1 Definition

In this project, you will be training reinforcement learning agent(s) in the **Torcs** environment which is a popular racing game environment among the researchers. Participants of the project will be competing with each other in a 1vs1 tournament. In the project you are given a gym like environment, which's specifications given below, to train your agent. In the environment, there are 6 bots(pre-programmed racers) as well as your agent(s). In the tournament event, racers of all the participants will be tested in unseen race tracks. In order to generalize well, you may train your agent in multiple tracks. You can also use the multi-agent paradigm(Train with two racers controlled by agents).

1.1 Gym Torcs

> **TORCS** *is a highly portable multi platform car racing simulation. It is used as ordinary car racing game, as AI racing game and as research platform.*

In the project, you will be using **gym torcs** environment. Torcs is not a native gym environment. You can communicate with the environment via sockets. Thankfully, you do not need to deal with communication or any extra details. Gym torcs is nearly identical to gym environments. Only differences are the reset and rendering. Due to a memory leak problem of the game, after multiple resets, you need to relaunch the game. You also need to relaunch the game if you want to render it in real time. There is a *results only* option that runs the race without rendering. Both the reset with relaunch and rendering are implemented in the gym environment so again, you do not need to worry about them. You can also randomly change the track by calling the reset method.

1.2 Environment Specifications

Observation List			
Name	Definition	Size	Range
Angle	Angle between the tangent of the track and the car	1	-1, 1
Track	Lidar sensor on front of the car scanning 180 degrees	19	-0.005, 1
TrackPos	Distance from the middle of the track, greater than 0.5 if off the track	1	-1, 1
Speed	Cartesian speeds where the x axis is always pointing the front of the car	3	0, 1
Wheel Speeds	Angular speeds(rad/s) for each wheel	4	0, 1
Rpm	engine speed	1	0, 1

Action List			
Name	Definition	Type	Range
Steering	Steering wheel, 1 to the very left and -1 to the right	Continuous	-1, 1
Throttle	Acceleration of the car(-1: no acceleration, 1: full acceleration)	Continuous	-1, 1
Brake	Brake(mostly for drifts), -1: no brake, 1: full brake	Continuous	-1, 1

Rewards are given at each step with the following rules:

- Cosine of the angle between the track and the car times the car's velocity

- Minus the sine of the angle between the track and the car times the car's velocity

- TrackPos(Distance between the middle point and the car along the normal vector of the track) / 5

- -10 if car turns to the opposite direction

Termination rules are as follows:

- Car turns to the opposite direction

- Progress of the car below the 5km/s

- Race completes

- Max time step is reached

2 Important Dates and Submission Material

You need to submit

- An 8-10 page technical report outlining the design of your agent and training process.

- A single slide that summarized your overall approach. This will be used for introducing your team at the tournament.

- Script and weight for your agent, which should be compatible with the environment we provided.

- **Deadline for submitting your report and code: May 27th**

- Tentative tournament date at ITU Magnet: May 30th

3 Tournament

The Tournament will be a single-elimination tournament where each competitor will race at least one round. At each round there will be a single race for each three test tracks and the winner is selected from the best of three (Hence the competitor). Only winners may progress and losers will be eliminated. Participants will be asked to submit their **policy function**s for the tournament. Note that, the same gym environment will be used at test time.

3.1 Other Important Tournament Related Information

- Similar to last year's competition for BLG 561E, the competition is sponsored by Eatron Technologies, and there will be monetary rewards for the first, second and third places (Prize money will be announced soon)

- Each team consist of up to 4 students, however you will split the prize money in case you win. Hence choose your size wisely.

- Your project grade will be based entirely on your technical report, hence your place in the competition does not affect your grade.

4 Installation

> **Install the required libraries**
> sudo apt-get install build-essential libxmu-dev libxmu6 libxi-dev libxine-dev libalut-dev freeglut3 freeglut3-dev cmake libogg-dev libvorbis-dev libxxf86dga-dev libxxf86vm-dev libxrender-dev libxrandr-dev zlib1g-dev libpng12-dev

PLIB 1.8.5

- download

- ./configure

- sudo make install

OpenALsoft 1.13

- download

- cd cmake

- cmake ..

- sudo make

- sudo make install

FreeALUT

- download

- ./configure

- sudo make

- sudo make install

TORCS

- git clone https://github.com/giuse/vtorcs.git

- cd vtorcs

- ./configure

- make

- make install

- make datainstall

After the installiation test it by simply typing *torcs* in the terminal. You can use the given scripts after successfully running Torcs.