

Guideline of Coding League 2024

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Karting League introduction

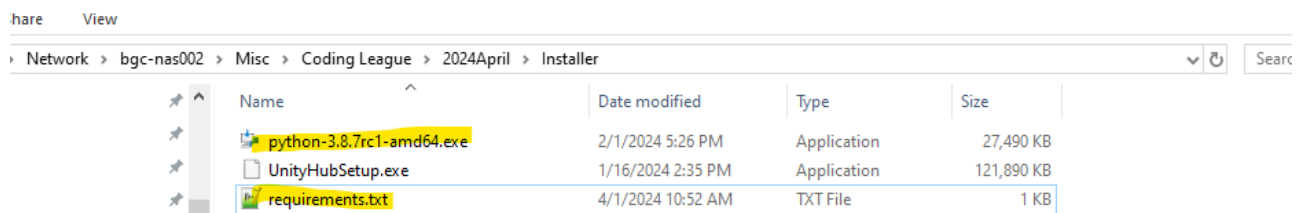
What is Karting league

- Karting League is a 3D kart racing game developed based on Unity's Karting Microgame Template.
- From this game you can learn knowledge about **vehicle physics, game mechanics and artificial intelligence**. We aim to foster interest in AI and reinforcement learning through Karting League, helping participants gain a better understanding of what reinforcement learning is. It would be our success if participants will be able to apply reinforcement learning to solve real-world problems and improve work efficiency in their future endeavors.

How to set up environment

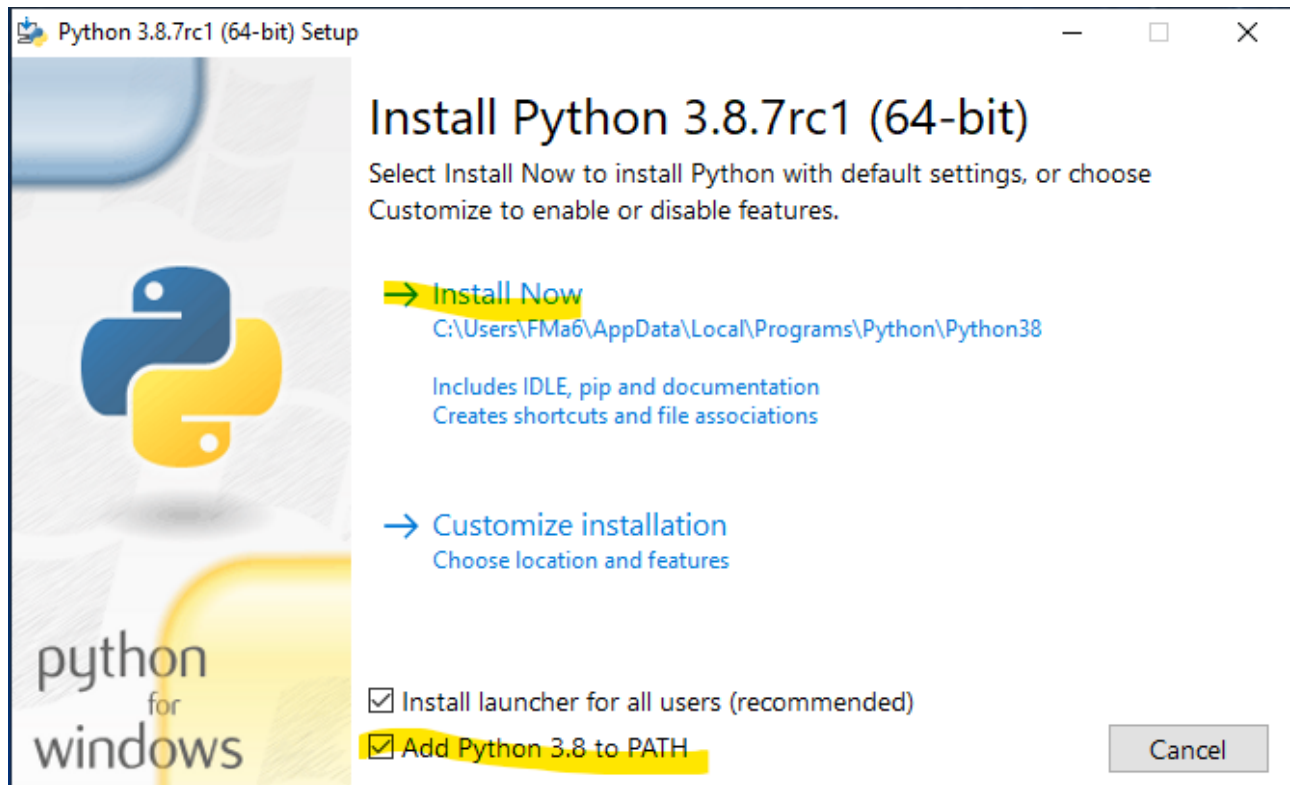
1.Download python and install packages

1. Open Folder **\\bgc-nas002\Misc\Coding League\2024April\Installer** and copy python-3.8.7rc1-amd64.exe and requirements.txt



Name	Date modified	Type	Size
python-3.8.7rc1-amd64.exe	2/1/2024 5:26 PM	Application	27,490 KB
UnityHubSetup.exe	1/16/2024 2:35 PM	Application	121,890 KB
requirements.txt	4/1/2024 10:52 AM	TXT File	1 KB

2. install python by double click python-3.8.7rc1-amd64.exe



3. validate python

```
python --version
```

```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.19044.1586]
(c) Microsoft Corporation. All rights reserved.

C:\Users\FMa6>python --version
Python 3.8.7rc1

C:\Users\FMa6>
```

4. Install packages:

- open cmd
- direct to the folder which requirements.txt exist

```
pip install -r requirements.txt -i https://pypi.tuna.tsinghua.edu.cn/simple
```

```
C:\Users\FMa6>cd Downloads

C:\Users\FMa6\Downloads>pip install -r requirements.txt -i https://pypi.tuna.tsinghua.edu.cn/simple
Looking in indexes: https://pypi.tuna.tsinghua.edu.cn/simple
Collecting torch==1.7.1 (from -r requirements.txt (line 1))
  Downloading https://pypi.tuna.tsinghua.edu.cn/packages/b3/d1/a5eae4fadbee9e31133b364a143aab54133fee5e6087e84c6a8f883b0f1/torch-1.7.1-cp38-cp38-win_amd64.whl (184.0 MB)
----- 184.0/184.0 MB 486.3 kB/s eta 0:00:00
Collecting tensorflow (from -r requirements.txt (line 2))
  Downloading https://pypi.tuna.tsinghua.edu.cn/packages/fb/59/3eb58629e3749d9f4fc1e522487af369f9bd4c451f465d3054961fab6bf8/tensorflow-2.13.1-cp38-cp38-win_amd64.whl (1.9 kB)
Collecting tensorboard (from -r requirements.txt (line 3))
  Downloading https://pypi.tuna.tsinghua.edu.cn/packages/bc/a2/ff5f4c299eb37c95299a76015da3f30211468e29d8d6f1d011683279baee/tensorboard-2.14.0-py3-none-any.whl (5.5 MB)
----- 5.5/5.5 MB 455.2 kB/s eta 0:00:00
Collecting mlagents==0.28.0 (from -r requirements.txt (line 4))
  Downloading https://pypi.tuna.tsinghua.edu.cn/packages/9d/b9/48d2afc106541546607bb90338541417e8fcfa456fd7be0c4ec7a23849ca/mlagents-0.28.0-py3-none-any.whl (164 kB)
----- 164.6/164.6 kB 247.0 kB/s eta 0:00:00
```

5. Run `mlagents-learn --help` to make sure the installation is successful. The "CUDA initialization" warning can be ignored.

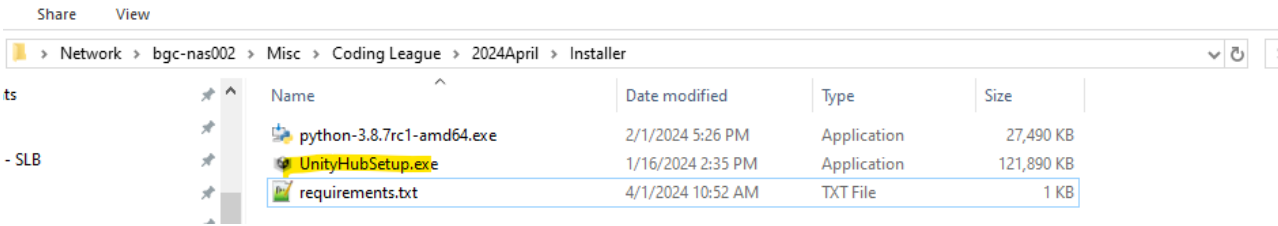
```
C:\Users\FMa6>mlagents-learn --help
usage: mlagents-learn.exe [-h] [--env ENV_PATH] [--resume] [--deterministic] [--force] [--run-id RUN_ID]
                        [--initialize-from RUN_ID] [--seed SEED] [--inference] [--base-port BASE_PORT]
                        [--num-envs NUM_ENVS] [--num-areas NUM_AREAS] [--debug] [--env-args ...]
                        [--max-lifetime-restarts MAX_LIFETIME_RESTARTS]
                        [--restarts-rate-limit-n RESTARTS_RATE_LIMIT_N]
                        [--restarts-rate-limit-period-s RESTARTS_RATE_LIMIT_PERIOD_S] [--torch] [--tensorflow]
                        [--results-dir RESULTS_DIR] [--width WIDTH] [--height HEIGHT]
                        [--quality-level QUALITY_LEVEL] [--time-scale TIME_SCALE]
                        [--target-frame-rate TARGET_FRAME_RATE] [--capture-frame-rate CAPTURE_FRAME_RATE]
                        [--no-graphics] [--torch-device DEVICE]
                        [trainer_config_path]

positional arguments:
  trainer_config_path

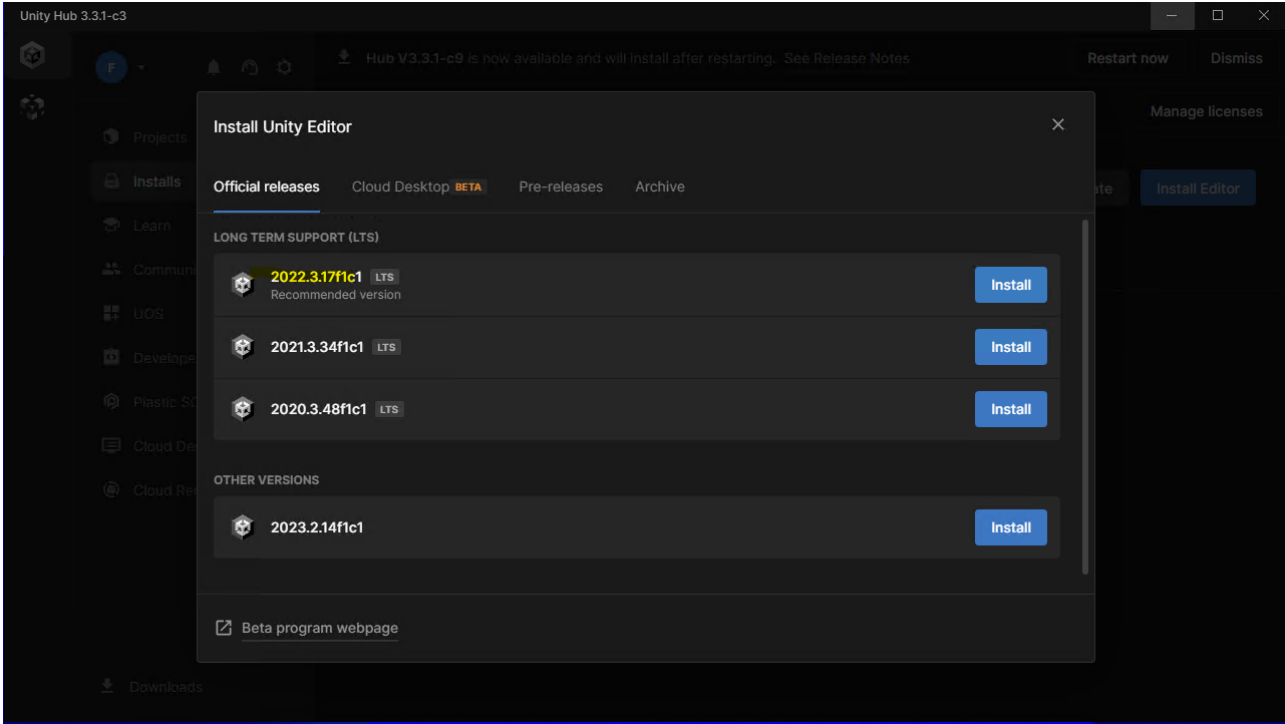
optional arguments:
  -h, --help            show this help message and exit
  --env ENV_PATH         Path to the Unity executable to train (default: None)
  --resume              Whether to resume training from a checkpoint. Specify a --run-id to use this option. If set
```

2.Download Unity

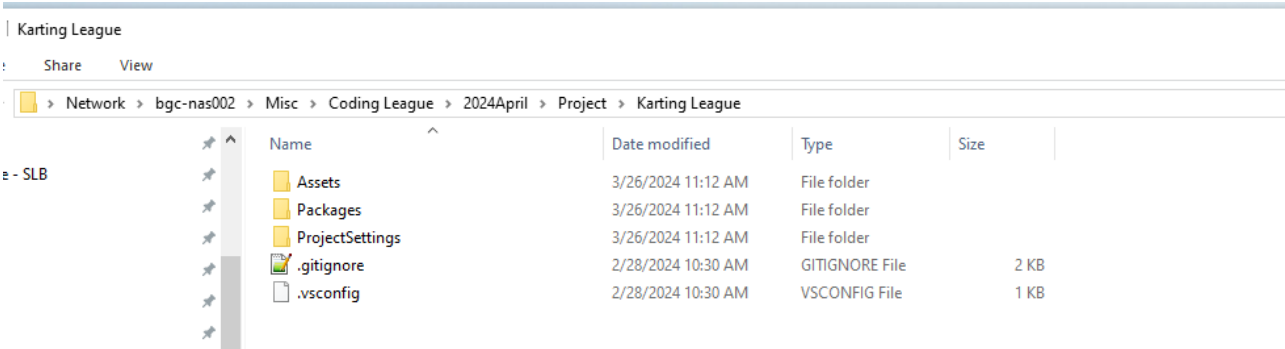
1. Open Folder `\\bgc-nas002\Misc\Coding League\2024April\Installer` and copy to your laptop and then install UnityHub



2. Install Unity choose version **2022.3.17f1c1**

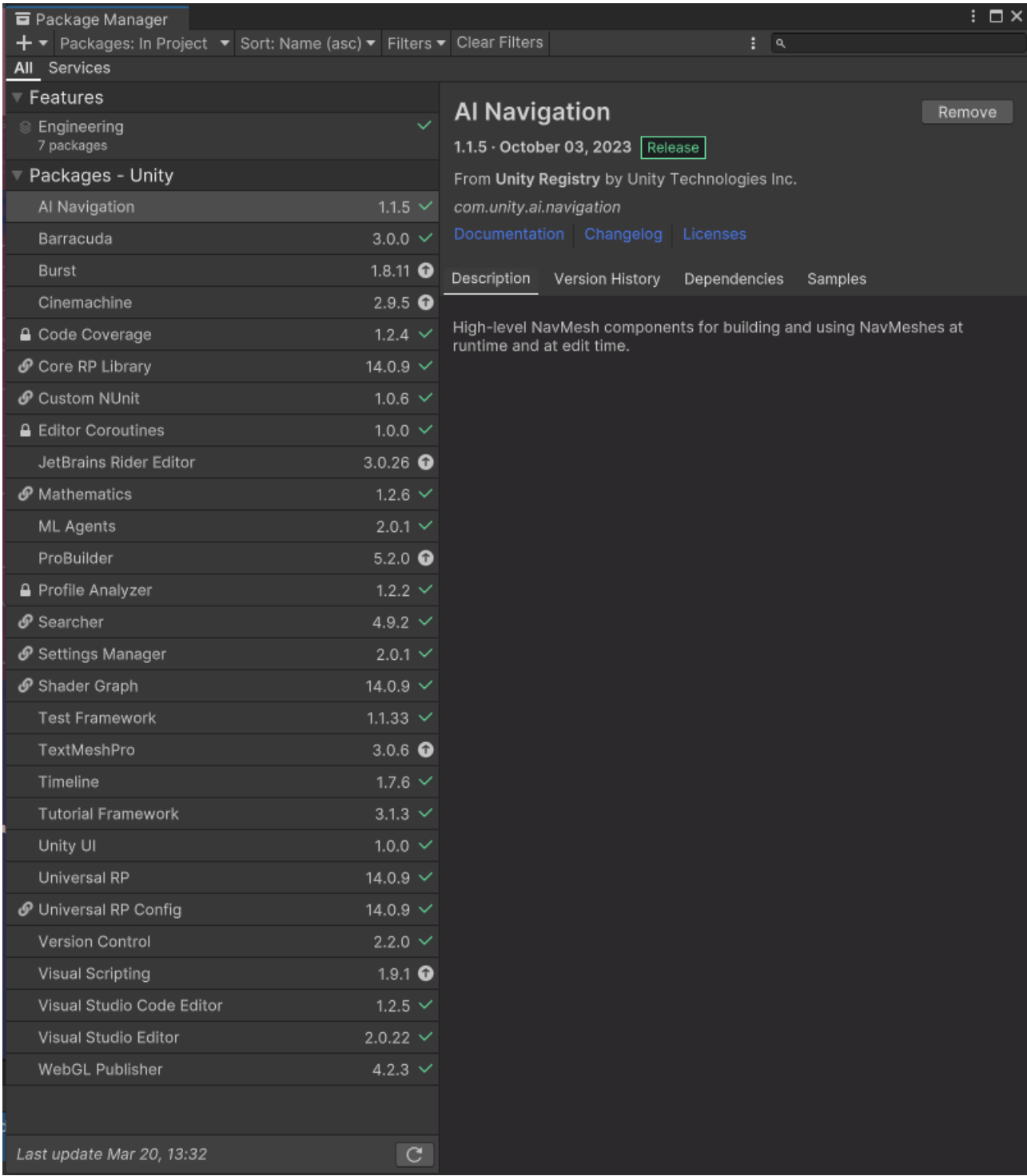


3. Copy the Karting League project from **\\bgc-nas002\Misc\Coding League\2024April\Project\Karting League**



4. Open the Karting League project in the Unity Editor.

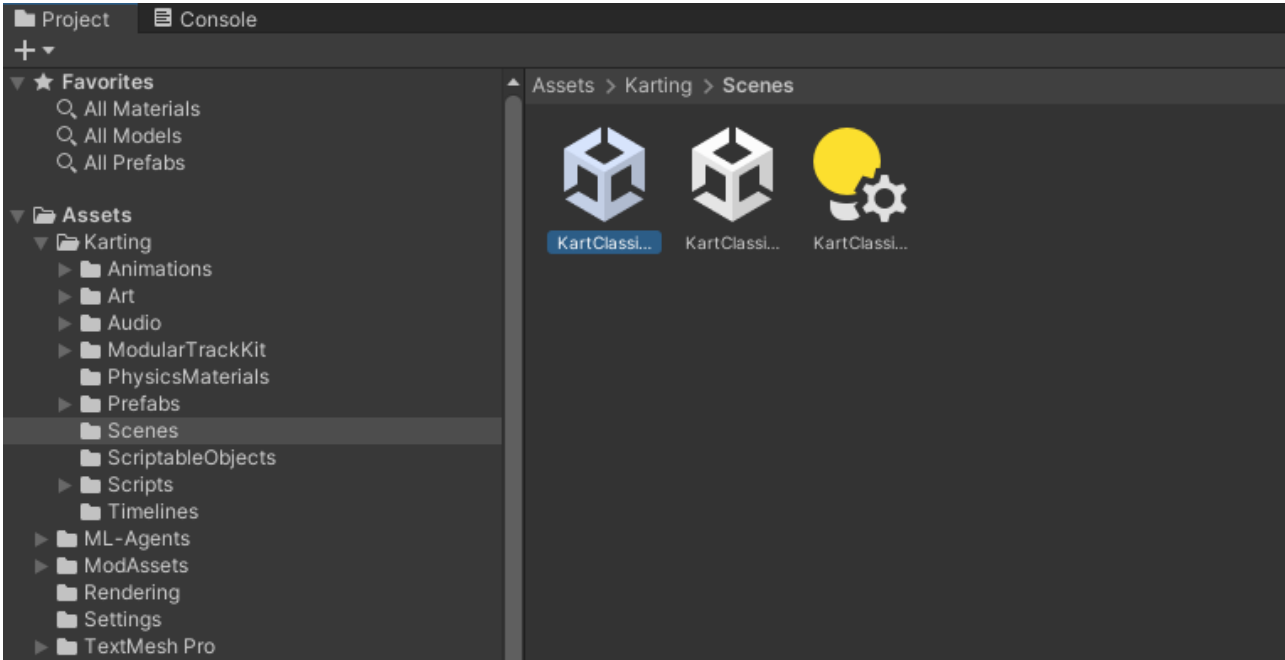
5. Open **Window** → **Package Manager**, make sure the **ML Agents** Unity package is installed.



How to train your model

1.Load Training Scene

- 1. Open the Karting League project in the Unity Editor.
- 2. In the **Project** window, go to the **Assets/Karting/Scenes** folder, there are two training tracks, you can open **KartClassic_TrainingA.unity** or **KartClassic_TrainingB.unity** to start your first train.



2.Update Training Configurations

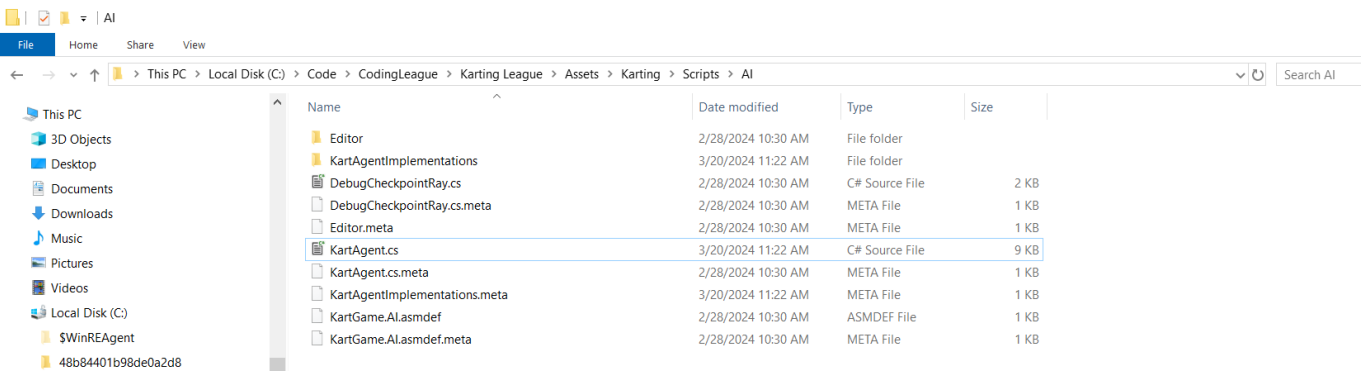
Model training configuration file location: **Karting League\Assets\Karting\Prefabs\AI\kart_trainer_config.yaml**.

Refer to the latest configuration format and rewrite the kart_trainer_config.yaml file accordingly, **otherwise the training will fail due to illegal format**.

Refer to [Training Configuration File](#) to adjust your own training parameters.

3.Update script

It's **mandatory** to implement your own Agent class, following the TODO comments in KartAgent.cs, File is here. File is here: **\Karting League\Assets\Karting\Scripts\AI\KartAgent.cs**



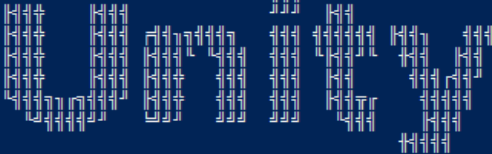
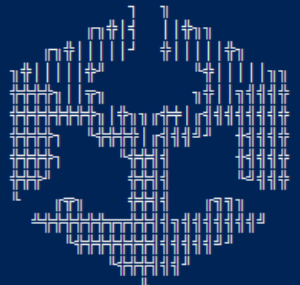
4.Start Training Session

- 1. Open a PowerShell.
- 2. Go to the **Karting League\Assets\Karting\Prefabs\AI** folder.
- 3. Start a training session:

```
magents-learn kart_trainer_config.yaml --run-id=KartTest
```

- If `mlagents-learn` runs successfully, the command line will display this:

```
PS C:\code\Karting League> mlagents-learn .\Assets\Karting\Prefabs\AI\kart_trainer_config.yaml --run-id=KartTest
```



```
Version information:
ml-agents: 0.28.0,
ml-agents-envs: 0.28.0,
Communicator API: 1.5.0,
PyTorch: 1.7.1+cpu
[INFO] Listening on port 5004. Start training by pressing the Play button in the Unity Editor.
```

Once the training starts, a **results** folder will be generated and updated as the training progresses. You can visualize training results by using TensorBoard:

ShareView

This PC

Local Disk (C:)

Code

CodingLeague

Karting League

Assets

Karting

Prefabs

AI

Name

Date modified

Type

Size

CustomizedConfigs

3/20/2024 11:22 AM

File folder

models

3/20/2024 11:22 AM

File folder

results

3/21/2024 4:21 PM

File folder

CustomizedConfigs.meta

3/20/2024 11:22 AM

META File

1 KB

kart_mg_trainer_config_upgrade.yaml

3/20/2024 11:22 AM

Yaml Source File

1 KB

kart_mg_trainer_config_upgrade.yaml.m...

3/20/2024 11:22 AM

META File

1 KB

kart_trainer_config_original.yaml

2/28/2024 10:30 AM

Yaml Source File

1 KB

kart_trainer_config_original.yaml.meta

2/28/2024 10:30 AM

META File

1 KB

KartClassic_NeuralNetwork.nn

2/28/2024 10:30 AM

NN File

97 KB

KartClassic_NeuralNetwork.nn.meta

2/28/2024 10:30 AM

META File

1 KB

models.meta

2/28/2024 10:30 AM

META File

1 KB

tensorboard --logdir results

"results" is the path to the results folder

(mlagents) C:\Code\CodingLeague\Karting-RL\Assets\Karting\Prefabs\AI>tensorboard --logdir results

Serving TensorBoard on localhost; to expose to the network, use a proxy or pass --bind_all

TensorBoard 2.13.0 at http://localhost:6006/ (Press CTRL+C to quit)

Then navigate to localhost:6006 in your browser to view the TensorBoard summary statistics.

The screenshot shows the TensorBoard web interface in a browser. The top navigation bar includes 'TensorBoard', 'TIME SERIES', 'SCALARS', 'DISTRIBUTIONS', 'HISTOGRAMS', and 'TEXT'. The main content area displays a grid of charts for the 'KartTestArcadeDriver' run. The charts include:

- Environment 3 cards:**
 - En.../Cumulative Rew...:** A line chart showing cumulative reward over 300k steps, fluctuating between -2 and -4.
 - Environment/Cumulative Reward_Hist:** A histogram showing the distribution of cumulative rewards, with a peak around -2.
 - Enviro.../Episode Length:** A line chart showing episode length over 300k steps, fluctuating between 0 and 100.
- Losses 2 cards:**
 - Losses/Policy Loss:** A line chart showing policy loss over 300k steps, decreasing from 3 to 1.
 - Losses/Value Loss:** A line chart showing value loss over 300k steps, decreasing from 8 to 2.
- Policy 6 cards:** A section for policy-related metrics.

The right sidebar contains a 'Settings' panel with options for 'GENERAL' (Horizontal Axis, Step, Enable step selection and data table, Enable Range Selection, Link by step 1000, Card Width), 'SCALARS' (Smoothing, Tooltip sorting method, Ignore outliers in chart scaling, Partition non-monotonic X axis), 'HISTOGRAMS' (Mode, Offset), and 'IMAGES' (Brightness, Contrast, Show actual image size).

6.Acquire Trained Model

If the training session ends or is interrupted, the model file .onnx will be saved in the results folder. Checkpoints are also saved as models.

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KartTest

ShareView

<< Code > CodingLeague > Karting League > Assets > Karting > Prefabs > AI > results > KartTest >

Search KartTest

	Name	Date modified	Type	Size
ds				
nts				
	ArcadeDriver	3/21/2024 4:21 PM	File folder	
	run_logs	3/21/2024 4:21 PM	File folder	
: - SLB	ArcadeDriver.meta	3/20/2024 2:08 PM	META File	1 KB
	ArcadeDriver.onnx	3/20/2024 2:11 PM	ONNX File	677 KB
	ArcadeDriver.onnx.meta	3/20/2024 2:11 PM	META File	1 KB
	configuration.yaml	3/20/2024 6:01 PM	Yaml Source File	3 KB
	configuration.yaml.meta	3/20/2024 1:54 PM	META File	1 KB
	run_logs.meta	3/20/2024 1:54 PM	META File	1 KB

References

[Unity ML-Agents Toolkit Documentation](#)

[Unity ML-Agents GitHub](#)

[Unity Karting Microgame](#)