 # Scan Matching Localization

Self-Driving Car Engineer Nanodegree
https://www.udacity.com/course/self-driving-car-engineer-nanodegree--nd013

Installation

Go to the Udacity workspace of the project "Scan Matching Localization" of the Lesson 3 "Localization" of the Self-Driving Car Engineer Nanodegree.

Copy the contents of the file code/c3-main.cpp into the file `/home/workspace/c3-project/c3-main.cpp` in the Udacity workspace of the project "Scan Matching Localization". You can do it by copying and pasting the contents of the file code/c3-main.cpp .

Usage

Press the blue button "Desktop". Start one terminal. Run the Carla simulator by using these Unix commands:

```
su - student # Ignore Permission Denied, if you see student@ you are good
cd /home/workspace/c3-project
./run_carla.sh
```

Start another terminal. Compile the project by using these Unix commands:

```
cd /home/workspace/c3-project
cmake .
make
```

Run the project with the NDT algorithm by using Unix command:

```
./cloud_loc
```

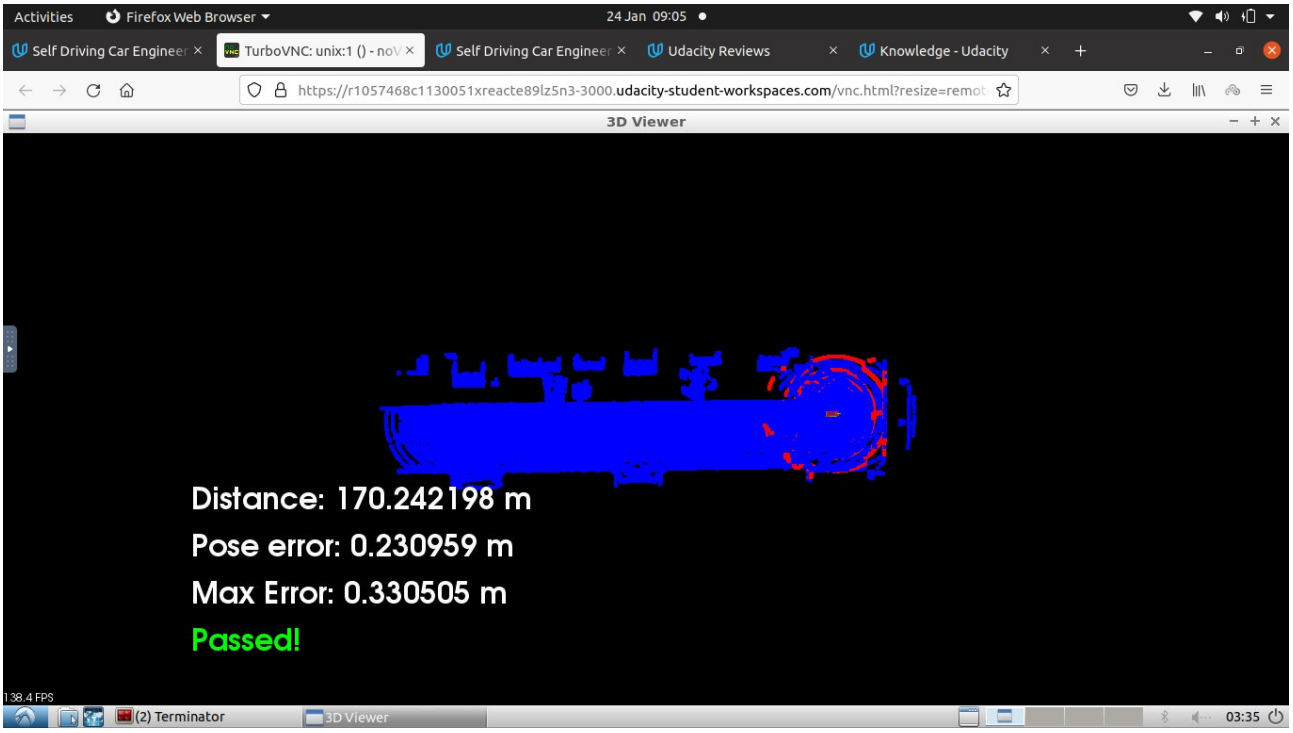
Or run the project with the ICP algorithm by using Unix command:

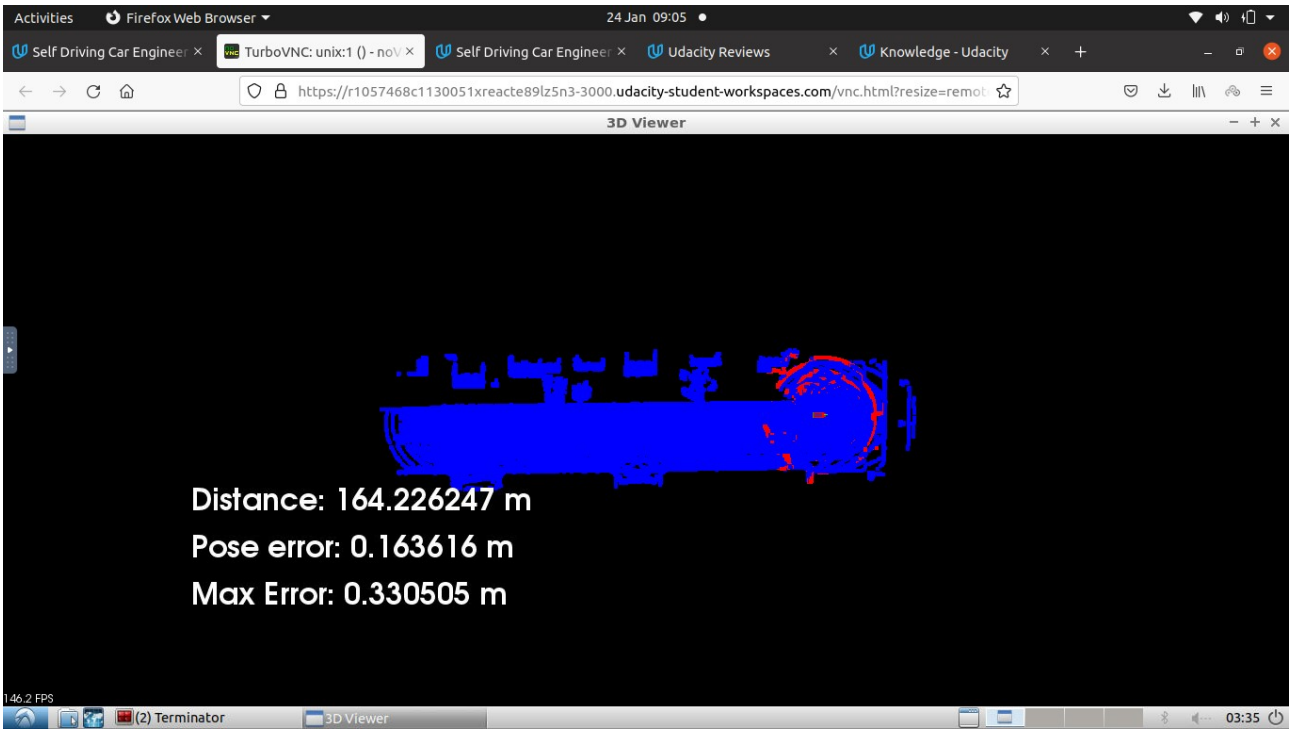
```
./cloud_loc 2
```

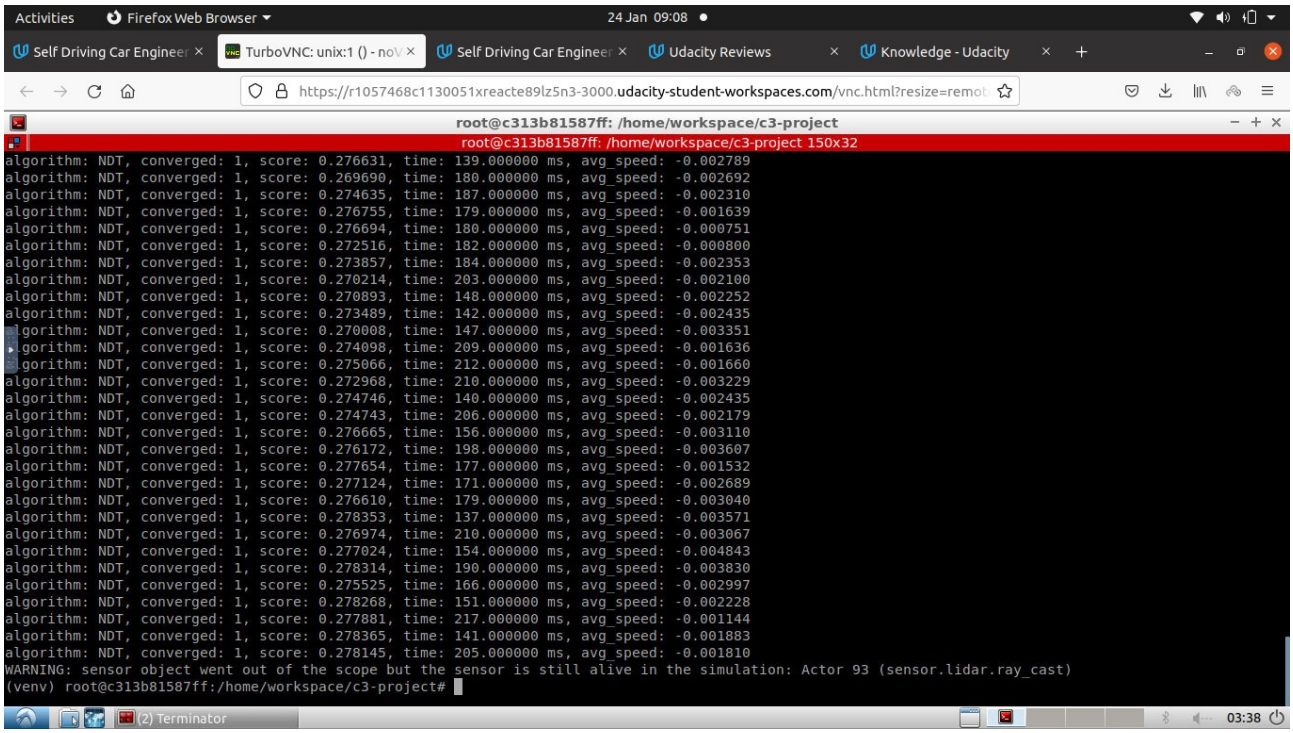
Once the project is running, click on the map and tap the UP key 3 times, with delays of 1 second between taps. If the green car gets left behind, run the project again and tap the UP key 3 times again. The second run or the third run usually produce better results than the results of the first run. **IMPORTANT: Never stop the Carla simulator.**

Result in Images

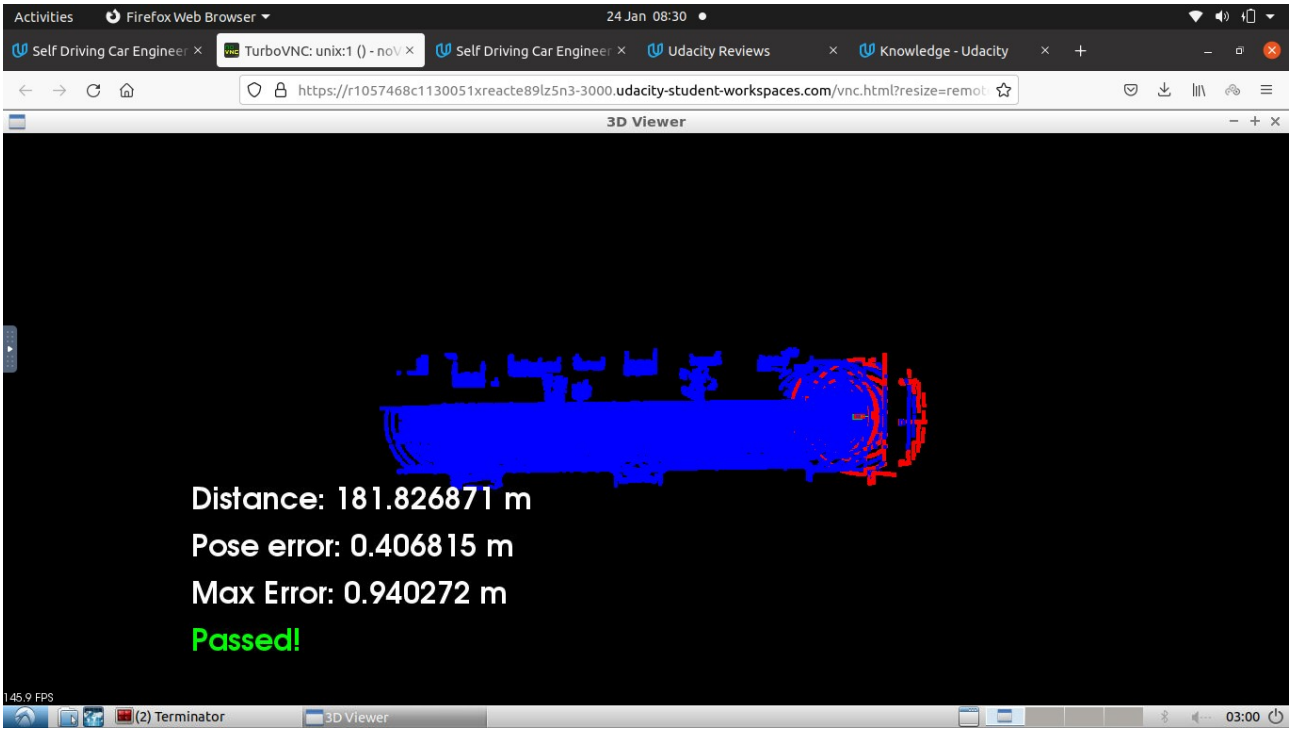
Scan Matching Localization with LIDAR Point Clouds - **Algorithm 1: Normal Distributions Transform NDT**
https://www.youtube.com/watch?v=EOKKcwuBtzo

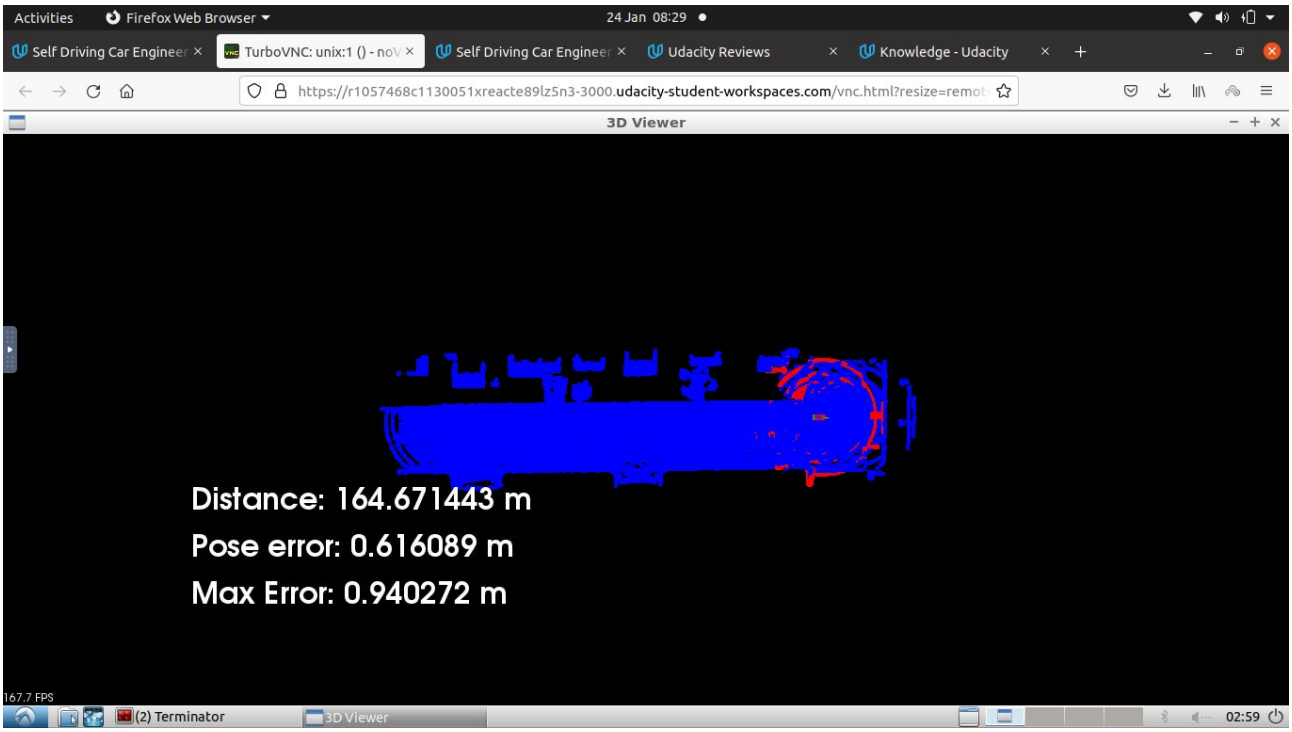


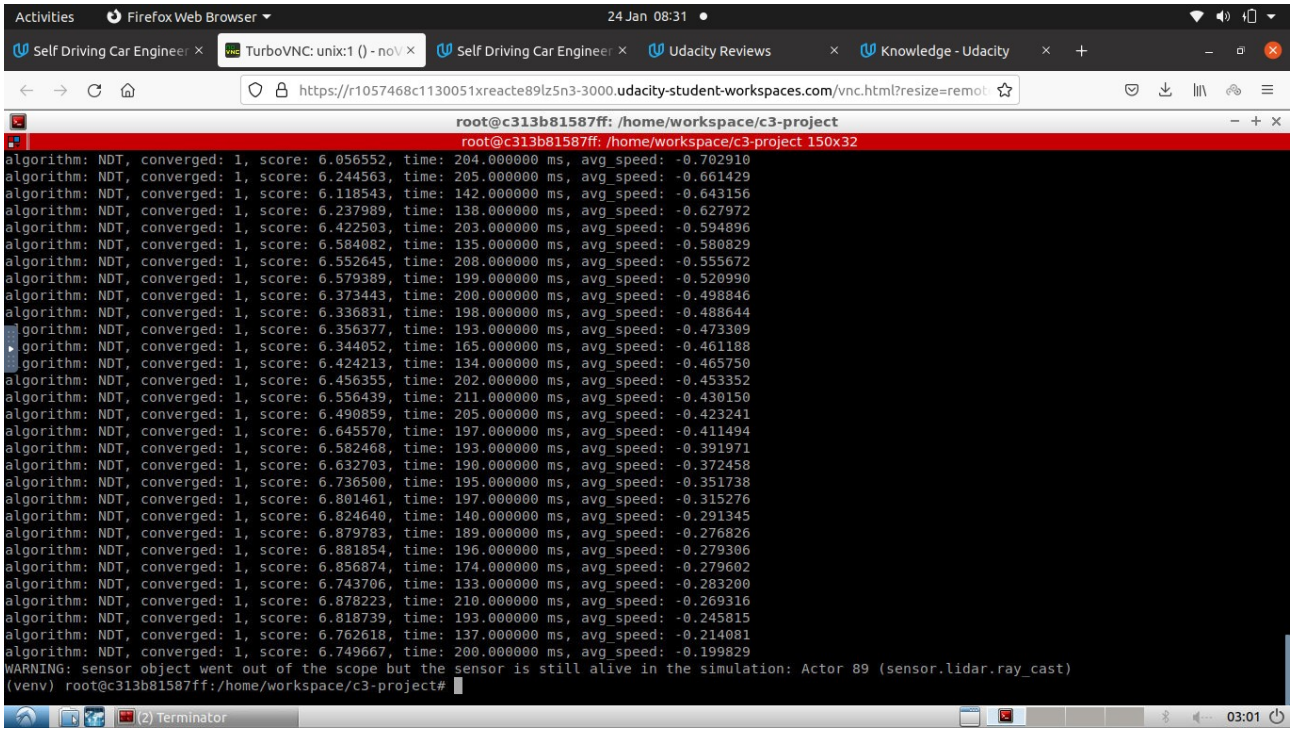




Scan Matching Localization with LIDAR Point Clouds - **Algorithm 2: Iterative Closest Point (ICP)**
https://www.youtube.com/watch?v=hZeZAm4jvW4




Activities
Firefox Web Browser
24 Jan 08:29
Self Driving Car Engineer
TurboVNC: unix:1 () - noV
Udacity Reviews
Knowledge - Udacity
https://r1057468c1130051xreacte89lz5n3-3000.udacity-student-workspaces.com/vnc.html?resize=remot
3D Viewer
Distance: 164.671443 m
Pose error: 0.616089 m
Max Error: 0.940272 m
167.7 FPS
(2) Terminator
3D Viewer
02:59


Activities
Firefox Web Browser
24 Jan 08:31
Self Driving Car Engineer
TurboVNC: unix:1 () - noV
Udacity Reviews
Knowledge - Udacity
https://r1057468c1130051xreacte89lz5n3-3000.udacity-student-workspaces.com/vnc.html?resize=remot
root@c313b81587ff: /home/workspace/c3-project
root@c313b81587ff: /home/workspace/c3-project 150x32
algorithm: NDT, converged: 1, score: 6.056552, time: 204.000000 ms, avg_speed: -0.702910
algorithm: NDT, converged: 1, score: 6.244563, time: 205.000000 ms, avg_speed: -0.661429
algorithm: NDT, converged: 1, score: 6.118543, time: 142.000000 ms, avg_speed: -0.643156
algorithm: NDT, converged: 1, score: 6.237989, time: 138.000000 ms, avg_speed: -0.627972
algorithm: NDT, converged: 1, score: 6.422503, time: 203.000000 ms, avg_speed: -0.594896
algorithm: NDT, converged: 1, score: 6.584082, time: 135.000000 ms, avg_speed: -0.580829
algorithm: NDT, converged: 1, score: 6.552645, time: 208.000000 ms, avg_speed: -0.555672
algorithm: NDT, converged: 1, score: 6.579389, time: 199.000000 ms, avg_speed: -0.520990
algorithm: NDT, converged: 1, score: 6.373443, time: 200.000000 ms, avg_speed: -0.498846
algorithm: NDT, converged: 1, score: 6.336831, time: 198.000000 ms, avg_speed: -0.488644
algorithm: NDT, converged: 1, score: 6.356377, time: 193.000000 ms, avg_speed: -0.473309
algorithm: NDT, converged: 1, score: 6.344052, time: 165.000000 ms, avg_speed: -0.461188
algorithm: NDT, converged: 1, score: 6.424213, time: 134.000000 ms, avg_speed: -0.465750
algorithm: NDT, converged: 1, score: 6.456355, time: 202.000000 ms, avg_speed: -0.453352
algorithm: NDT, converged: 1, score: 6.556439, time: 211.000000 ms, avg_speed: -0.430150
algorithm: NDT, converged: 1, score: 6.490859, time: 205.000000 ms, avg_speed: -0.423241
algorithm: NDT, converged: 1, score: 6.645570, time: 197.000000 ms, avg_speed: -0.411494
algorithm: NDT, converged: 1, score: 6.582468, time: 193.000000 ms, avg_speed: -0.391971
algorithm: NDT, converged: 1, score: 6.632703, time: 190.000000 ms, avg_speed: -0.372458
algorithm: NDT, converged: 1, score: 6.736500, time: 195.000000 ms, avg_speed: -0.351738
algorithm: NDT, converged: 1, score: 6.801461, time: 197.000000 ms, avg_speed: -0.315276
algorithm: NDT, converged: 1, score: 6.824640, time: 140.000000 ms, avg_speed: -0.291345
algorithm: NDT, converged: 1, score: 6.879783, time: 189.000000 ms, avg_speed: -0.276826
algorithm: NDT, converged: 1, score: 6.881854, time: 196.000000 ms, avg_speed: -0.279306
algorithm: NDT, converged: 1, score: 6.856874, time: 174.000000 ms, avg_speed: -0.279602
algorithm: NDT, converged: 1, score: 6.743706, time: 133.000000 ms, avg_speed: -0.283200
algorithm: NDT, converged: 1, score: 6.878223, time: 210.000000 ms, avg_speed: -0.269316
algorithm: NDT, converged: 1, score: 6.818739, time: 193.000000 ms, avg_speed: -0.245815
algorithm: NDT, converged: 1, score: 6.762618, time: 137.000000 ms, avg_speed: -0.214081
algorithm: NDT, converged: 1, score: 6.749667, time: 200.000000 ms, avg_speed: -0.199829
WARNING: sensor object went out of the scope but the sensor is still alive in the simulation: Actor 89 (sensor.lidar.ray_cast)
(venv) root@c313b81587ff:/home/workspace/c3-project#
(2) Terminator
03:01