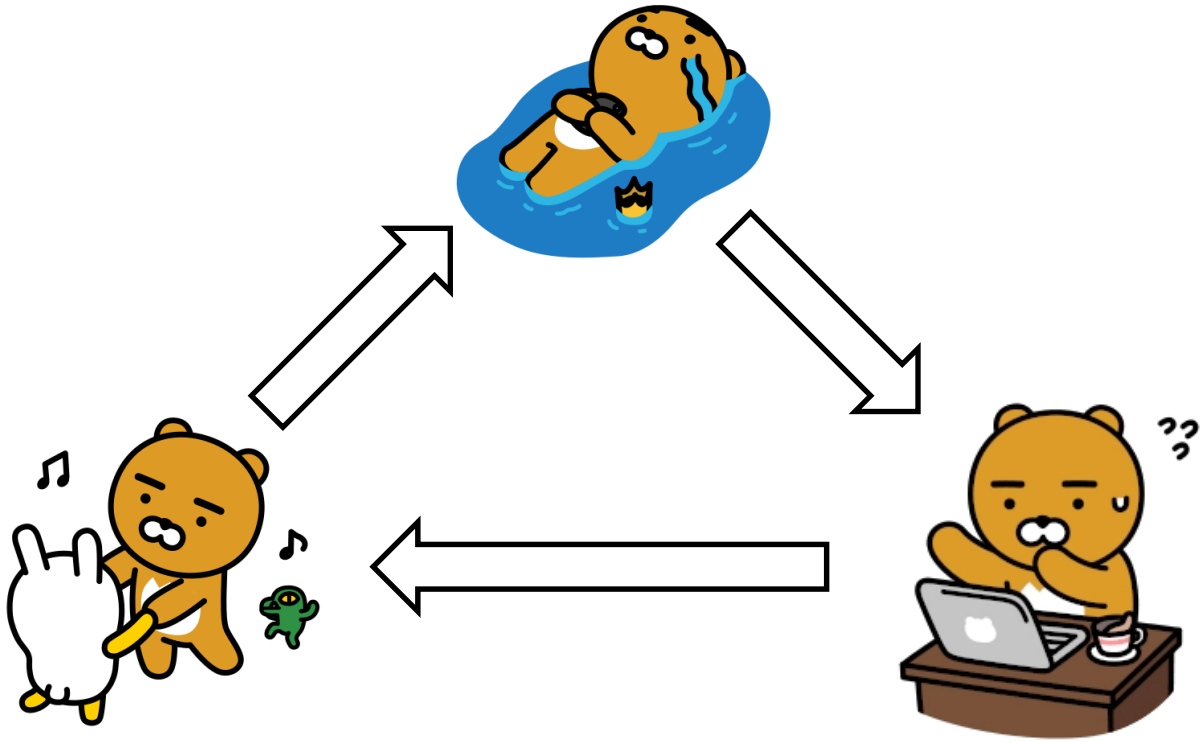


Vehicle Simulator

DRL Algorithm

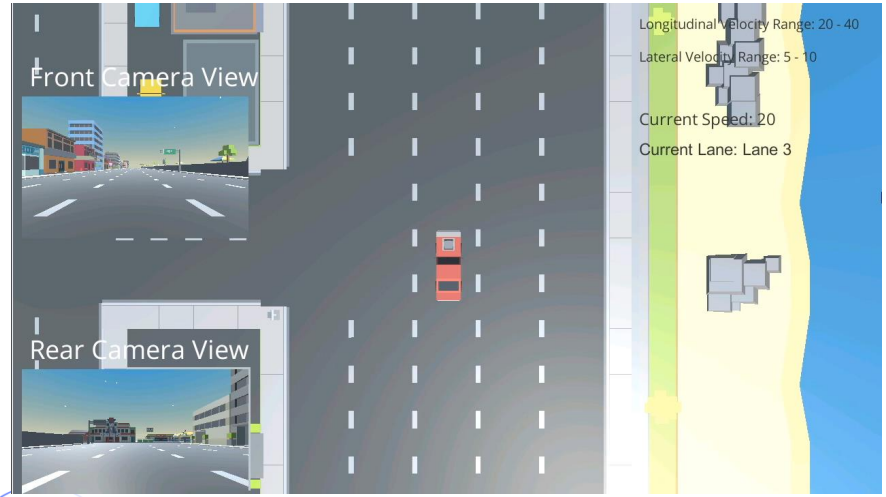
How I met Unity

Communication between Unity and python

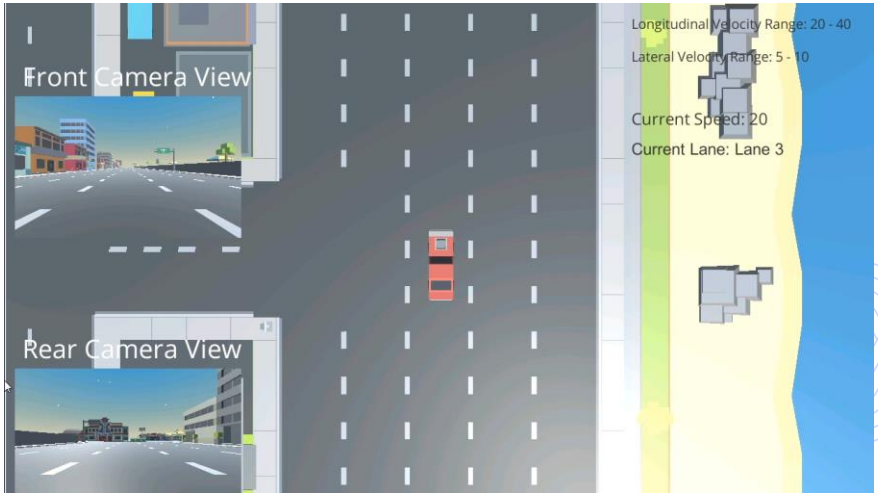


How I met Unity

Result



Before Training

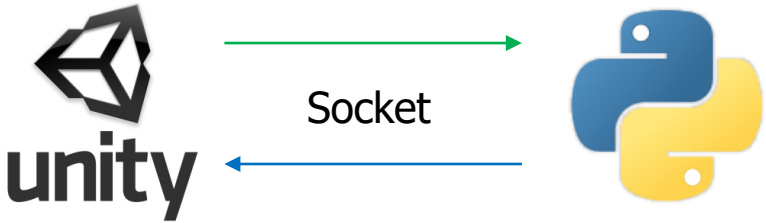


After Training

How I met Unity

Communication between Unity and python

- There are lots of bugs in the implementation using Socket
  - Communication is disconnected after a certain length
  - It needs lots of coding for minor changes
  - Sync problem
  - There is a difference in speed between Unity and python code
- Trying to solve problems for about 1 to 2 months
  - Almost 70% of the problems were solved!!
  - I had a plan to upload it on Github



How I met Unity

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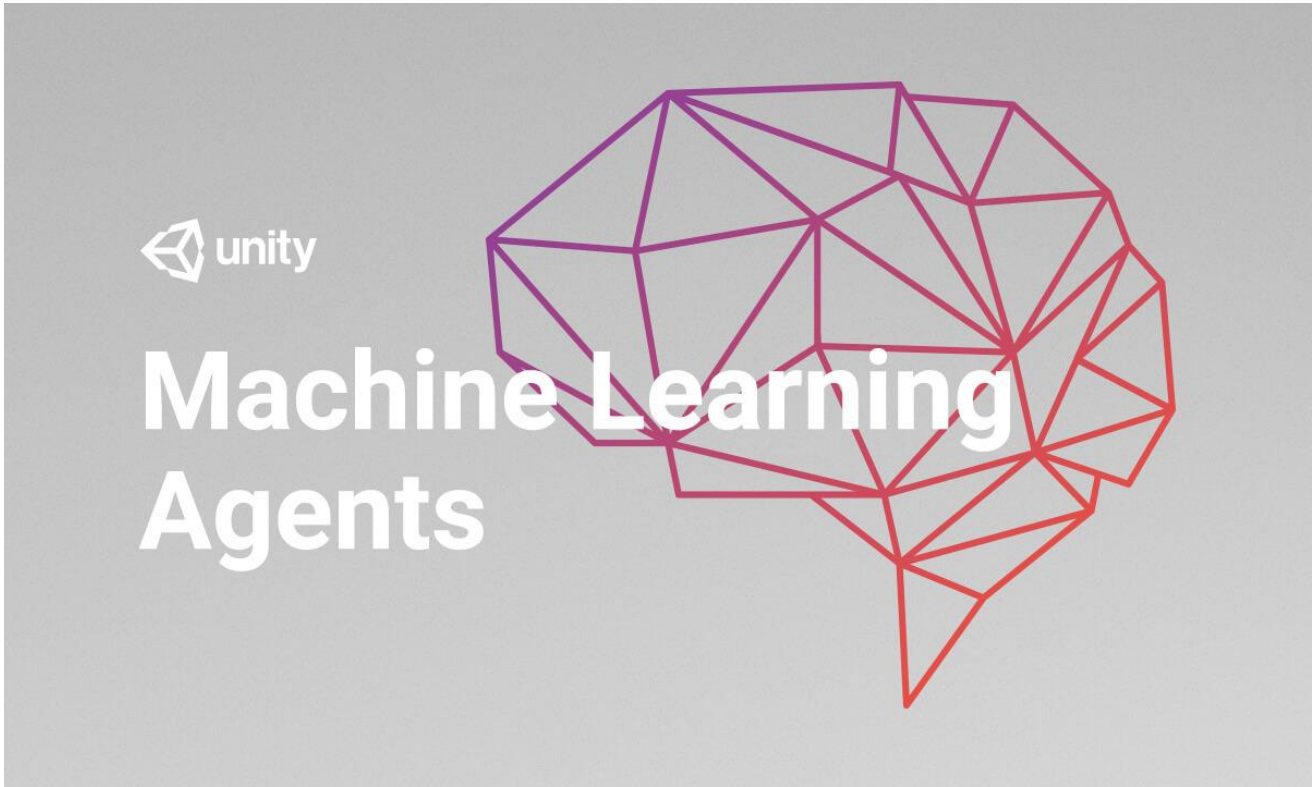

2017 . 09 . 19

How I met Unity

How I met Unity

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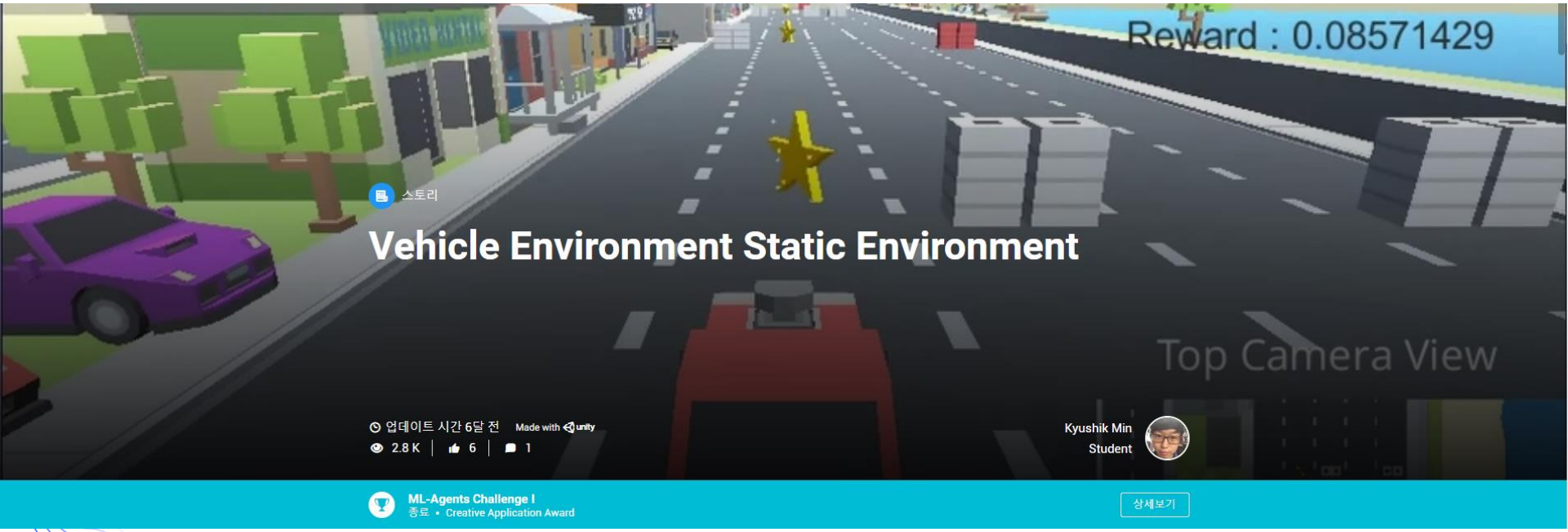

How I met Unity

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Vehicle Simulator

Unity ML-agents

How I met Unity

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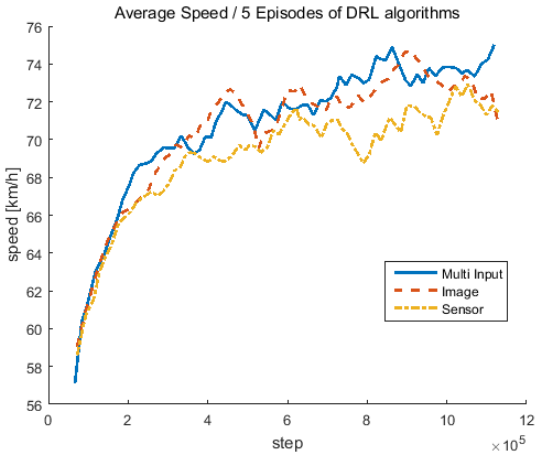
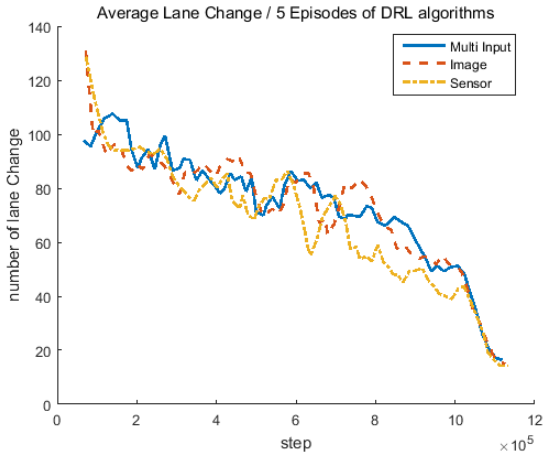
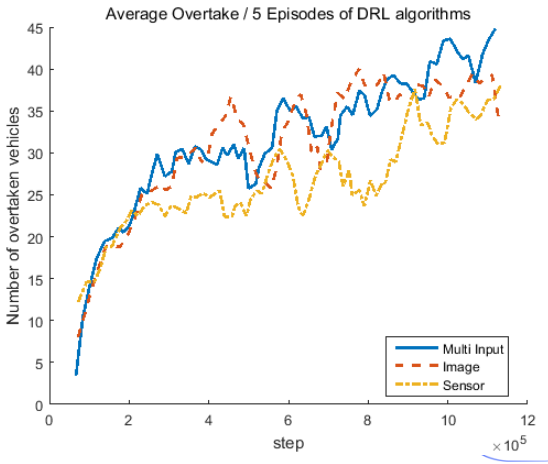
Speed



Lane Change



Overtake



Input Configuration	Average Speed (km/h)	# of Average Lane Change	# of Average Overtaking
Camera Only	71.0776	15	35.2667
LIDAR Only	71.3758	**14.2667**	38.0667
Multi-Input	**75.0212**	19.4	**44.8**

How I met Unity

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2018 IEEE Intelligent Vehicles Symposium (IV)
Changshu, Suzhou, China, June 26-30, 2018

Deep Q Learning Based High Level Driving Policy Determination

Kyushik Min, Hayoung Kim and Kunsoo Huh, *Member, IEEE*

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How I met Unity

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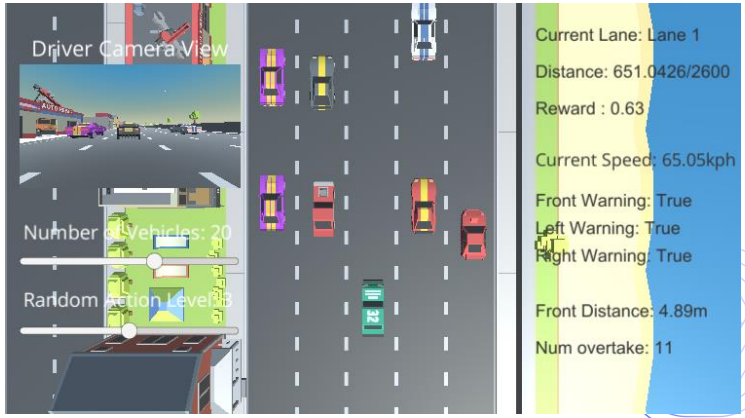
Simulator Ver. 0.1



Simulator Ver. 1.3

GitHub

https://github.com/MLJejuCamp2017/DRL_based_SelfDrivingCarControl

Unity ML-Agents

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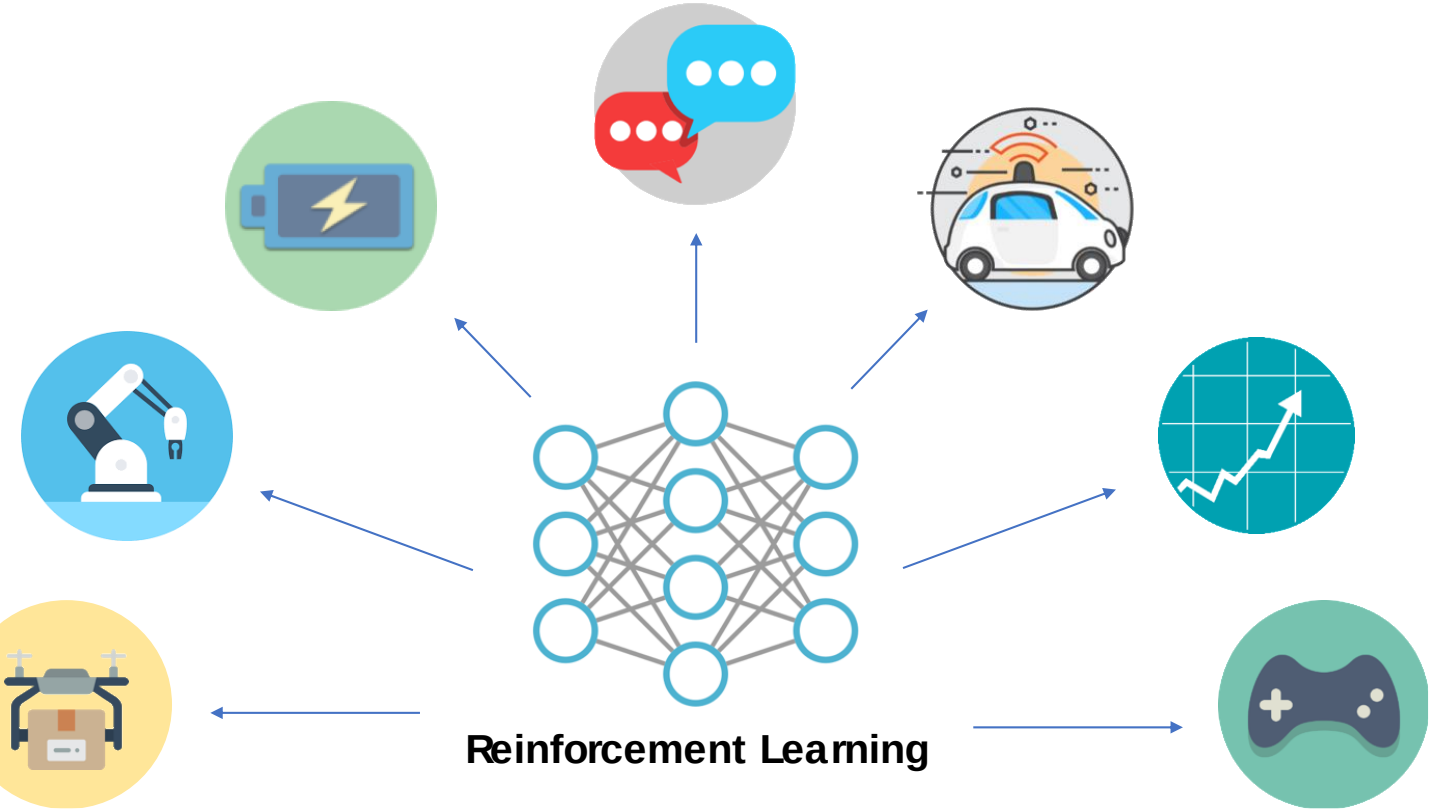
Unity ML-agents

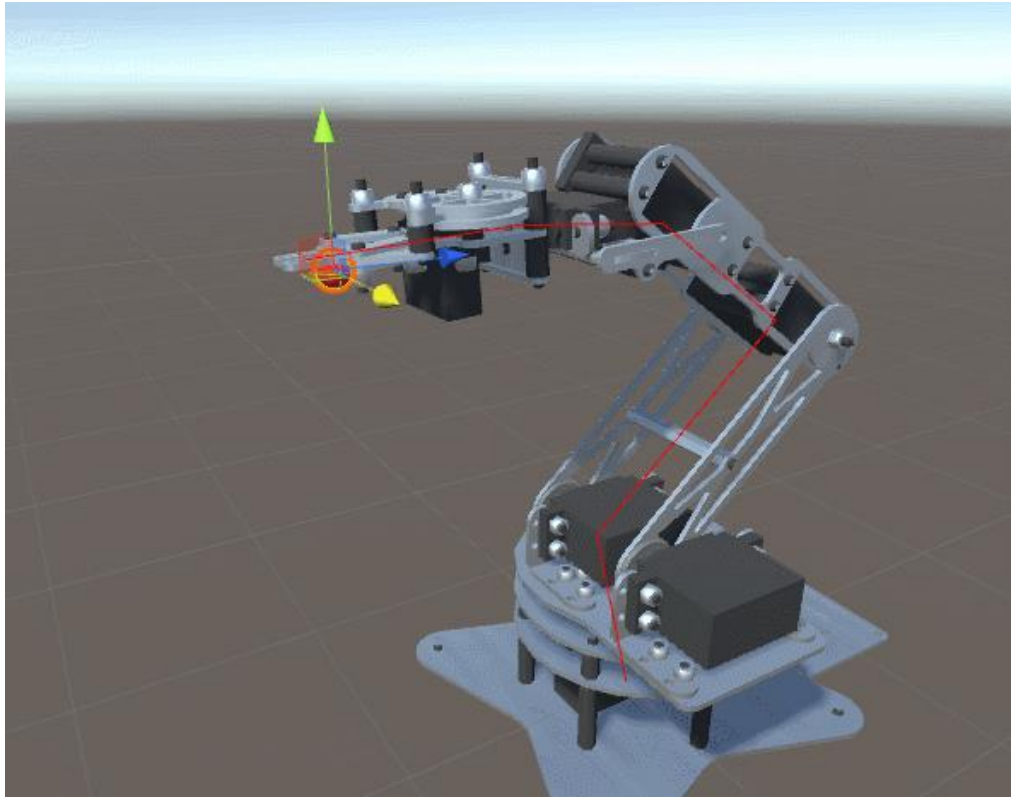
Agony of those who study RL

Environment for verification

Unity ML-agents



Unity ML-agents



Unity ML-agents

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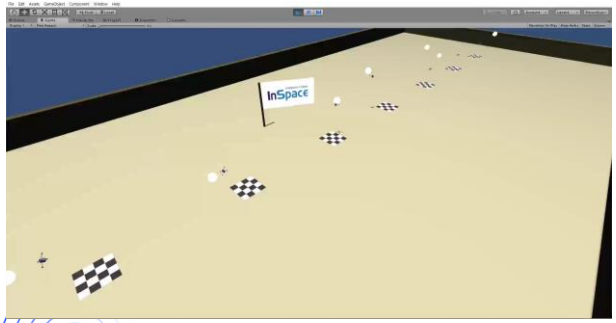
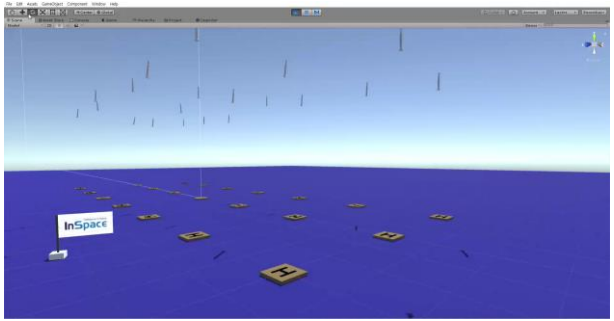
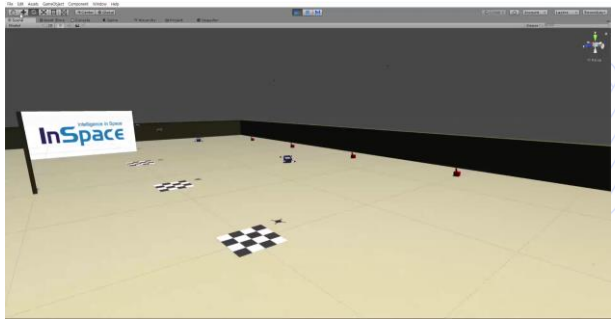
Intelligence in Space
InSpace

Taeyoung Kim

Hyunho Lee







Unity ML-agents

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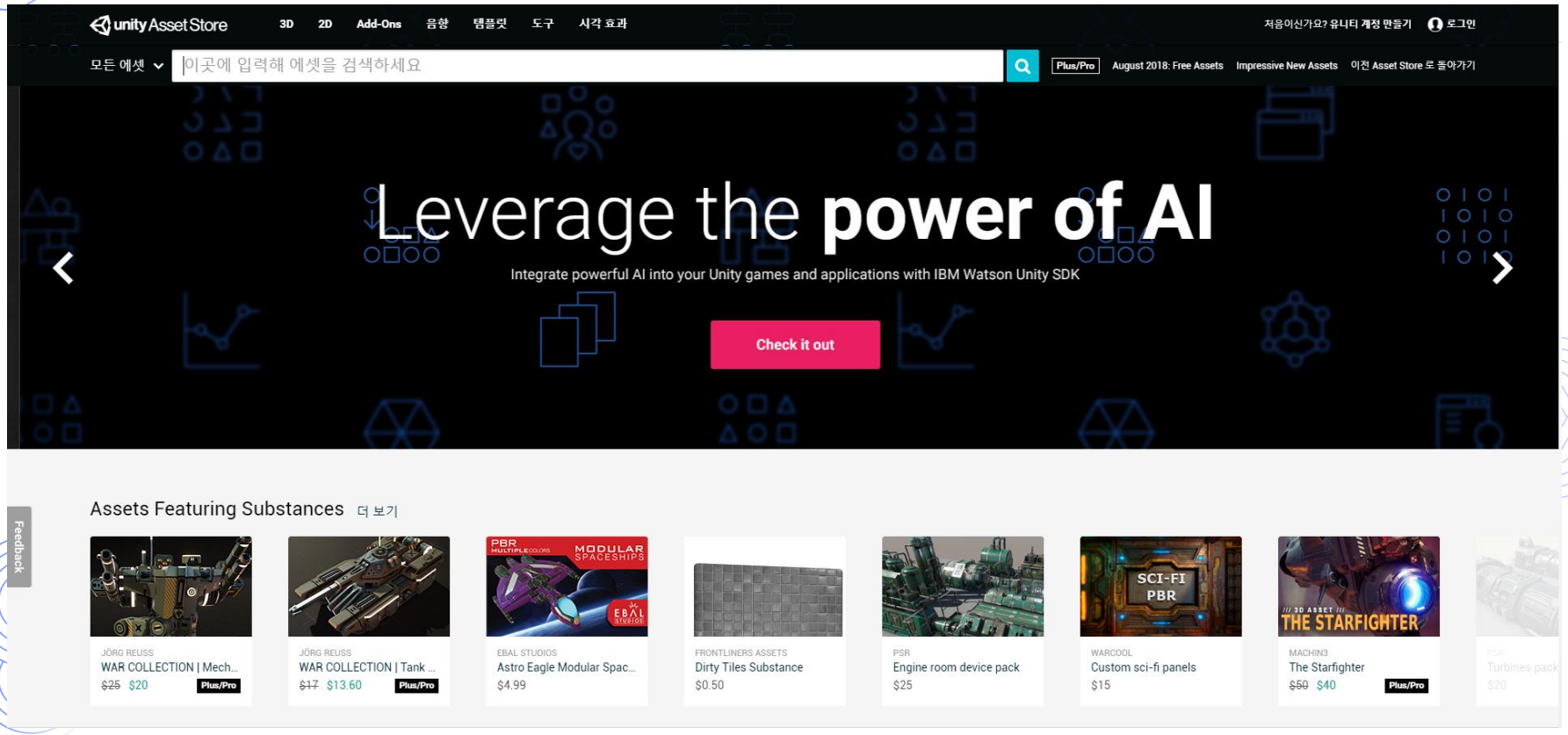
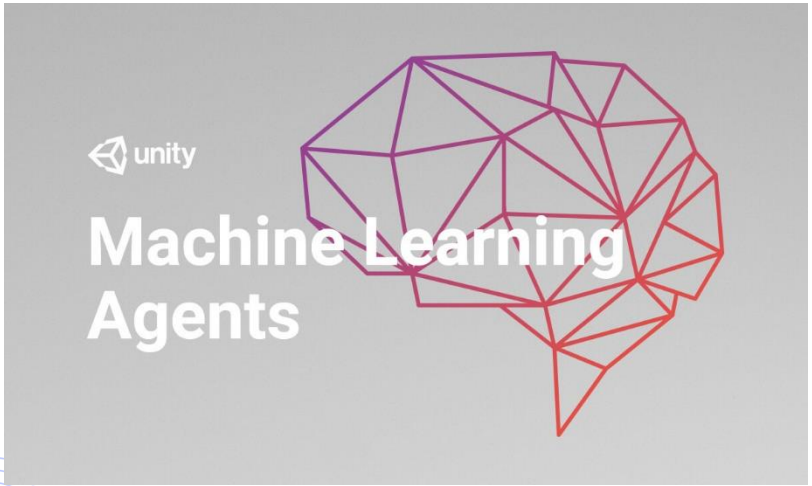
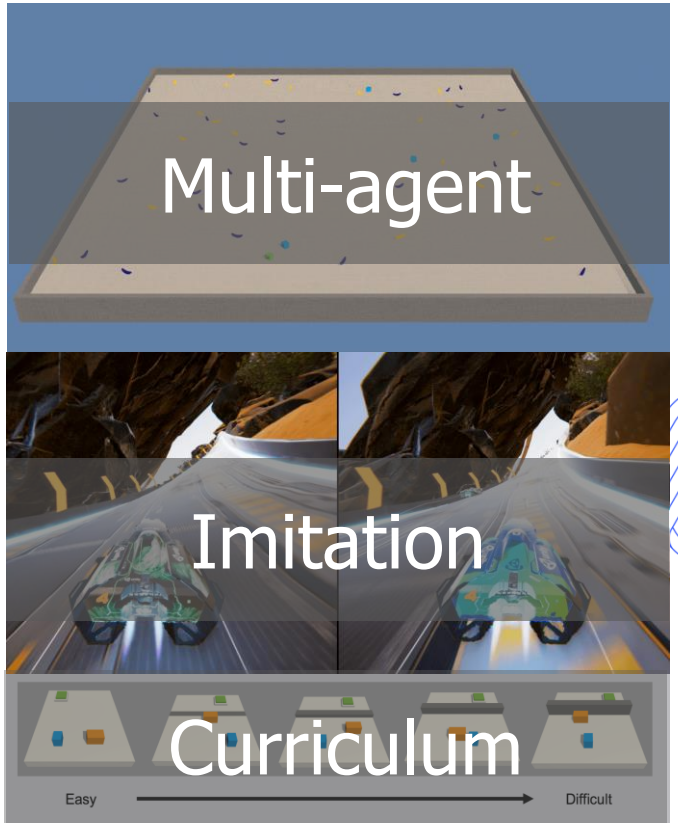


Unity ML-agents





Unity ML-agents

unity

democratizing game development

democratizing environment development

for reinforcement learning

Conclusion

Conclusion

Making Environment for RL

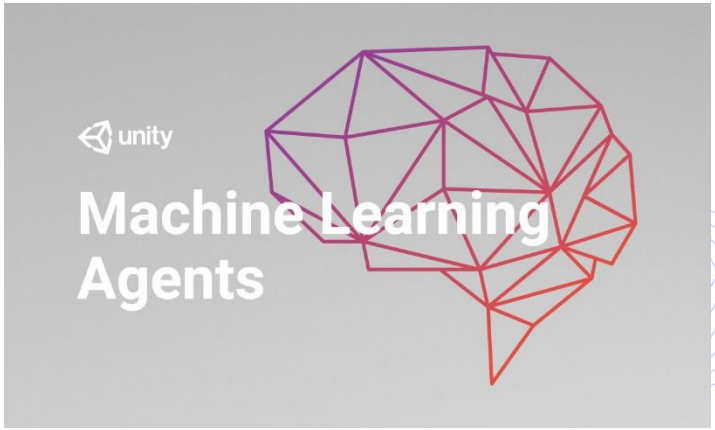
Difficulty in making the environment

Unstable communication

Low graphic

Complex coding

Implementation of physics model



Unity ML-agents solves the problems!

Conclusion

https://github.com/Kyushik/Unity_ML_Agent

Conclusion

Future Work

- Create various environments using Unity ML-agents
- Write papers and perform projects using Unity ML-agents
- Recruit team to study Unity ML-agents at Facebook page Reinforcement Learning Korea
  - Create environments for reinforcement learning
  - Make manual about ML-agents
- Seminar on Unity ML-agents at DeepLab Intensive Course in Modu Labs.

모두의연구소

THANK YOU

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