Conde_Simulator

(Autonomous Driving Simulator)

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Context

- Autonomous Driving
- Portuguese Robotics Open (Festival Nacional de Robótica)
- Autonomous Driving Competition at *Portuguese Robotics Open*

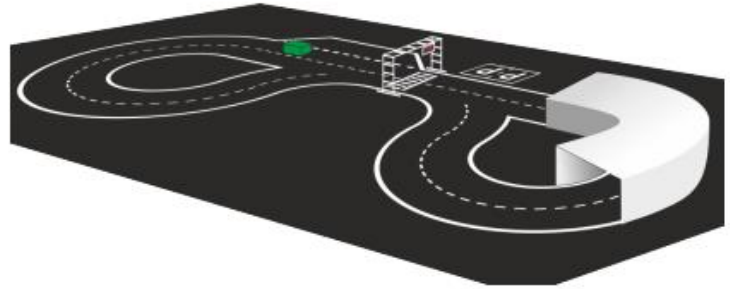
Levels of Autonomy

http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/

- **Level 0:** This one is pretty basic. The driver (human) controls it all: steering, brakes, throttle, power. It's what you've been doing all along.
- **Level 1:** This driver-assistance level means that most functions are still controlled by the driver, but a specific function (like steering or accelerating) can be done automatically by the car.
- **Level 2:** In level 2, at least one driver assistance system of "both steering and acceleration/ deceleration using information about the driving environment" is automated, like cruise control and lane-centering. It means that the "driver is disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND foot off pedal at the same time," according to the SAE. The driver must still always be ready to take control of the vehicle, however.
- **Level 3:** Drivers are still necessary in level 3 cars, but are able to completely shift "safety-critical functions" to the vehicle, under certain traffic or environmental conditions. It means that the driver is still present and will intervene if necessary, but is not required to monitor the situation in the same way it does for the previous levels. Jim McBride, autonomous vehicles expert at Ford, said this is "the biggest demarcation is between Levels 3 and 4." He's focused on getting Ford straight to Level 4, since Level 3, which involves transferring control from car to human, can often pose difficulties. "We're not going to ask the driver to instantaneously intervene—that's not a fair proposition," McBride said.
- **Level 4:** This is what is meant by "fully autonomous." Level 4 vehicles are "designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip." However, it's important to note that this is limited to the "operational design domain (ODD)" of the vehicle—meaning it does not cover every driving scenario.
- **Level 5:** This refers to a fully-autonomous system that expects the vehicle's performance to equal that of a human driver, in every driving scenario—including extreme environments like dirt roads that are unlikely to be navigated by driverless vehicles in the near future.

Rules and More Info

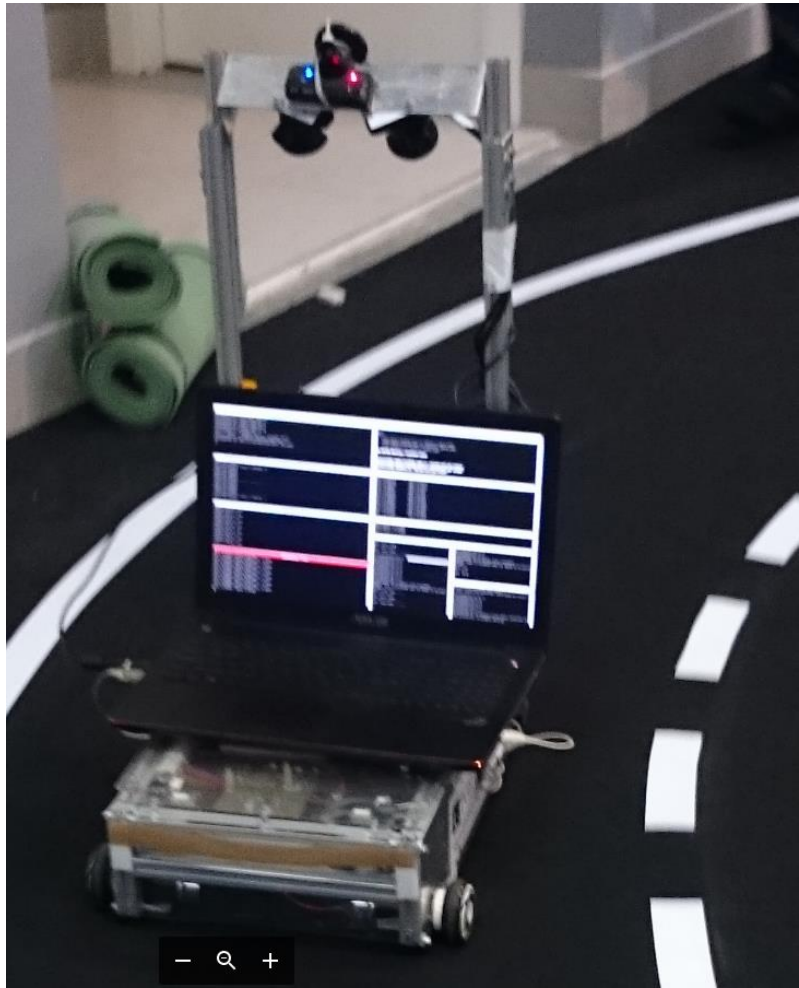
- Portuguese Robotics Open
- http://robotica2016.ipb.pt/indexen.html
  - Scroll down (or find text “Major” in the page)
  - Select “Major” (Sénior)
  - Select “Autonomous Driving”



- Rules for 2016:
  - http://robotica2016.ipb.pt/docs/Regras_Autonomous_Driving.pdf

“Conde” Robot

- Arduino_Serial + Differential Drive
- (Brushless Motors)
- 3 PS2Eye cameras
- LiPo Batteries
- (RGB Leds)
- Laptop on top of compter
- Full ROS
- Simulation / Real Robot transparent

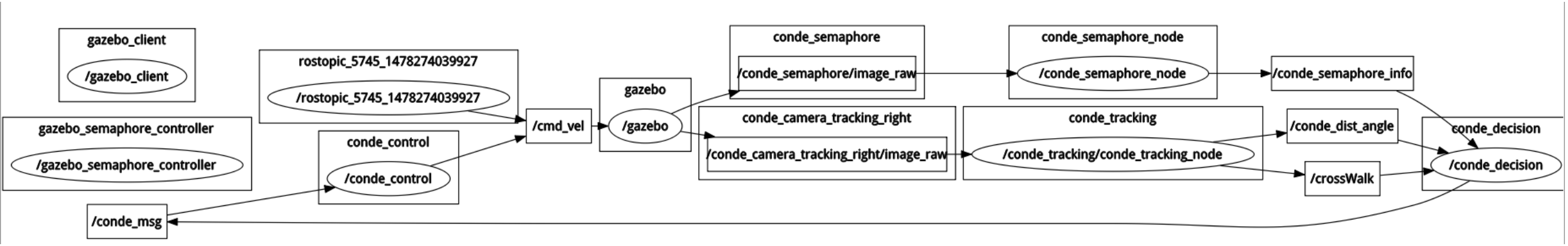


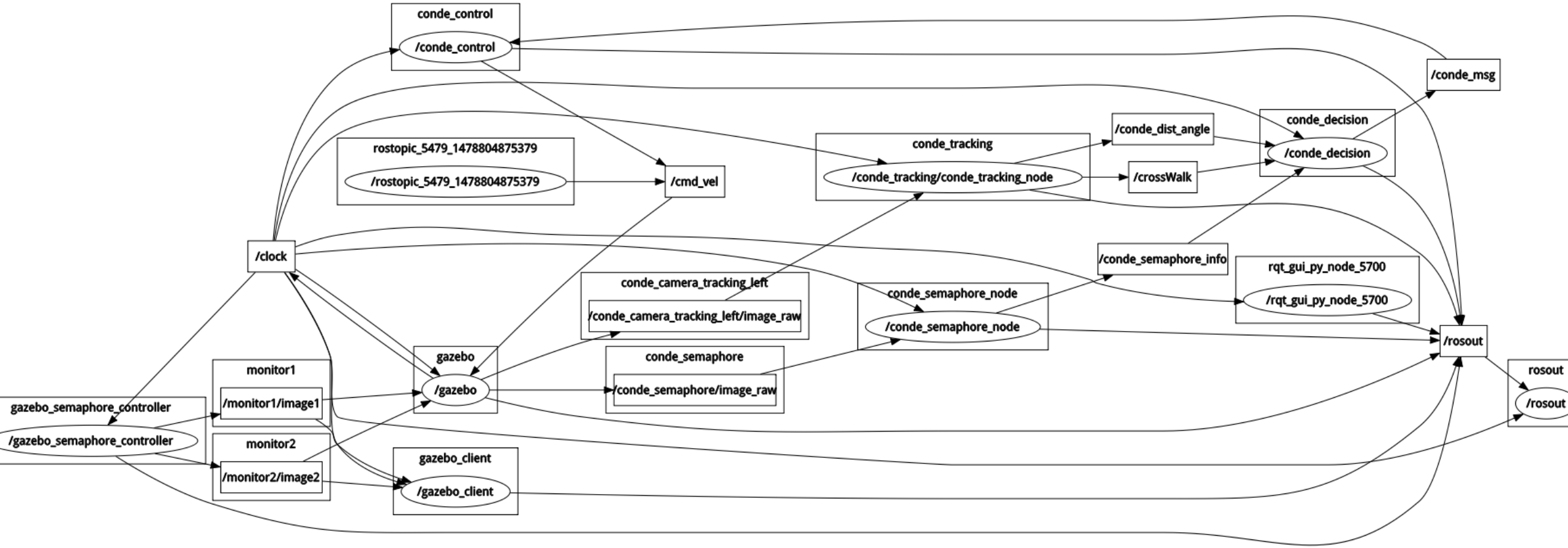
Modules

- ROS + Gazebo (3D, physics) => WORLD
  - roslaunch conde_world main.launch
- Process Screen “Semaphore” (3rd camera)
  - rosrun conde_semaphore conde_semaphore_node
- Hi Level Decision =>
  - rosrun conde_decision conde_decision_node
- Differential Control
  - rosrun conde_control conde_control_node
- Control Interface for the info to show on the Screen “Semaphore” of the track
  - rosrun gazebo_semaphore gazebo_semaphore_node
- Left and Right Cameras targeting the ground
  - roslaunch conde_tracking run.launch

rosrun rqt_graph rqt_graph

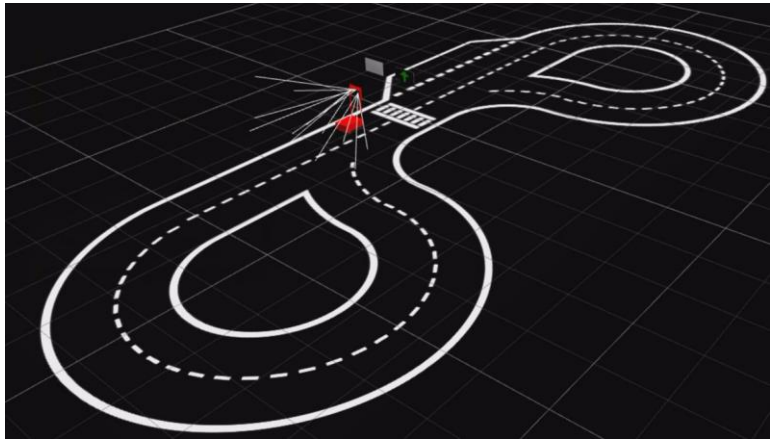
RQT Graph



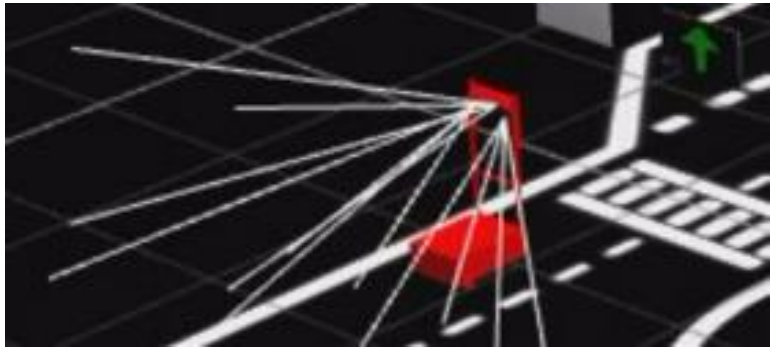

conde_control
/conde_control
/conde_msg
conde_decision
/conde_decision
/conde_dist_angle
/crossWalk
conde_tracking
/conde_tracking/conde_tracking_node
rostopic_5479_1478804875379
/rostopic_5479_1478804875379
/cmd_vel
/clock
/conde_semaphore_info
rqt_gui_py_node_5700
/rqt_gui_py_node_5700
conde_camera_tracking_left
/conde_camera_tracking_left/image_raw
conde_semaphore_node
/conde_semaphore_node
/rosout
gazebo
/gazebo
conde_semaphore
/conde_semaphore/image_raw
monitor1
/monitor1/image1
rosout
/rosout
gazebo_semaphore_controller
/gazebo_semaphore_controller
monitor2
/monitor2/image2
gazebo_client
/gazebo_client

Installing Conde_Simulator

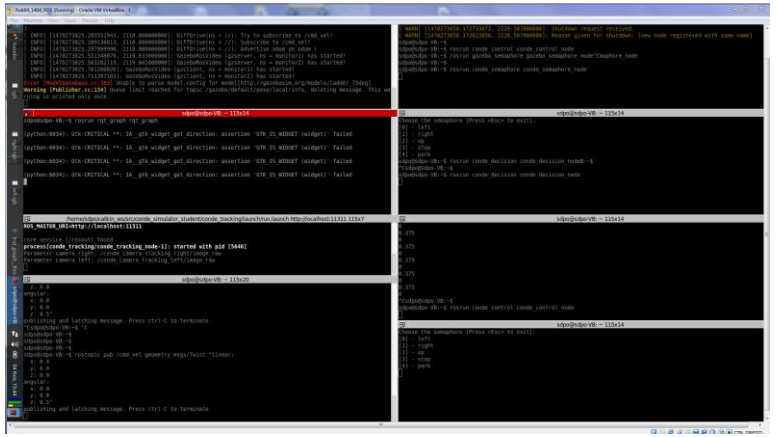
- => Ask professor for the **virtual machine image**…



- Install ROS INDIGO
- hg clone https://bitbucket.org/ee09115/conde_simulator_student
- Copy the “models” directory to the ~/.gazebo (hudden!) directory
- catkin_make
- Launch:

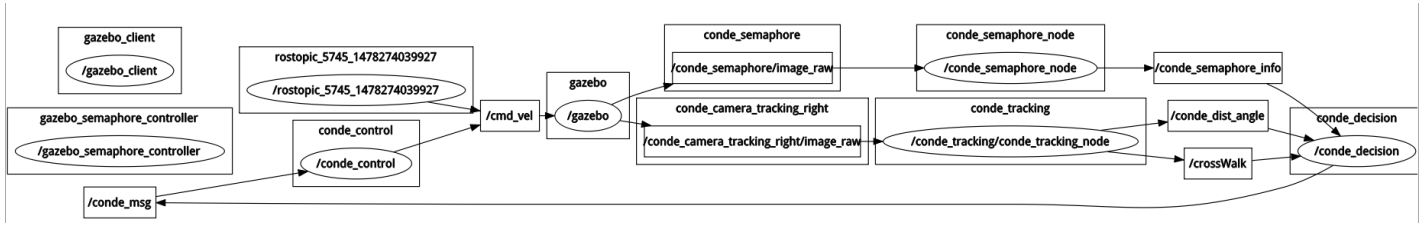


roslaunch conde_world main.launch
rosrun conde_semaphore conde_semaphore_node
rosrun conde_decision conde_decision_node
rosrun conde_control conde_control_node
rosrun gazebo_semaphore gazebo_semaphore_node
roslaunch conde_tracking run.launch



Test & Debug

- Debug: rosrun rqt_graph rqt_graph



- Test: rostopic pub /cmd_vel geometry_msgs/Twist
  (end with a space and press tab key twice)

```
sdpo@sdpo-VB:~$ rostopic pub /cmd_vel geometry_msgs/Twist "linear:
  x: 0.25
  y: 0.0
  z: 0.0
angular:
  x: 0.0
  y: 0.0
  z: 0.25"
publishing and latching message. Press ctrl-C to terminate
```

/home/sdpo/catkin_ws/src/conde_simulator_student/conde_world/launch/main.launch http://localhost:11311 115x15

```
sdpo@sdpo-VB:~$ roslaunch gazebo_ros empty_world.launch
... logging to /home/sdpo/.ros/log/732ccaf4-a829-11e6-81b0-080027156d22/roslaunc
h-sdpo-VB-2126.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://sdpo-VB:44915/

SUMMARY
========

PARAMETERS
 * /rosdistro: indigo
 * /rosversion: 1.11.20
```

sdpo@sdpo-VB: ~ 115x7

```
sdpo@sdpo-VB:~$
sdpo@sdpo-VB:~$ rosrun conde_semaphore conde_semaphore_node
```

sdpo@sdpo-VB: ~ 115x7

```
sdpo@sdpo-VB:~$ rosrun conde_control conde_control_node
```

sdpo@sdpo-VB: ~ 115x21

```
sdpo@sdpo-VB:~$ rostopic pub /cmd_vel geometry_msgs/Twist "linear:
  x: 0.25
  y: 0.0
  z: 0.0
angular:
  x: 0.0
  y: 0.0
  z: 0.25"
publishing and latching message. Press ctrl-C to terminate
```

/home/sdpo/catkin_ws/src/conde_simulator_student/conde_tracking/launch/ru

```
core service [/rosout] found
process[conde_tracking/conde_tracking_node-1]: started with pid [3941]
Parameter camera_right: /conde_camera_tracking_right/image_raw
Parameter camera_left: /conde_camera_tracking_left/image_raw
```

sdpo@sdpo-VB: ~ 115x21

```
(reverse-i-search)`dec': rosrun conde_decision conde_^Ccision_node
sdpo@sdpo-VB:~$ rosrun conde_decision conde_decision_node
0.375
0
0.375
0
0.375
0
```

sdpo@sdpo-VB: ~ 115x20

```
[0] - left
[1] - right
[2] - up
[3] - stop
[4] - park
```