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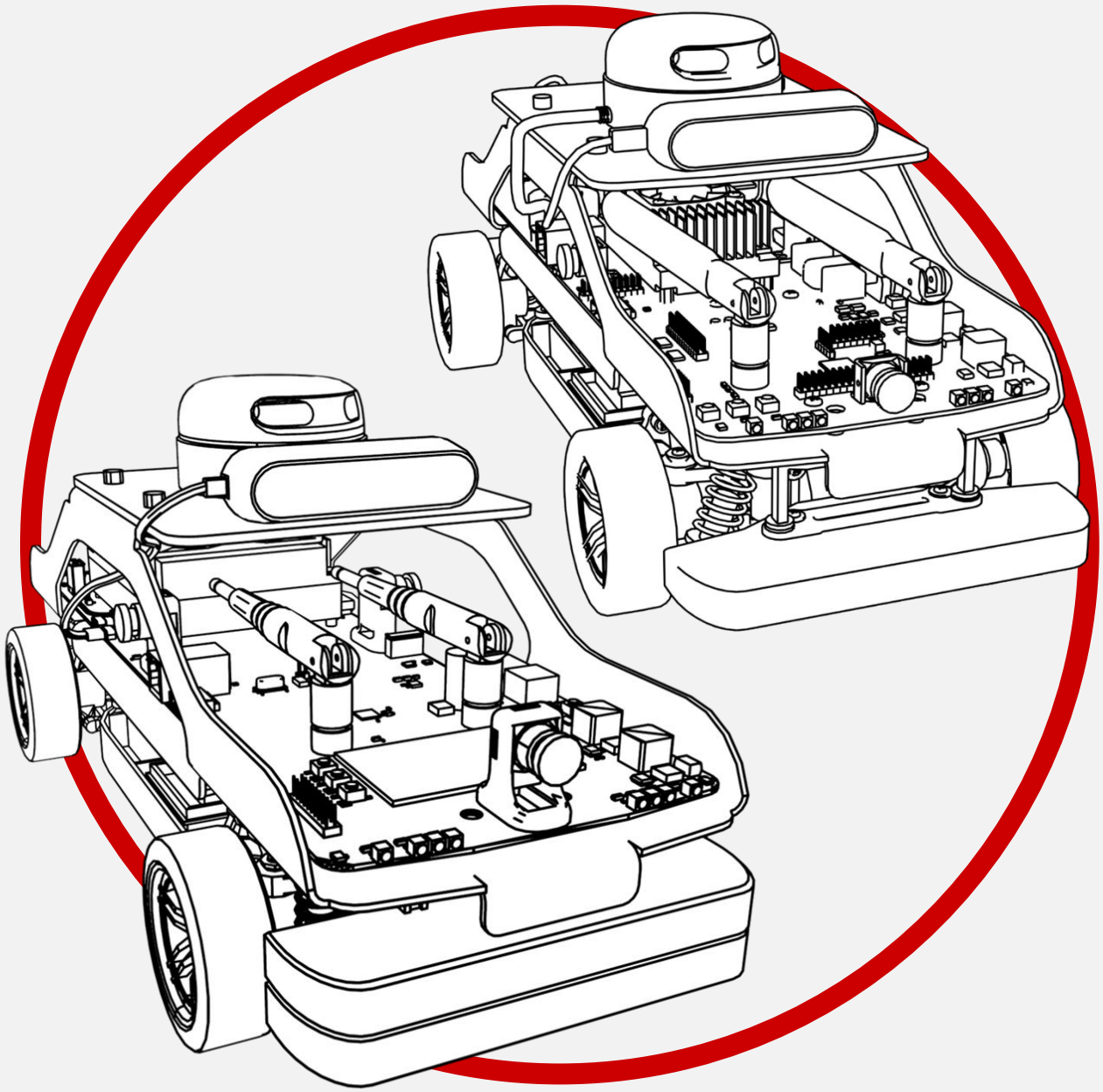

Self-Driving Car Studio

Student Setup Guide – QCar 1 and 2

v 2.0 — 1st Oct 2024

For more information on the solutions Quanser Inc. offers, please visit the web site at: http://www.quanser.com

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Caution

This equipment is designed to be used for educational and research purposes and is not intended for use by the public. The user is responsible for ensuring that the equipment will be used by technically qualified personnel only. While the end-effector board provides connections for external user devices, users are responsible for certifying any modifications or additions they make to the default configuration.

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Self-Driving Car Studio

Quanser's Self-Driving Car Studio contains curriculum designed to get students familiar with topics related to autonomous vehicles. Topics are intuitively subcategorized for convenience. Coding lab guides are developed in Python and can be used with both a physical and virtual implementation of the QCar and QCar 2.

A. Getting Started

This guide is meant to describe the process of running skills activities and can be used to understand how to run things in Python. For examples or hardware tests, please review the User Guide – Python and User Guide – Simulink of your corresponding QCar under Documents/Quanser/User Manuals/qcar or qcar2.

Skills activities are meant to guide students in exploring a series of topics related to Self-Driving vehicles.

The existing skills activities cover the following 5 topics.:

- Sensor Interfacing – Acquiring and processing data of the car sensors
- State Estimation – Kalman Filter
- Vehicle Control – Implementing speed and steering controller
- Environment Interpretation – LiDAR and occupancy grid mapping
- Image Interpretation – Camera calibration and line detection

B. Activity Structure

Skills activities contain **Lab Guides** for students to follow along to complete the activity and familiarize them with Self-Driving concepts. Lab Guides will point students to a variety of **concept reviews** that will outline concepts they will need to complete each guide.

It's encouraged for students to use the **Concept Reviews** (Documents / Quanser / concept_reviews) to become familiar with the theoretical concepts being presented during each skill activity. **Lab Guides** describe the workflow students follow during each stage of the Self-Driving vehicle pipeline. Students should be familiar with Python to be able to successfully complete these labs.

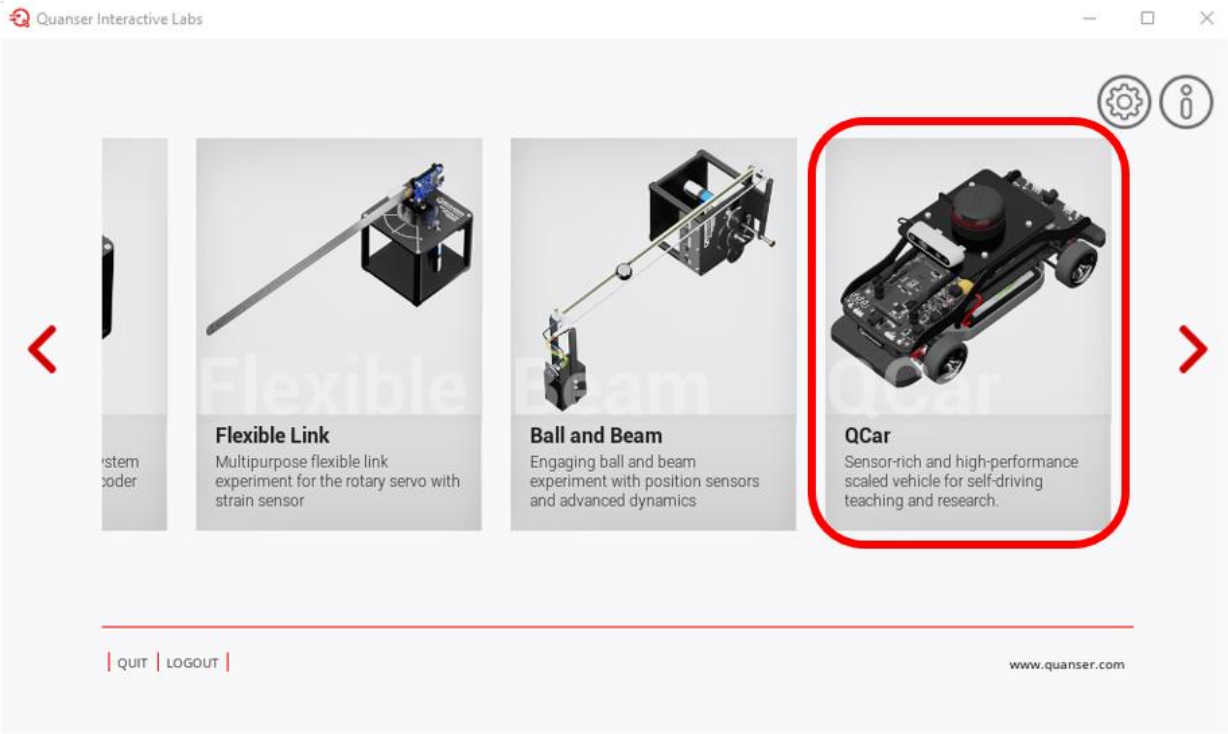
C. Workspace Deployment

To give students more flexibility, the teaching content is developed to be able to run in both the physical and virtual QCar or QCar 2, as well as their corresponding physical and virtual map.

Physical QCar

Virtual QCar

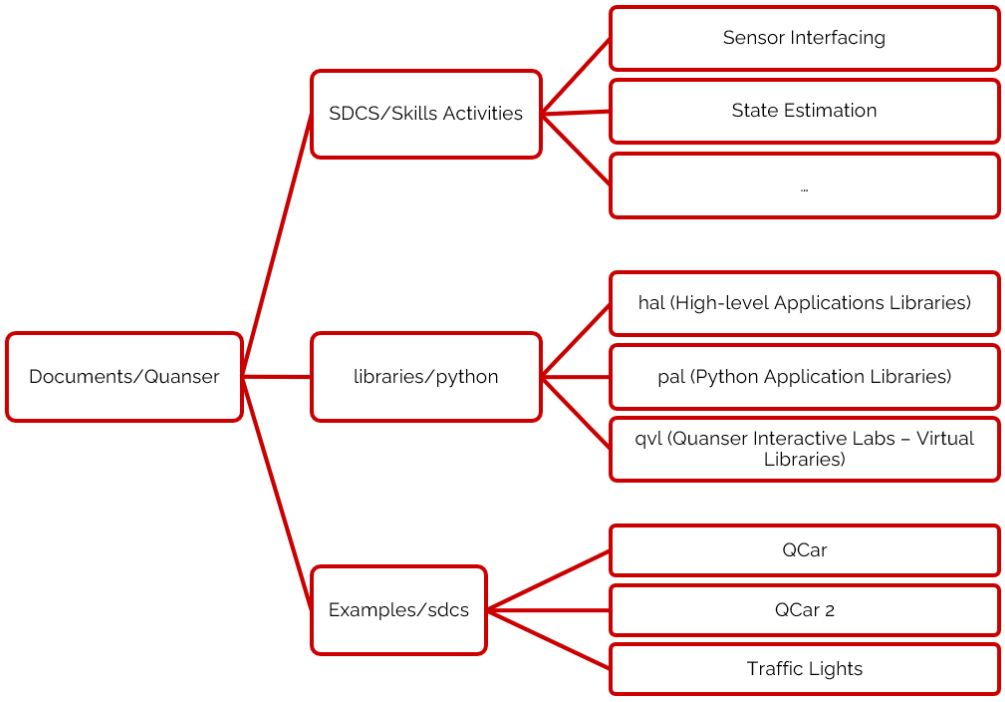
For virtual skills activities, if using QCar or QCar 2, use Quanser Interactive Labs and select QCar as well as the corresponding workspace for running the virtual labs:



Each skills activity will highlight which workspace needs to be used for the lab. These workspaces include **Cityscape, Cityscape Lite, Studio and Plane.**

D. File Structure

The skills activities will import different libraries depending on use for the virtual or physical QCar. If using a PC supplied by Quanser or a PC with the resources installed, your folder structure should look like this, if running the physical QCar, the same structure will exist in the QCar, refer to the User Manual – Python (in Documents/Quanser/User Manuals) for the specific QCar for more information on moving these libraries into the QCar:



Code structure for QCar resources

You do not need to include the qvl python library in the QCar if you are using the physical system. However, there is no problem if the qvl libraries are copied over to the QCar.

E. Running Skills Activities

Although the files to run the examples and skills activities in Python are similar, the way to run files in the different physical QCars is a bit different. The commands for virtual QCar stay the same for both cars.

Hardware - QCar 1

Accessing IO on the physical QCar requires the current user to have **sudo** authority. The commands need to be ran directly in the car as follows:

```
sudo PYTHONPATH=$PYTHONPATH python3 <PYTHON FILE NAME>.py
```

Hardware - QCar 2

Accessing IO on the physical QCar 2 does not require sudo authority or the path to the environment variables. Note that QCar 2 does not have python2, and therefore the command python and python3 point to the same python installation. The command directly on the QCar 2 to:

```
python <PYTHON FILE NAME>.py  -or-  python3 <PYTHON FILE NAME>.py
```

Virtual QCar and QCar 2

For examples or skills activities running using the virtual QCar in Quanser Interactive Labs, use the following command on your PC with Quanser Interactive Labs, usually Windows is:

```
python <PYTHON FILE NAME>.py  -or-  python3 <PYTHON FILE NAME>.py
```

F. Lab Guide Requirements

If you have the Quanser supplied Ground Control Station, it should have all the necessary packages installed to run the virtual labs. If you downloaded the SDCS or Research Resources from the Quanser website and ran the setup.bat file as well as setting up Python to be added on path, your computer should be set to run all the virtual labs.

To run the physical labs, QCar should also have all the necessary libraries preinstalled. However, it is important to note that you will need to manually move specific files to add the Quanser libraries of hal and pal, see the User Manual – Python for your specific QCar for more information. Please be careful to not update existing QCar libraries outside the updates described in the user manuals as they might need to be kept a specific version, however, you can install new libraries that you might need for your development.

To upgrade any of the Quanser Modules in the PC or the QCar, see the User Manual – Python for your specific QCar under Development Details > Quanser Modules.

(Note: if using the physical QCar, it should already have all the necessary libraries to run the examples, and the skills activities installed. If the QCar has an error due to missing libraries, please contact Quanser's tech support at tech@quanser.com for help)

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