

Self Autonomous Driving

Jun Won Sung
Jung Hwan Yim
Ken Zhou

 University at Buffalo
School of Engineering and Applied Sciences



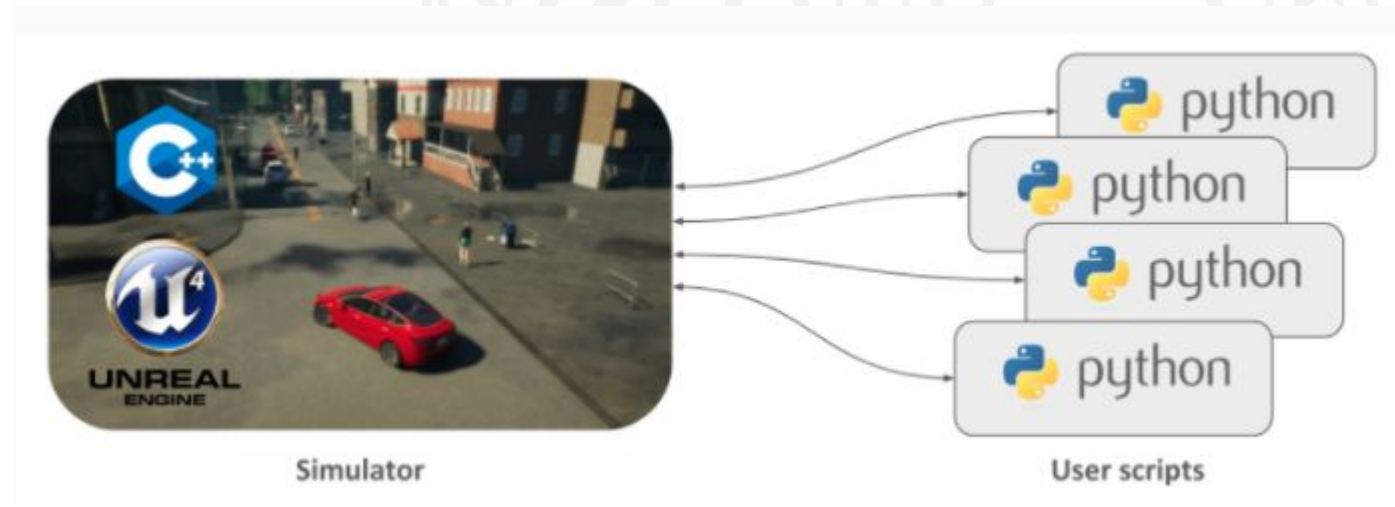
Project Description

- Our objective is to train our agent to be capable of self-driving in the CARLA Environment.
 - Drive Without Collision
 - Drive On the Road
 - Drive According to a Real Life Setting
- Build Up Environment
 - Asynchronous Environment (Default)
 - Synchronous Environment
- A2C



Background of CARLA Environment

- Open-source autonomous driving simulator
- Help democratize autonomous driving R&D, serving as a tool that can be easily accessed and customized by users.
- CARLA is grounded on Unreal Engine to run the simulation and uses the OpenDRIVE standard to define roads and urban settings.
- API handled in Python and C++.



Implementation of Environment

In



Gaming Instance

Sync Environment

Waiting until the Agent Choosing Action

Async Environment

Waiting until the Agent Choosing Action

A2C Environment

Following Line

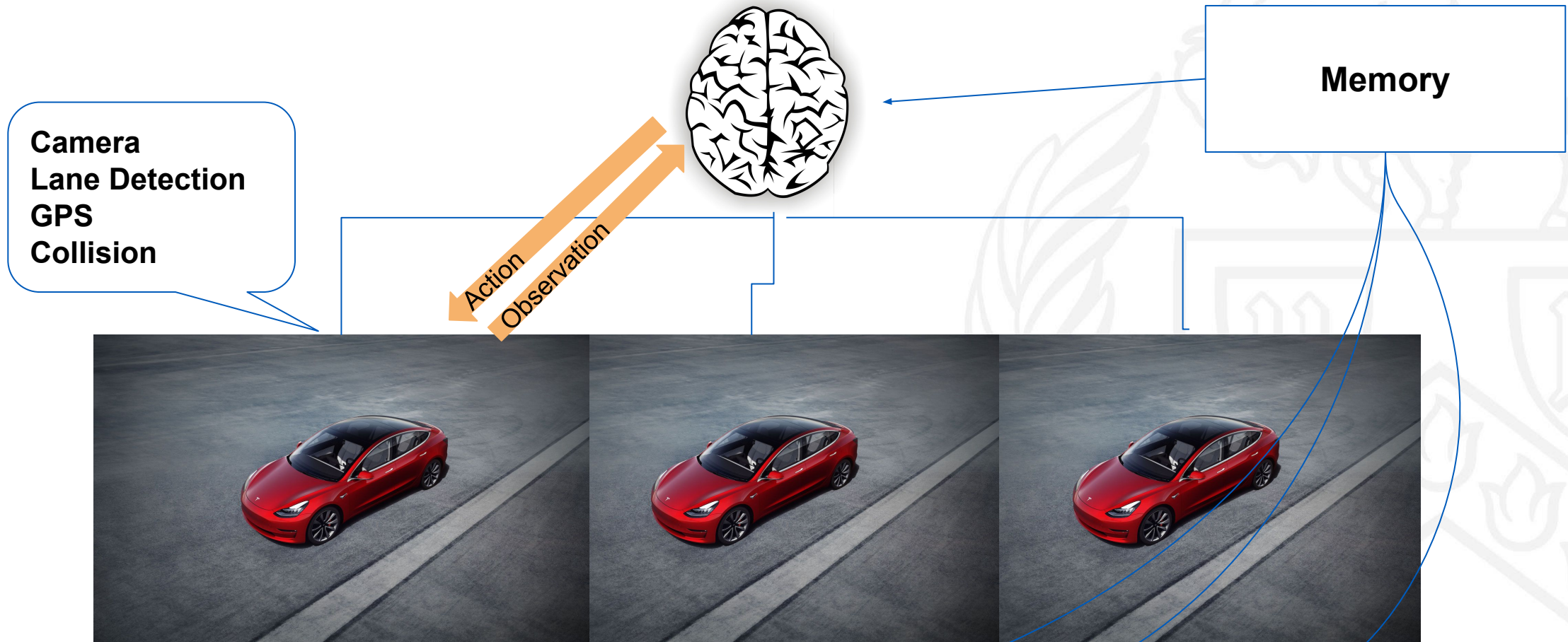
- State : (3, 84, 84) shaped image.
- Action : 200
(float steer, float throttles, boolean reverse)
- Reward
 - Collision: -200
 - Speed :
 - $v < 20$ km/h: -1
 - $v > 80$ km/h: -3
 - otherwise : +1
 - Cross :
 - Solid Line : -100
 - Broken Line : -50
 - other Line : -10
 - Hovering :
 - in $1e-1$: -50
 - in $5e-1$: -30

DQN Environment

Without Collision

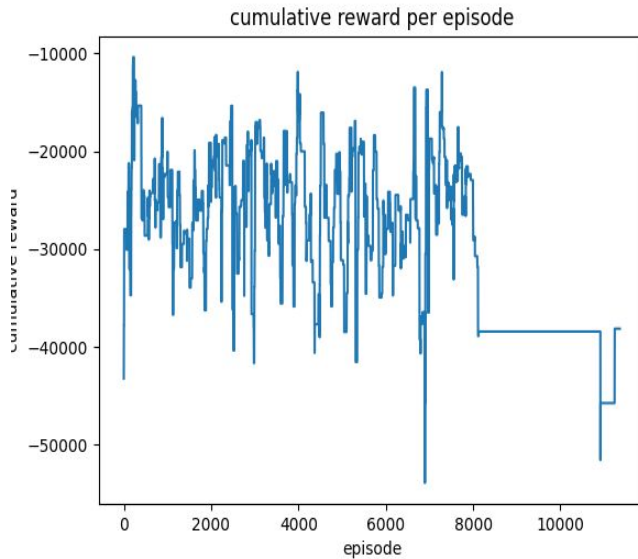
- State : (480, 640, 3) shaped image.
- Action : 3
steer left, straight, right
(0, 1, 2)
- Reward
 - Collision: -200
 - Speed less than 50 km h: -1
 - Else +1

Implementation of Agent

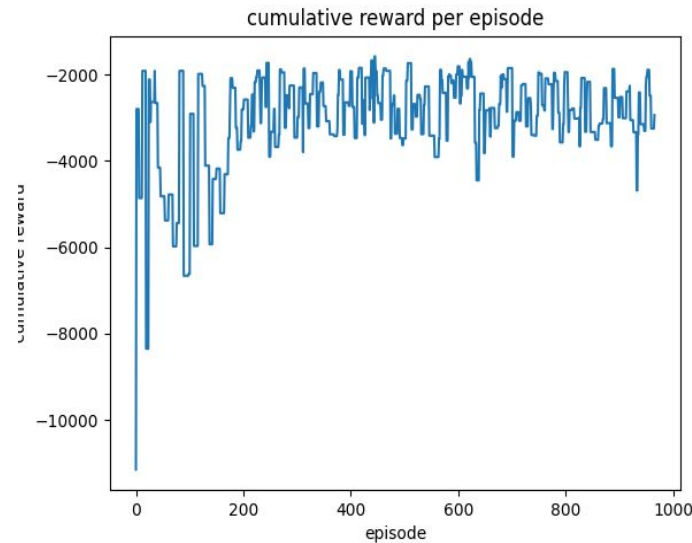


A2C Result - Training

Async Environment

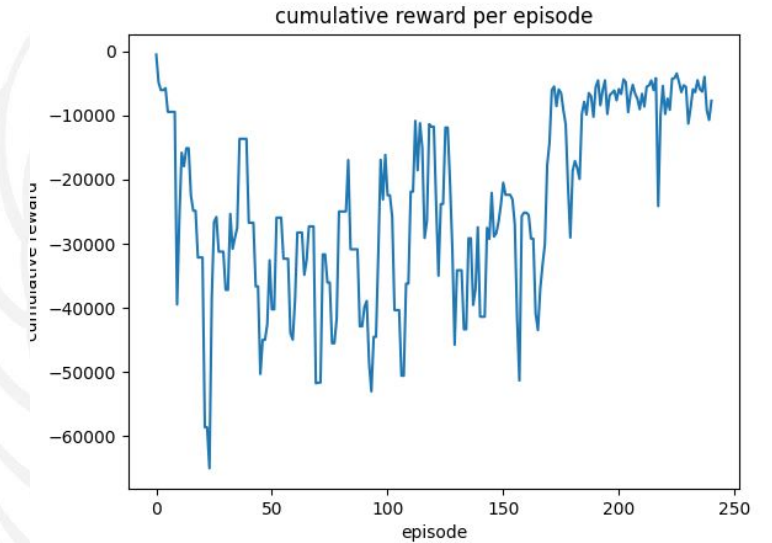


7 Processors
with the Advantage Step 5



2 Processors
with the Advantage Step 5

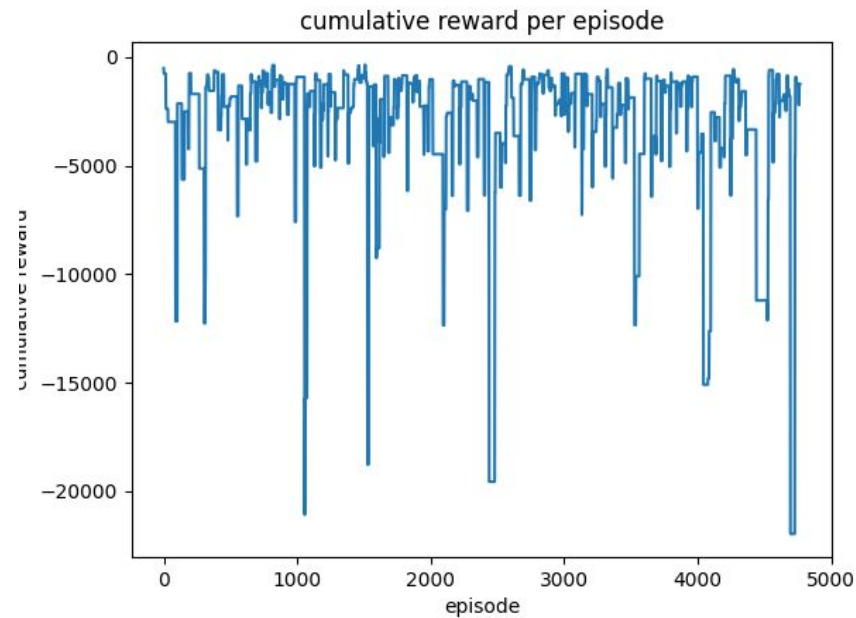
Sync Environment



3 Processors
with the Advantage Step 5

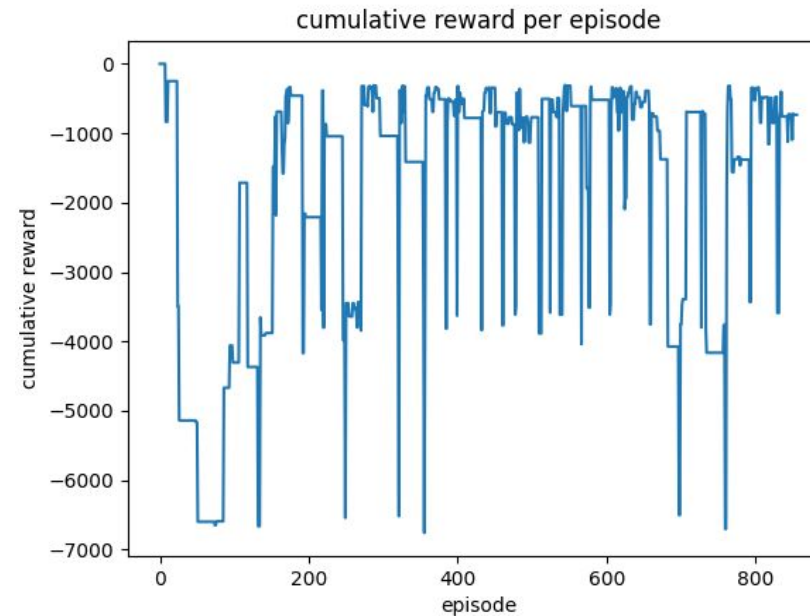
A2C Result - Training

Async Environment



2 Processors
with the Advantage Step 5

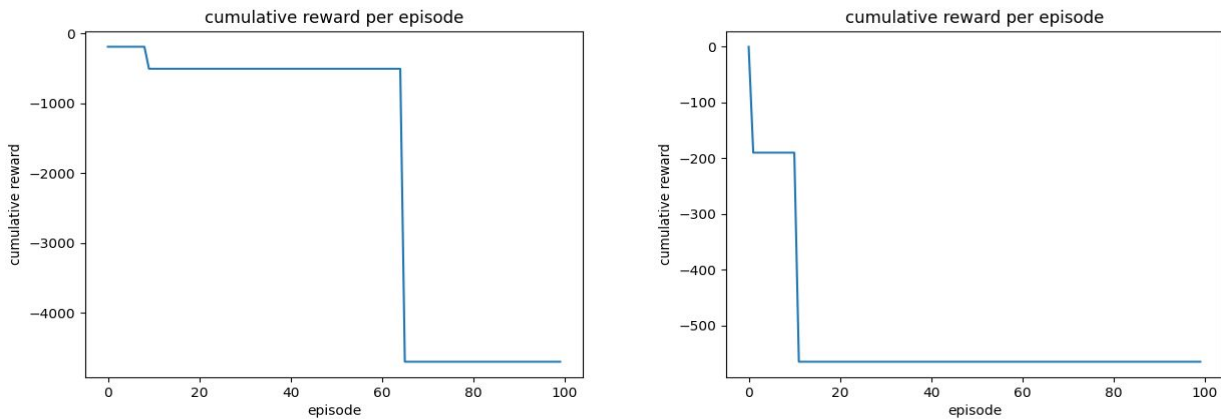
Sync Environment



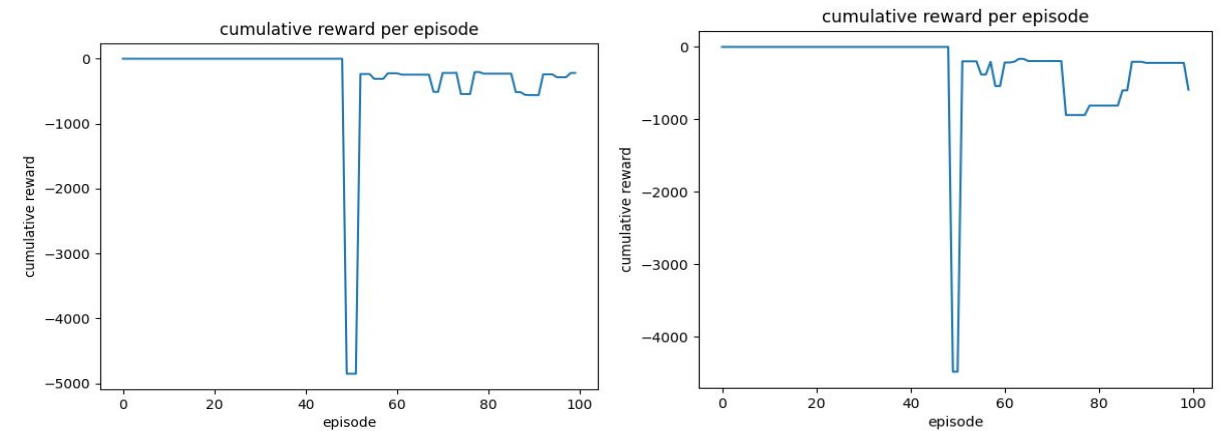
2 Processors
with the Advantage Step 5

A2C Result - Testing

Async Environment

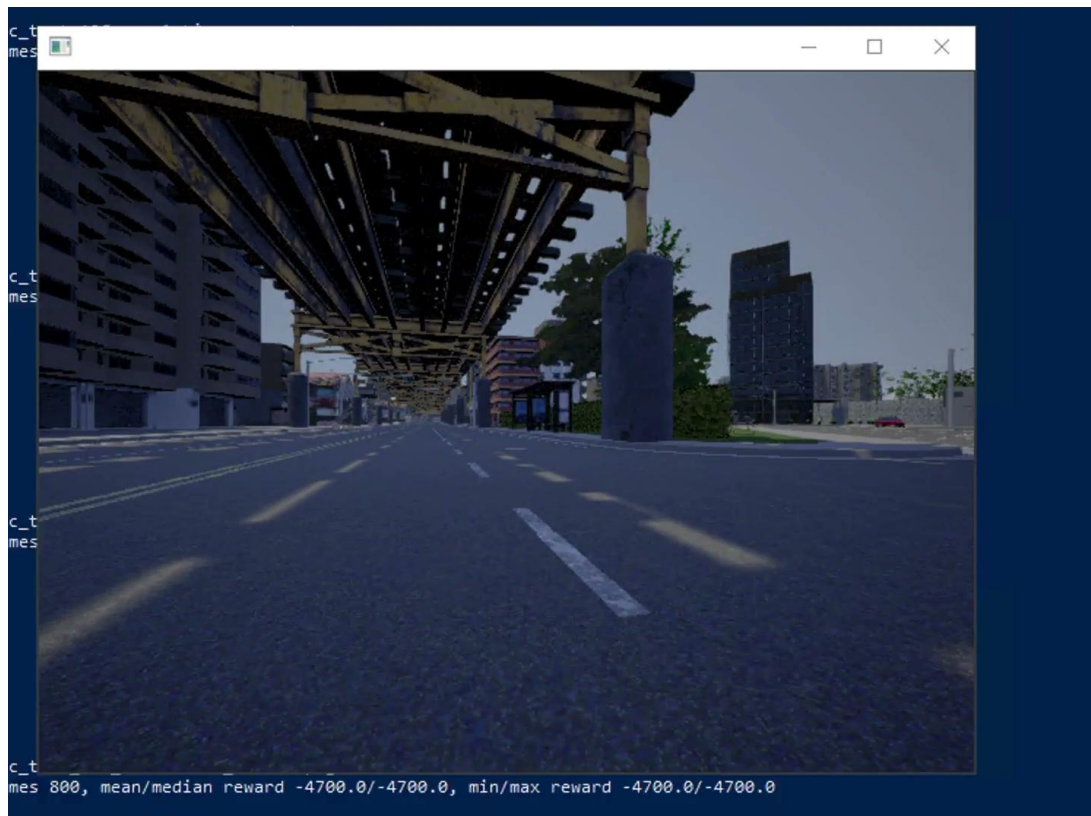


Sync Environment



A2C Simulation

Async Environment



Sync Environment



Key Observations

- The Synchronous Environment helps the agent training the minor features in the environment and reducing the missing feature. So, The agent in the Synchronous environment turn right with the fixed axis.
- The Asynchronous Environment is strong to learn the major behaviors. So, the agent in the Asynchronous environment learned moving straight and typical turn right.
- Especially, the A2C consists of the master and agents. Because the master needs to communicate with agents, the latency is maximized rather than the environment's latency.
- In real world, there are a tons of Asynchronous Environment which could be converted to Synchronous Environment. To prevent the side effect of the latency, new architecture of the distributed reinforcement learning is needed.

Thank you

