C   USER'S MANUAL

C.1   This User's manual is for the people who can navigate through a computer. Those who know how computers work and has some experience in downloading packages and installations from the command prompt will be able to quickly get the necessary components to be installed and will be able to run the program. Those who can navigate the computer may take more time in installing the necessary components, but will be able to easily run the program once everything is installed.

C.2   Installation Instructions

(1) Downloading the CARLA simulation environment:

  (a) System Requirements:

    (i) The CARLA simulation is built for Windows and Linux only (Windows is recommended)

    (ii) The computer will require at least 6GB of GPU but 8GB of GPU is recommended

    (iii) The CARLA simulation will require roughly 20GB of space

    (iv) Python 3 (Python 3.8.10 is recommended) will be needed for Windows
Python 3.8.10 Installation Link

Fig. 13. Python 3 downloadable files

Make sure to download the proper 64-bit version for your OS system (32-bit will result in installation errors for CARLA later). During the installation setup, make sure to select the option to install pip, and also select the option to add Python to environment variables.

    (v) Pip version 20.3 or higher will be required to install client libraries for CARLA

(vi) To check your python version type the following command in the terminal:

```
py -3.8 --version
```

you should get Python 3.8.10 in the terminal

(vii) To check your pip version type the following command in the terminal:

```
py -3.8 -m pip --version
```

you should get pip 21.1.1 from [where pip is located on your computer] (python 3.8)

If pip is not installed, then

(viii) To install the dependencies, in the terminal, type the following command:

```
py -3.8 -m pip install --user pygame numpy
```

(b) CARLA Installation:

(i) Open this link: CARLA package

(ii) Click on CARLA 0.9.15 to begin the download

(iii) Once CARLA is downloaded, type the following command in the terminal to download CARLA client libraries:

```
py -3.8 -m pip install carla
```

(iv) Once CARLA is completely downloaded, locate where the CARLA installation is located on the computer and copy the path to the file; cd [path to CARLA] and type the following command to run/check the CARLA simulator:

```
CARLAUE4.exe
```

A window should pop up showing the CARLA World Simulator that will be used for the lane keeping program.

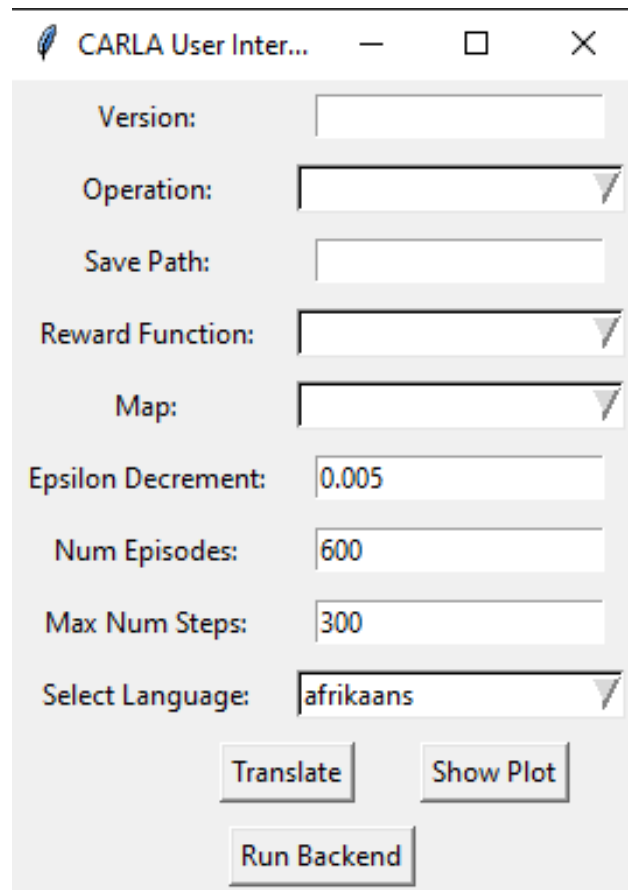Fig. 14. CARLA World Simulator

(2) Downloading Lane Keeping Code:

   (a) Ensure you have git installed on your computer

   (b) Open this link: D3QN Lane Keeping

   (c) Click on the Code button and copy the HTTPS url to the clipboard

   (d) Open a new terminal, create a new folder, cd to that folder and type the following command:

```
git clone [url that was copied from github]
```

   (e) Once the code is cloned into your folder, cd into CSCE-482-Capstone-Project-Q-Learning and run the following command to ensure that the code was cloned properly:

```
py -3.8 frontend.py
```

A window should pop up containing the user interface for the dueling double lane keeping simulation for CARLA

Fig. 15. Front-end Interface

C.3 Operating Instructions

(1) Run CARLA environment:

    (a) Navigate to the folder where CARLA was installed using the terminal and type the following command to run the simulator:

```
CARLAUE4.exe
```

(2) Run Lane Keeping Code:

    (a) Open another terminal, navigate to the cloned folder i.e. CSCE-482-Capstone-Project-Q-Learning and type the following command to run the project:

```
py -3.8 frontend.py
```

    (b) Input the following information for the double lane keeping simulation for CARLA

        (i) Version
- Specify a name for what you want pre-pended on your saved models

        (ii) Operation
- Choose between creating a new model, loading a pre-existing model, or tuning a pre-existing model

        (iii) Save Path
- If the operation is 'Load' or 'Tune', specify the path to the saved model

        (iv) Reward Function
- Reward function that will be used for lane keeping

        (v) Map
- Map that will be used to test lane keeping

        (vi) Epsilon Decrement
- How much epsilon will decrease by for every positive reward

        (vii) Number of Episodes
- Maximum number of episodes for the simulation

        (viii) Max Number of Steps
- Maximum number of steps per episode

        (ix) Language
- Choose language of your choice

(3) Navigate through CARLA simulator:

    (a) With both the lane keeping code and CARLA simulator running, you are free to navigate through the application
- Use the 'W','A','S','D' keys to navigate to the spawn point of the vehicle
- If there is a vehicle navigating on the road, the model works

(4) Let Programs run Overtime

    (a) The model now has the necessary tools required to train the dueling double deep q-network for autonomous driving.

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