



Computer science for robotics



What is the link?



Inside a robot, there is always a computer!

To learn how to code a robot, we must understand some
computer science

3 topics

- Images
- Middleware (ROS)
- Numpy and OpenCV (Python libraries)

Images

When I take a photo on a numeric camera, how is it saved?

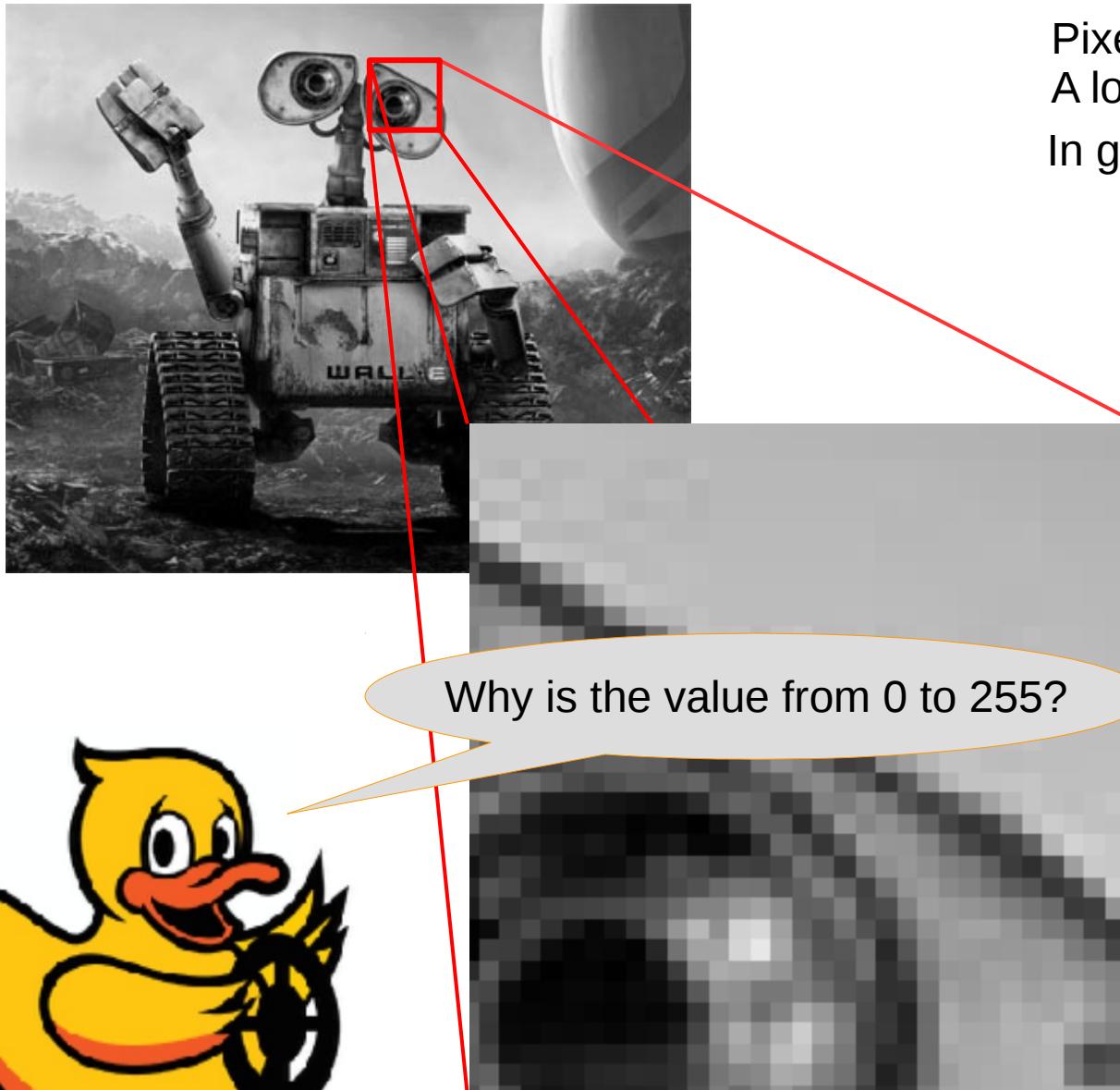
How is it sent from the camera to a computer, and then to another?



Like with Facebook!



Images are a table of pixels!



Pixel: little square of one color.
A lot of pixels form an image!

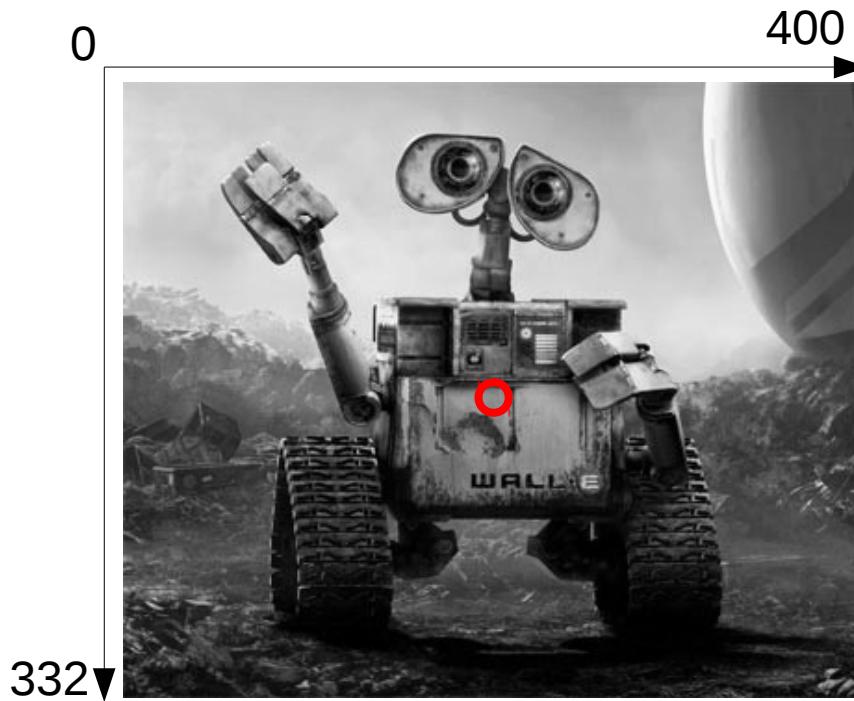
In grayscale, only one value per pixel:

- black: 0
- white: 255
- gray: all in between!

0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0

Image resolution

Resolution: number of pixels in an image



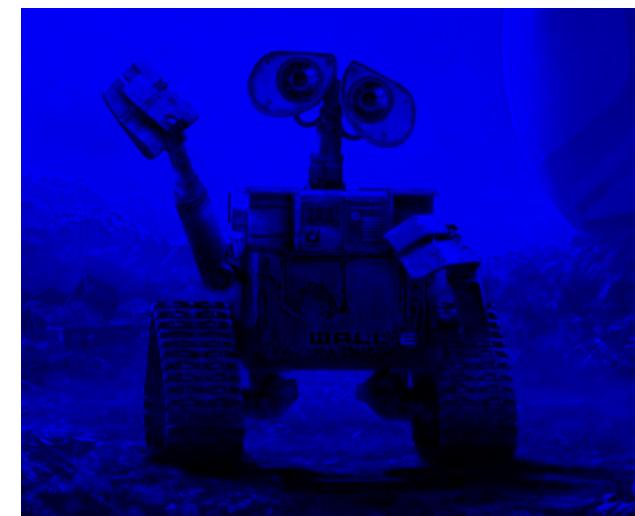
Question: what are the coordinates of the point in the center of the image?

BGR color pictures

In each pixel, 3 values from 0 to 255:

- B for BLUE
- G for GREEN
- R for..? RED

0 - 0 - 0	0-0-127	0-0-255	127-0-255
0-127-0	0-127-127	0-127-255	127-127-255
0-255-0	0-255-127	0-255-255	127 - 0 - 0
127-255-0	127-255-127	127-255-255	255 - 0 - 0
255-255-0	255-255-127	255-255-255	127-127-127



+



+



Your turn!

You are given an image.

Flip it!

0

400

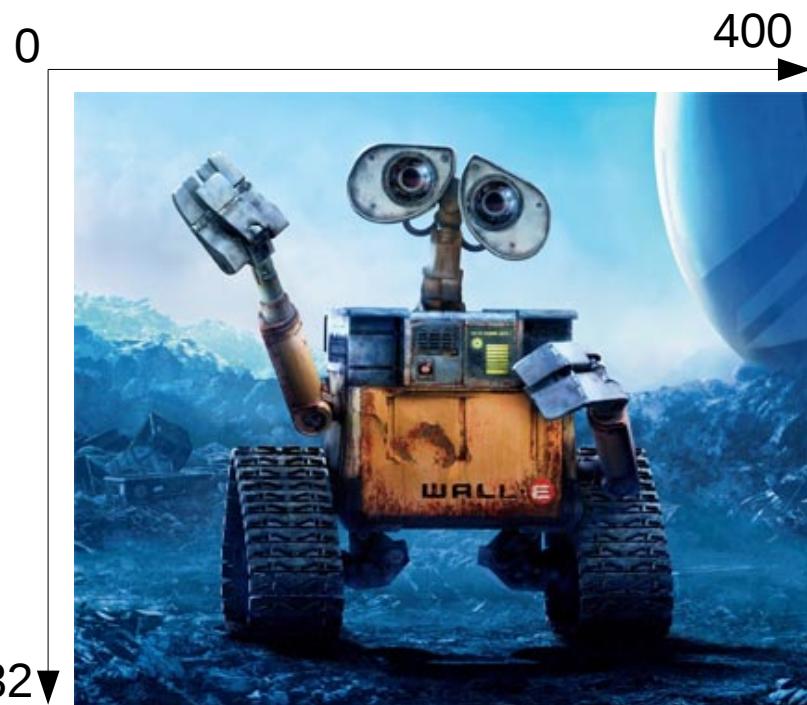


Flip

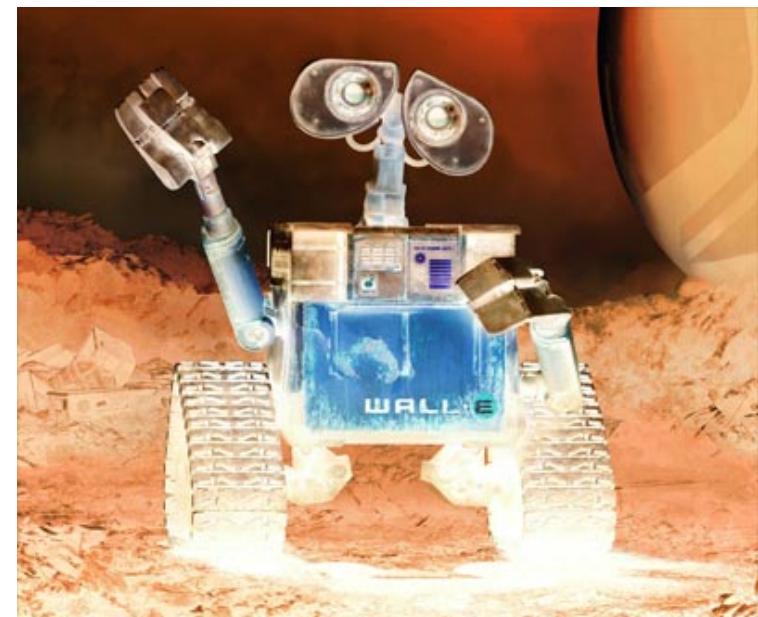


Your turn!

You are given an image.
Inverse it!



Inverse



ROS

- A middleware
- Used in most universities and industries
- Allows to focus on the program and not the frame

OK... but what does this mean?





“Program” that receives the
sensor’s measurements

I got this measurement!

“Program” that decides
what to do

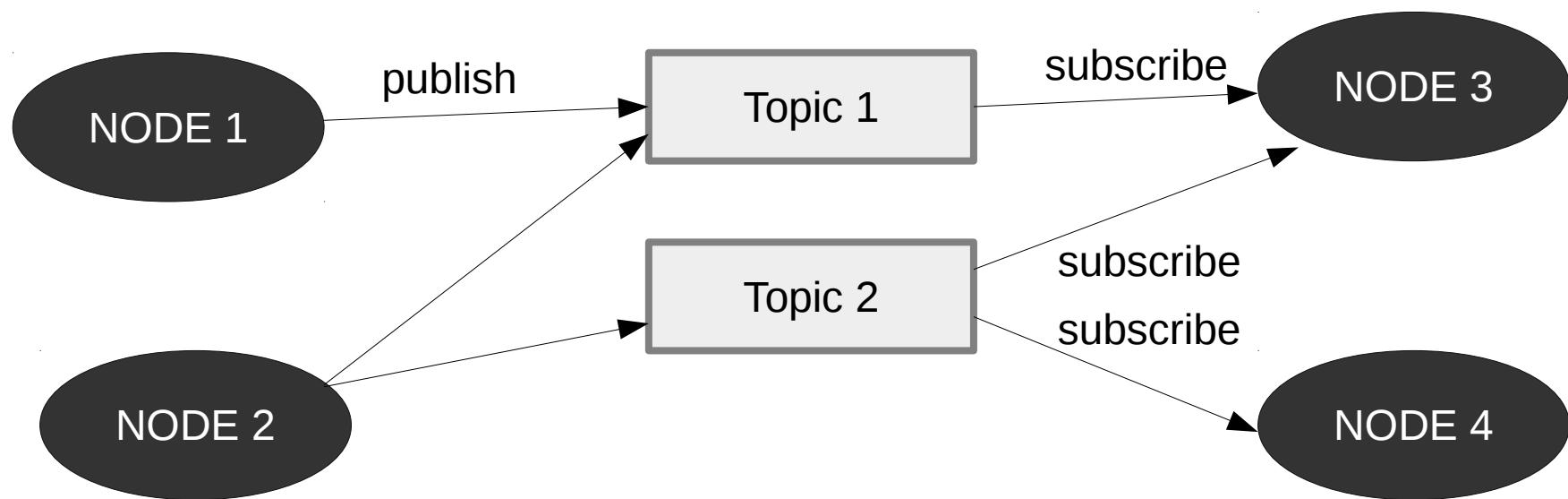
I need to do that!

“Program” that tells the
actuators what to do

Actuator



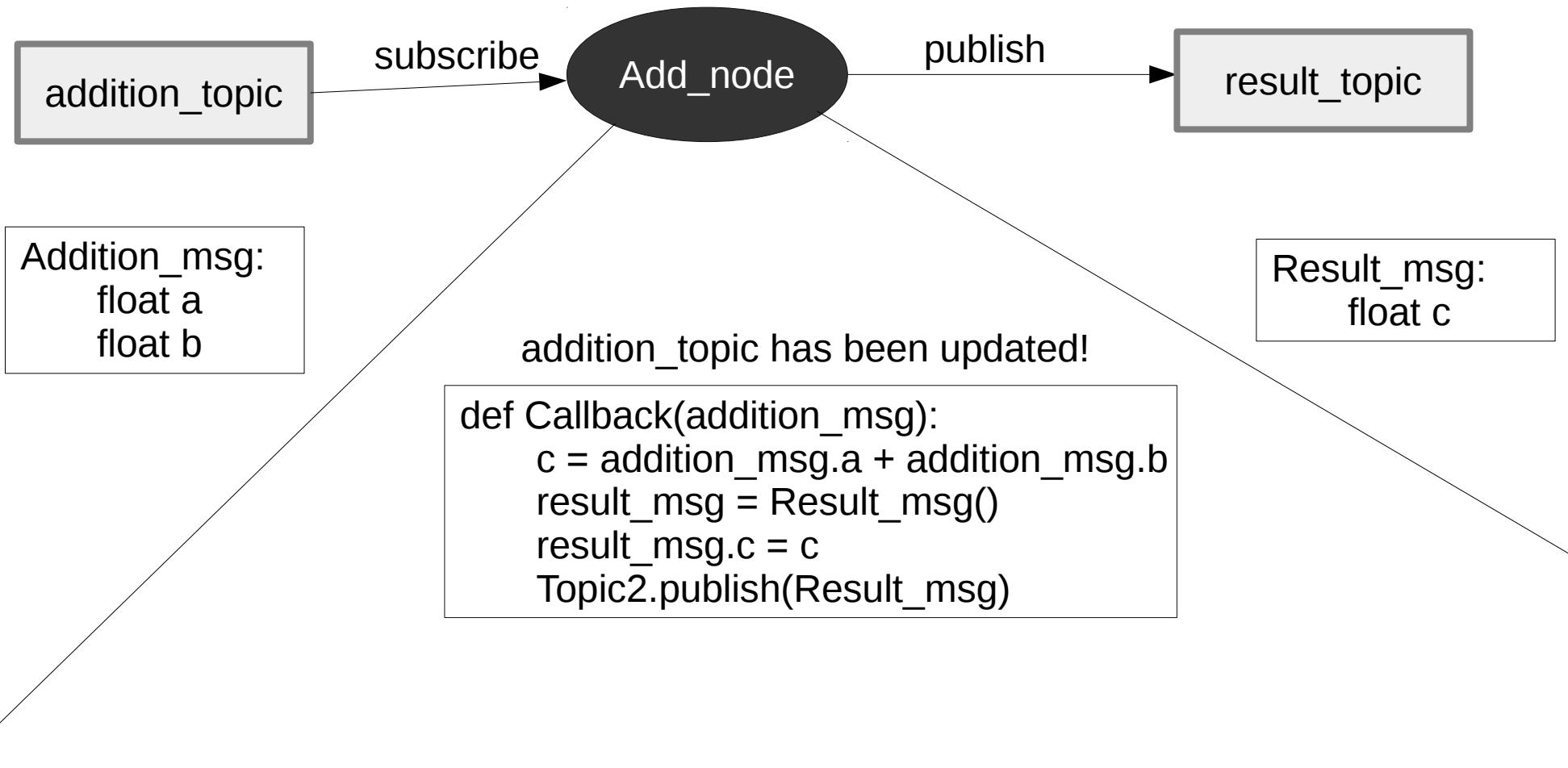
Nodes and topics



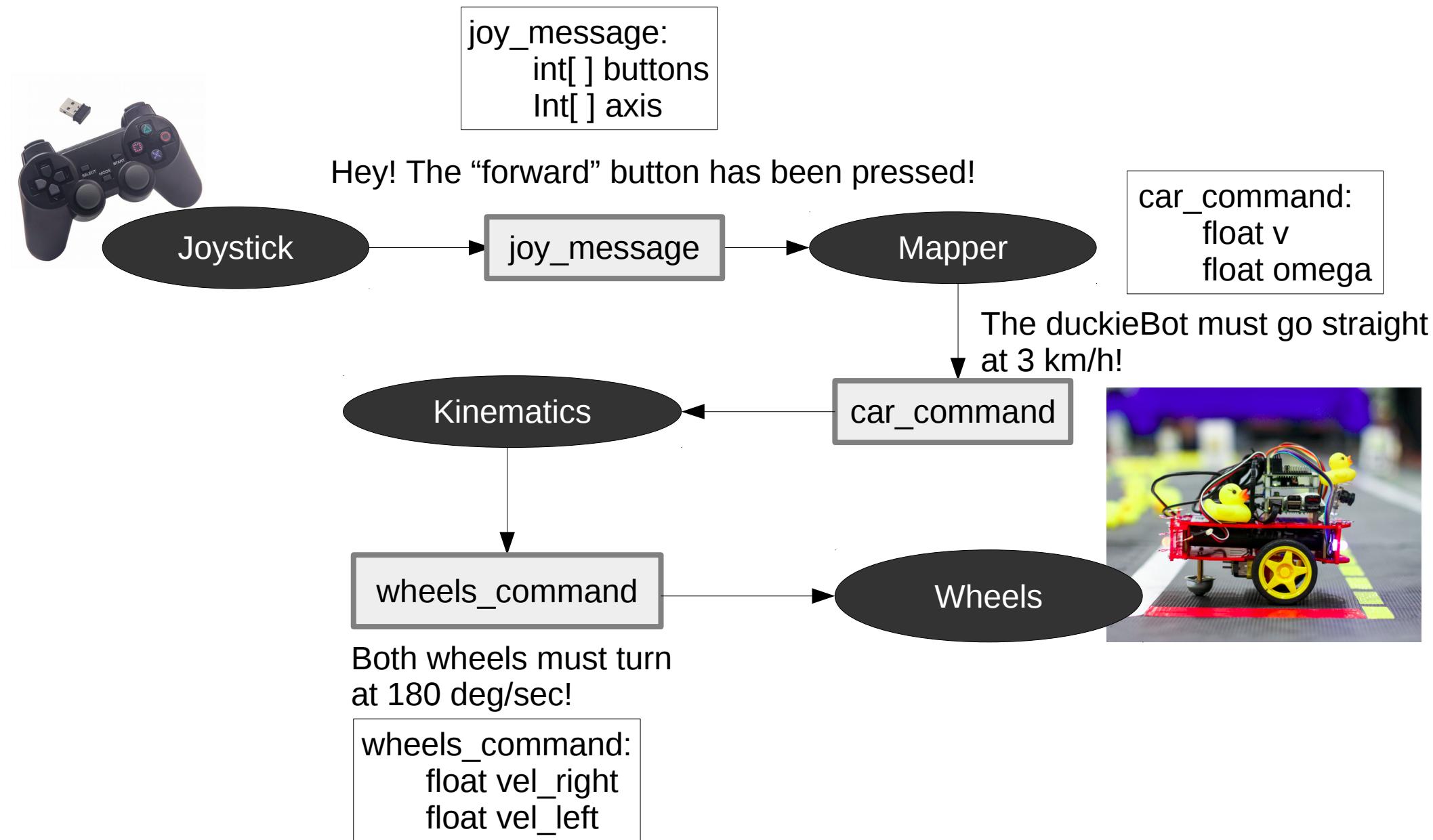
Each topic accepts only 1 type of message

Receiving a message

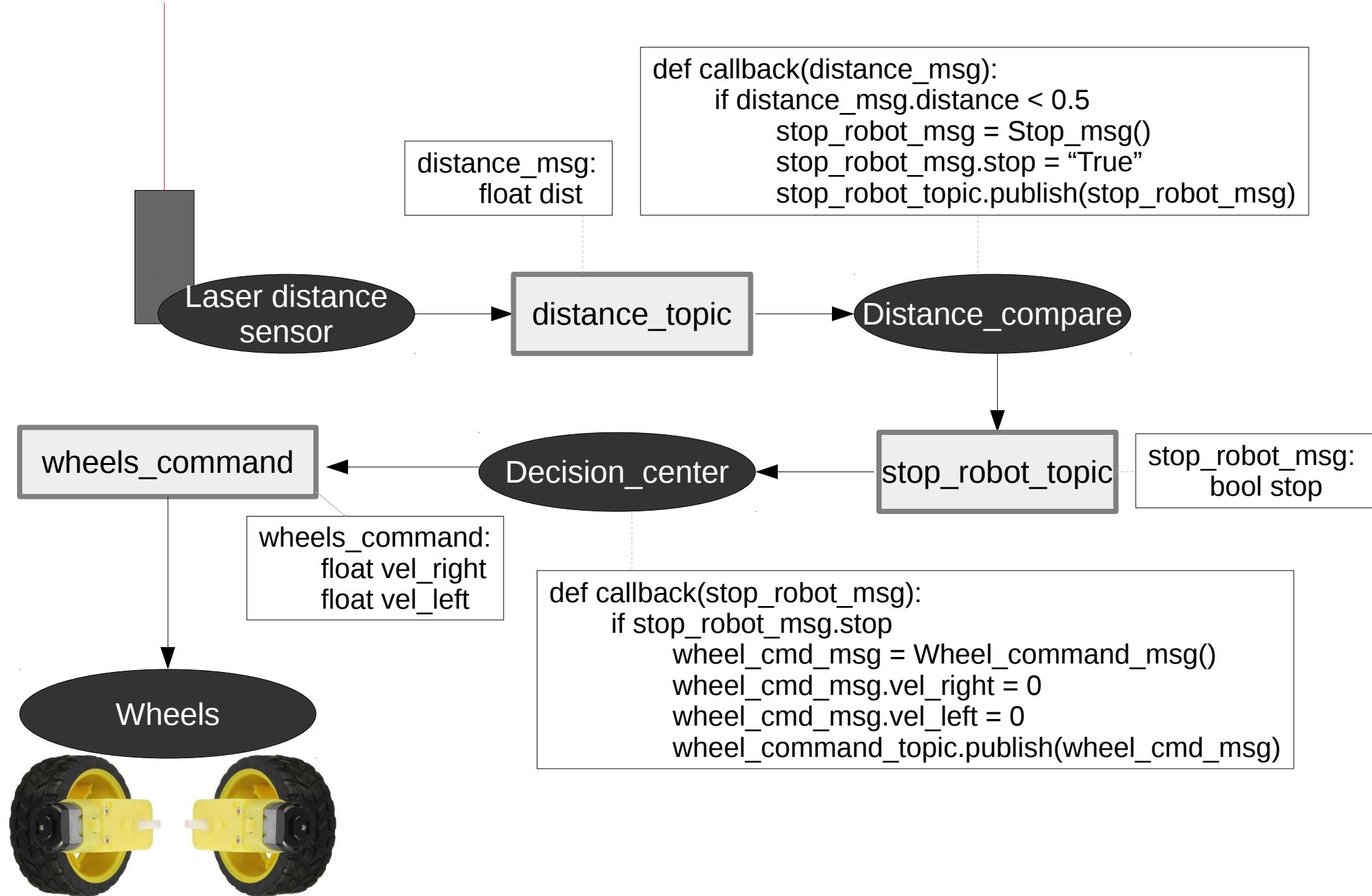
Addition example



Chain example: driving with a joystick



Exercise: what is this doing?



Exercise: what is this doing?

