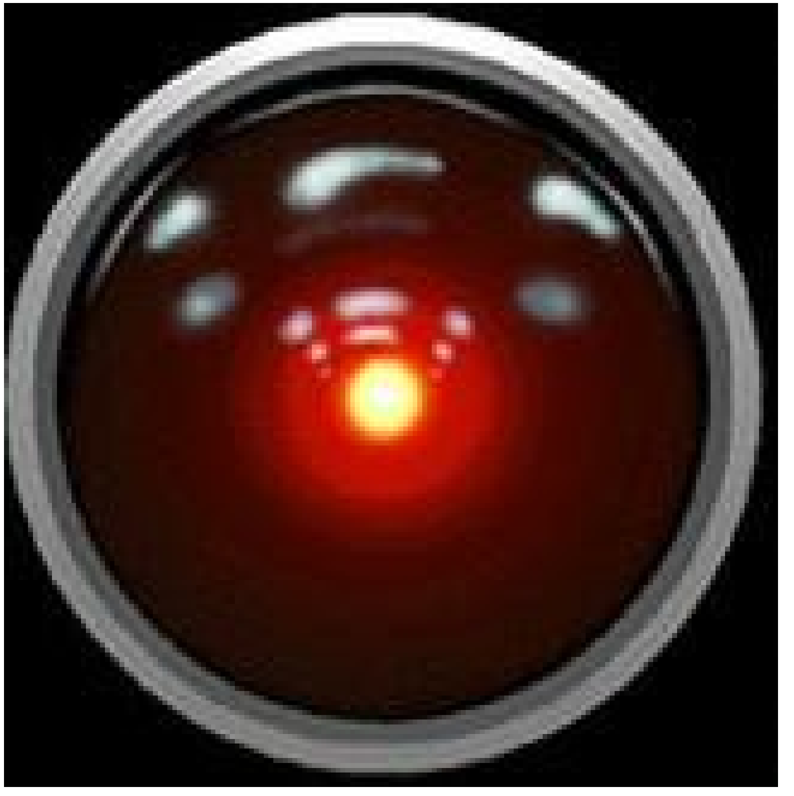


CS 378: Autonomous Intelligent Robotics

Instructor: Jivko Sinapov

http://www.cs.utexas.edu/~jsinapov/teaching/cs378/

Announcements

FRI Summer Research Fellowships:

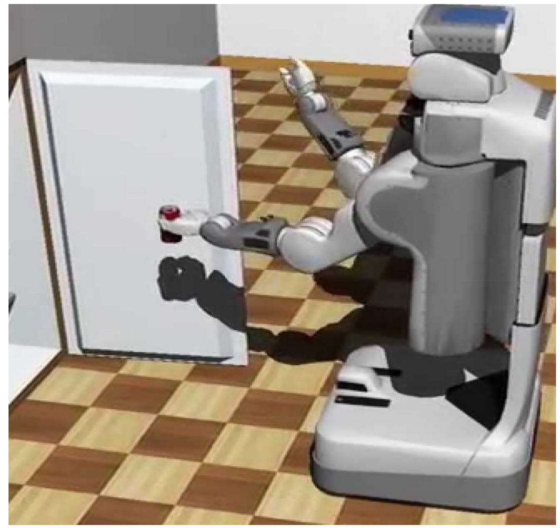
https://cns.utexas.edu/fri/beyond-the-freshman-lab/fellowships

Applications are due March 1st but apply now!

Funding is available for 4-5 students per FRI stream

Progression

2D simulation



3D simulation

Real World

The Gazebo 3D simulator

- Install gazebo_ros package:

  sudo apt-get install ros-indigo-gazebo-ros

- Run the simulator:

  roslaunch gazebo_ros rubble_world.launch

- Guide for installing the gazebo simulator on Mac OS: http://gazebosim.org/tutorials?tut=install_from_source&cat=install

Readings for this week

D. McDermott (1981). "Artificial intelligence meets natural stupidity". Ch. 5 in Mind Design: Philosophy, Psychology, Artificial Intelligence, pp. 143-160, MIT Press.

Rich Sutton (2001). "Verification, The Key to AI".

Rich Sutton (2001). "Verification".

Today

- Overview of Homework 3 solution
- ROS launch files example
- Discussion on Homework 4: Multi-Agent System

ROS Launch Files

- Example with turtlesim
- Using waitForService("...") when launching multiple nodes at once
- A few things about roslaunch files:
  - A launch file may include another launch file, even from a different package
  - To start a launch file:

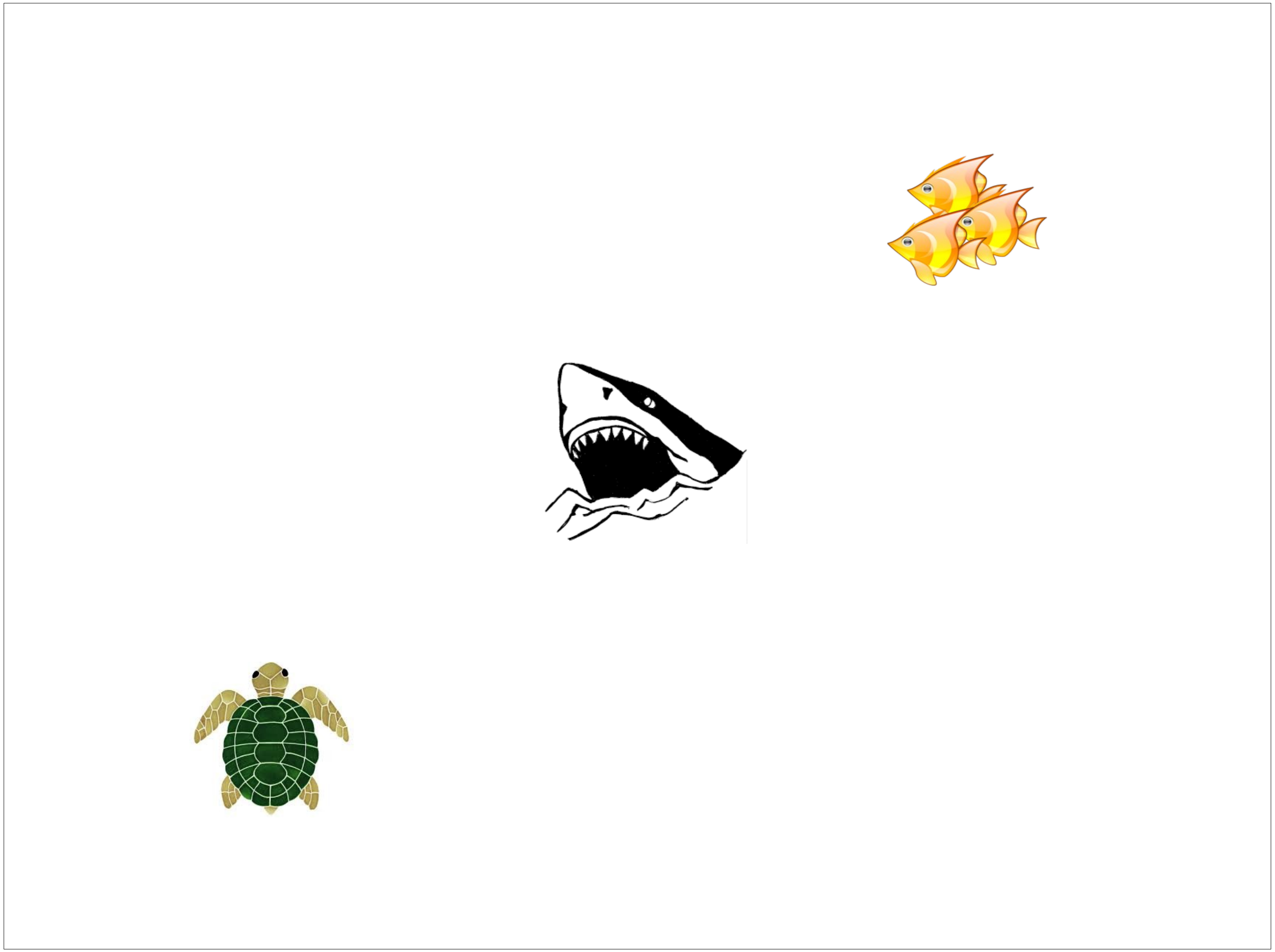
    roslaunch <package_name> <roslaunch_filename>
  - No need to start a roscore

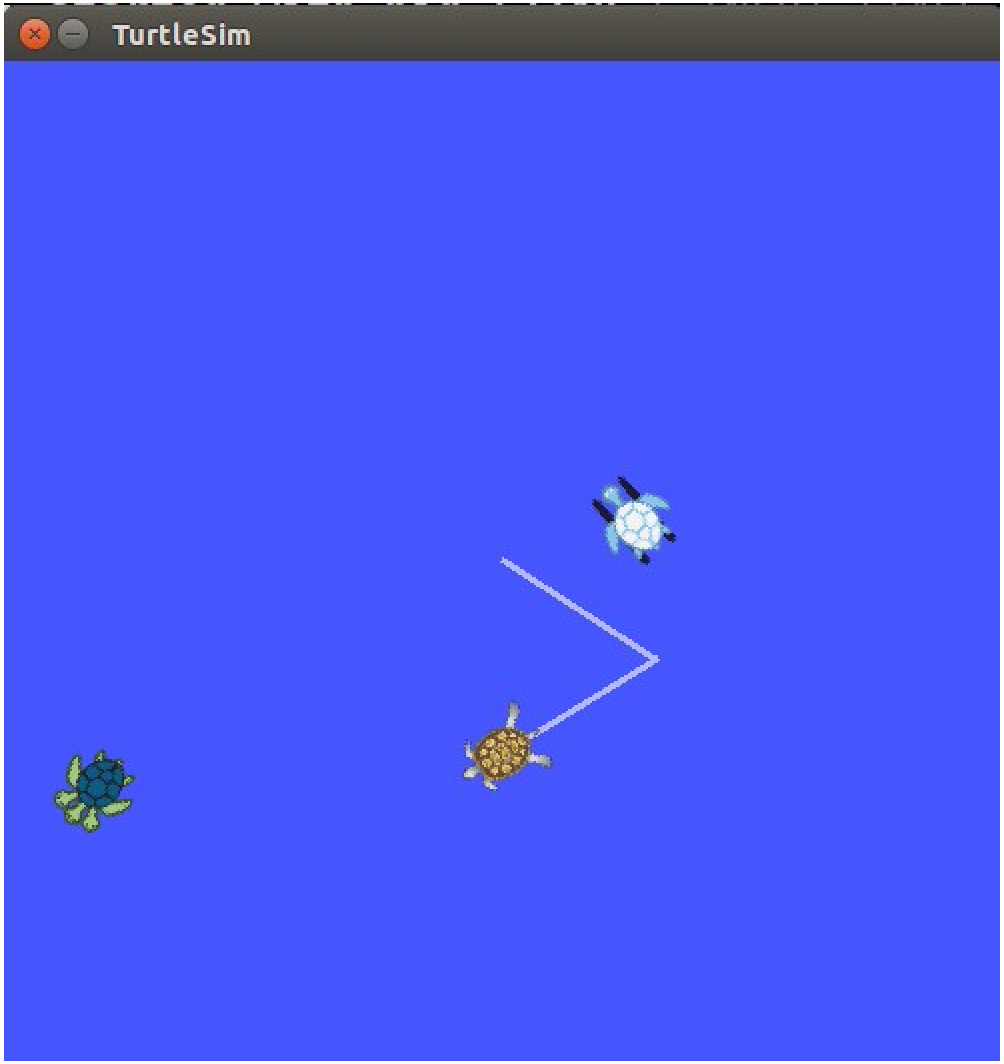
Homework 4: Multi-Agent System

Homework 4: Multi-Agent System

- How should we break down the problem?
- What should each agent “sense” about the environment
- How should each agent make a decision about its linear or angular velocity at each time step?

Reactive Paradigm Example



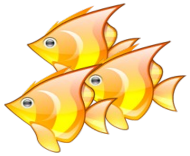

TurtleSim

Breaking the problem down

- What dependencies should the package have?
- How many nodes / launch files do I need to write?
- How should I modify the CMakeLists.txt file?
- What part is easy and what part is hard? Where should I start?

What should go in your ROS package

What is easy and what is hard?



Easy / Simple

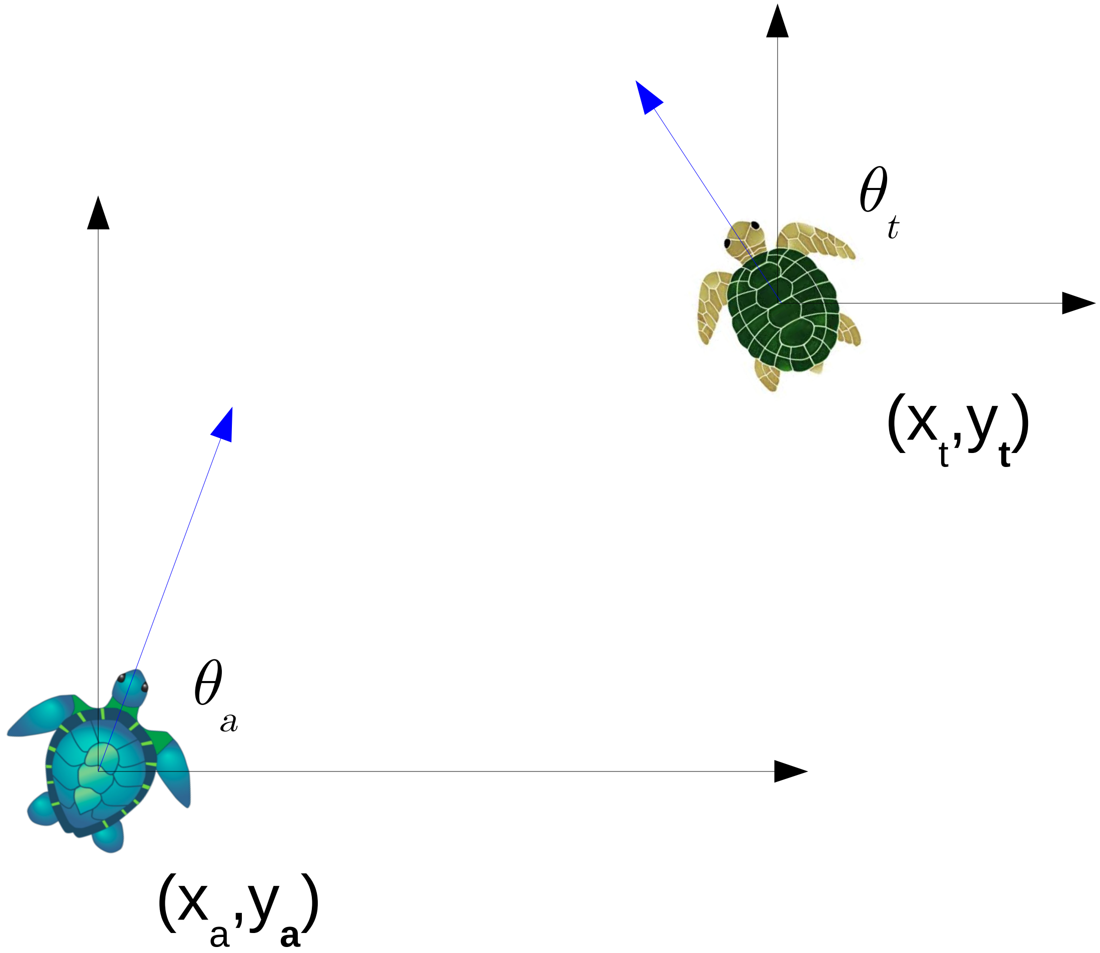
Hard / Complex

Implementing a random walk

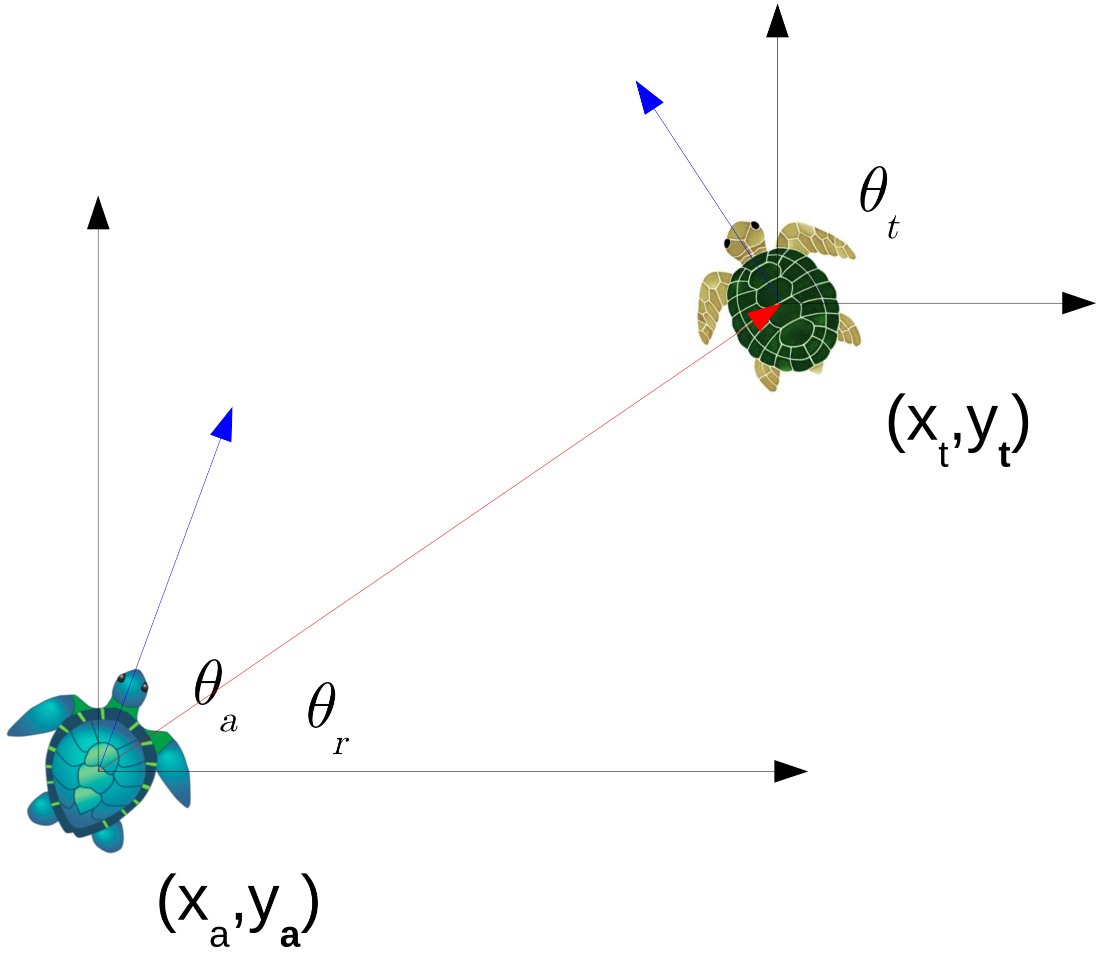
Implementing a following behavior

- What should the agent know about itself and the target?

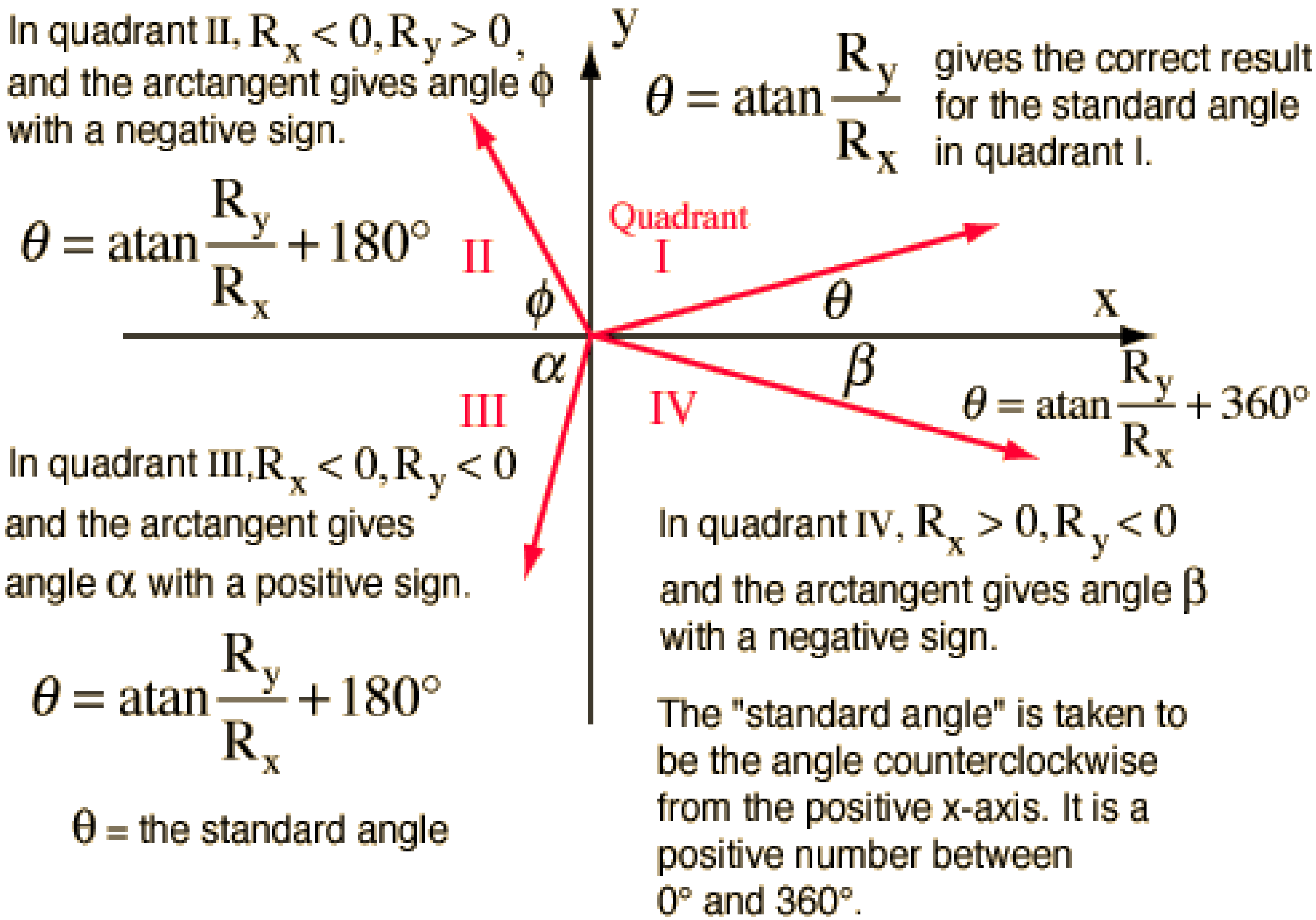
Following Behavior



Following Behavior

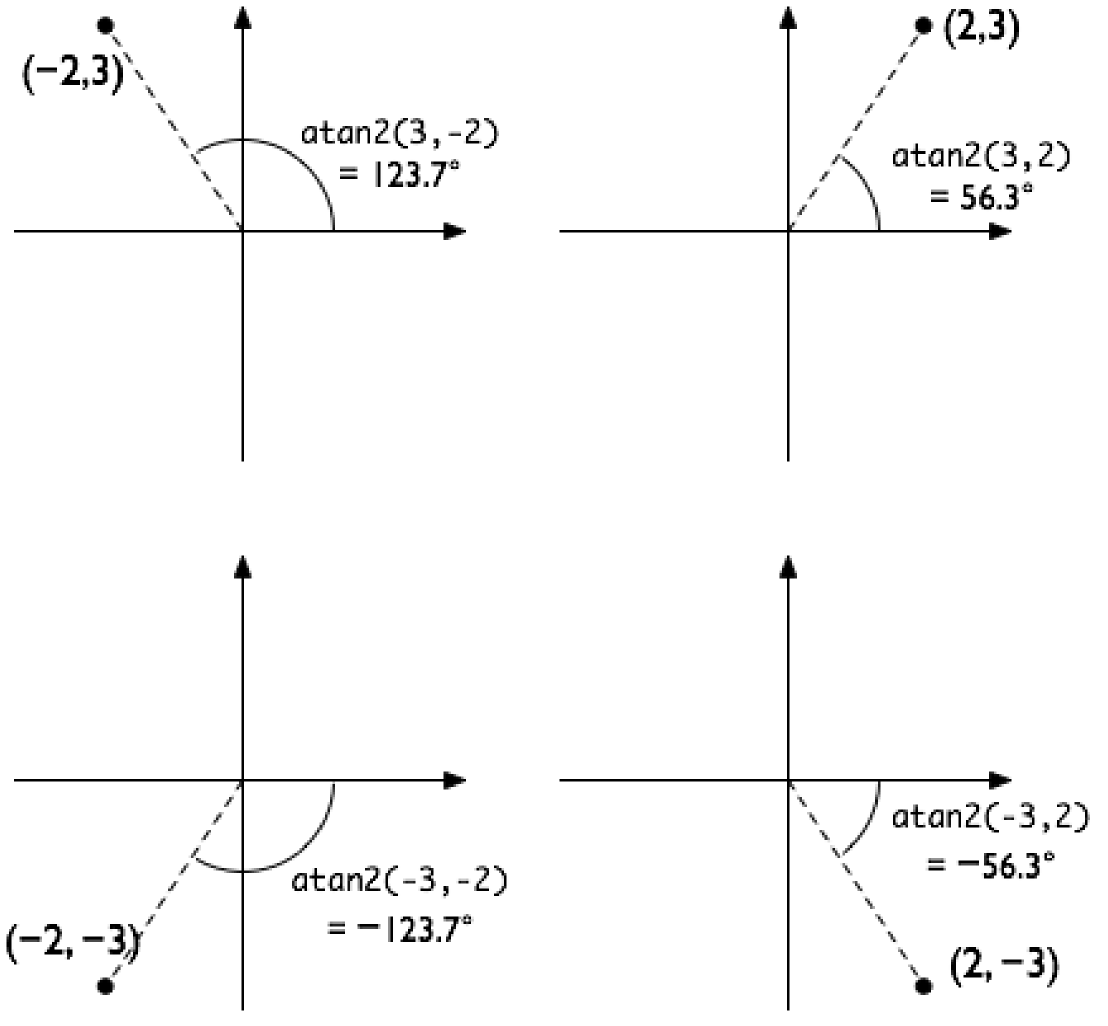


Computing the angle



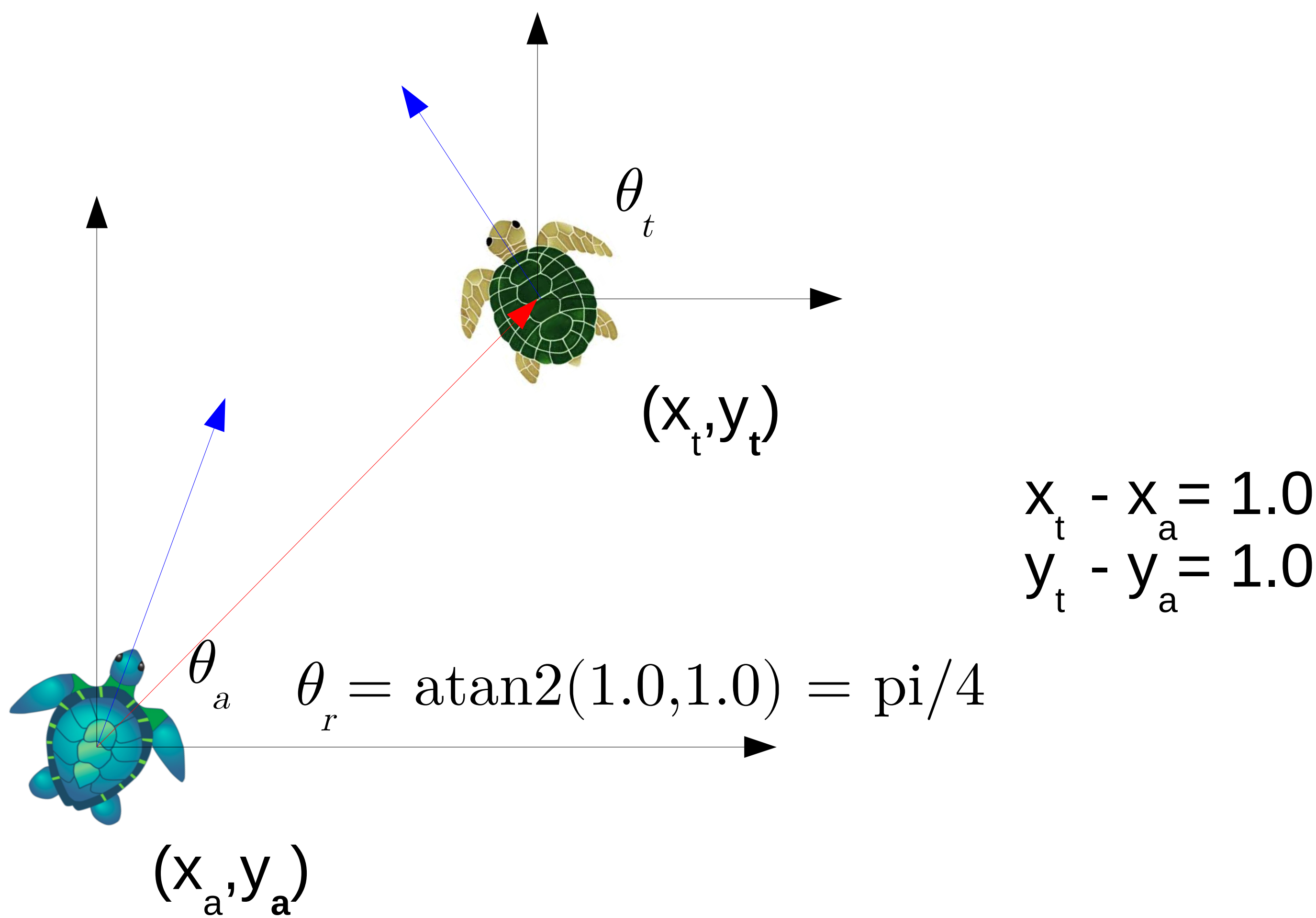
[http://gamedev.dmlive.co.nz/wp-content/uploads/2014/08/atnp4.gif]

Computing the angle

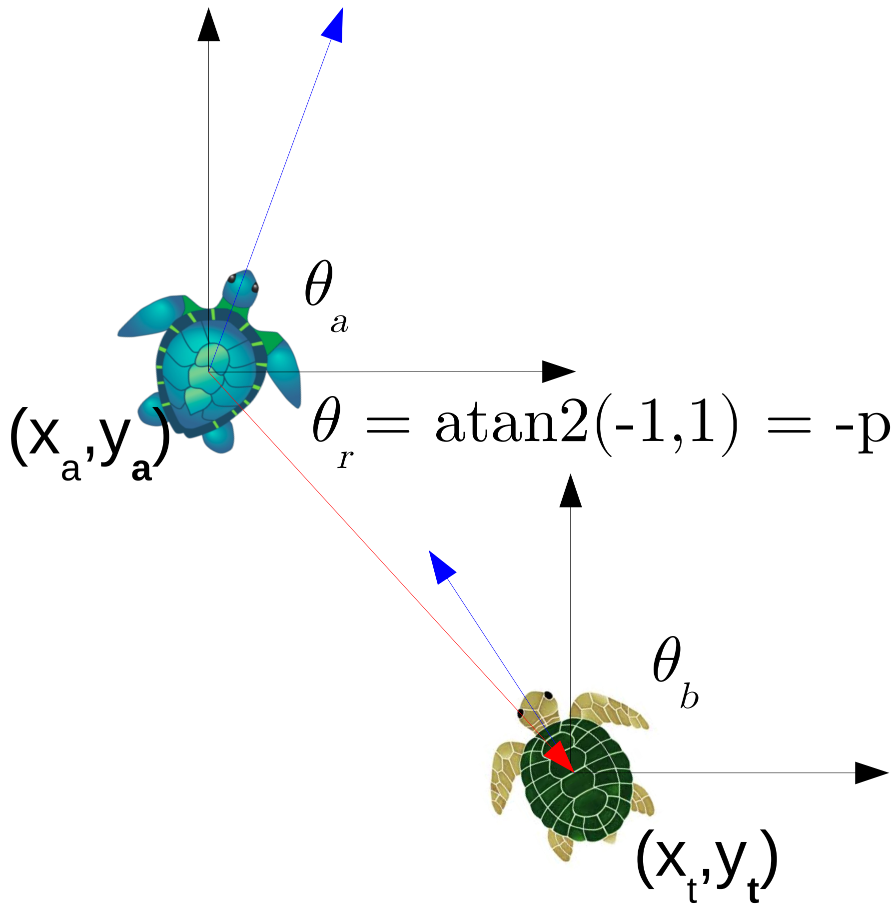


[http://i.stack.imgur.com/xQiWG.png]

Computing the relative angle

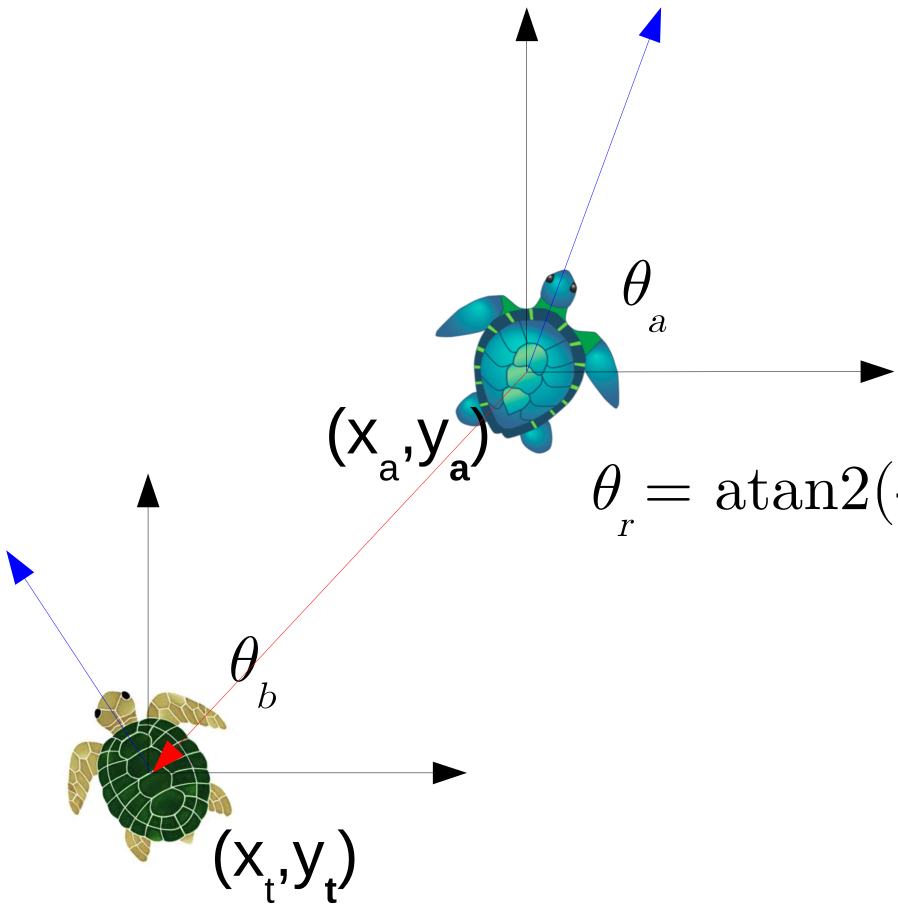


Computing the relative angle



$x_t - x_a = 1.0$
$y_t - y_a = -1.0$

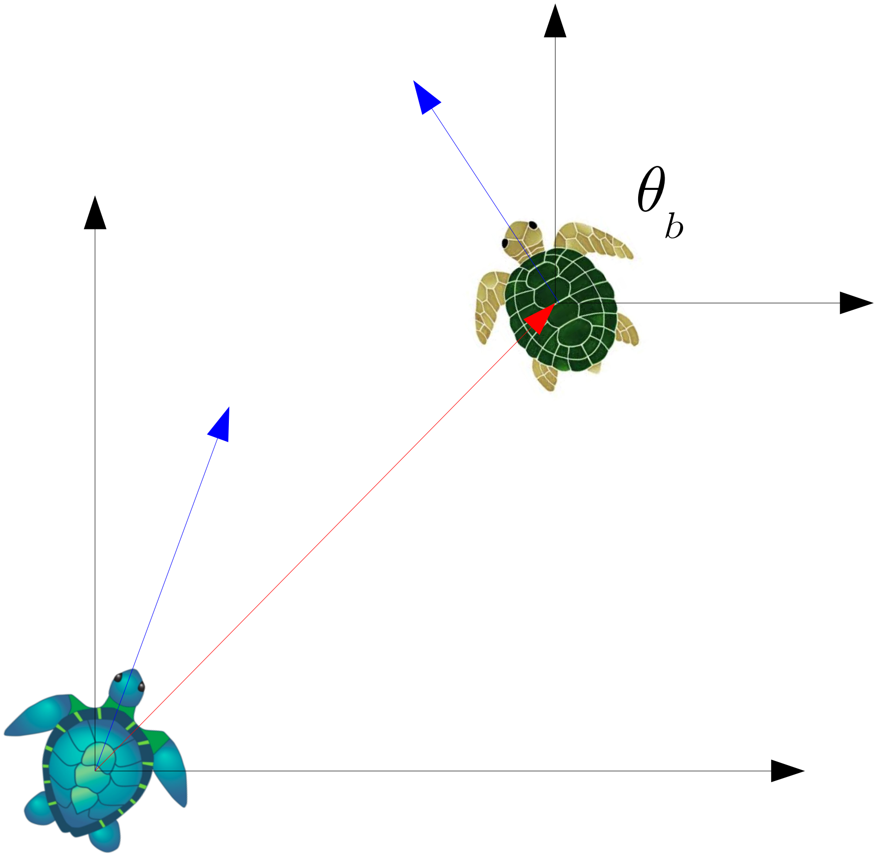
Computing the relative angle



$$\theta_r = \text{atan2(-1,-1)} = \text{-3*pi/4}$$

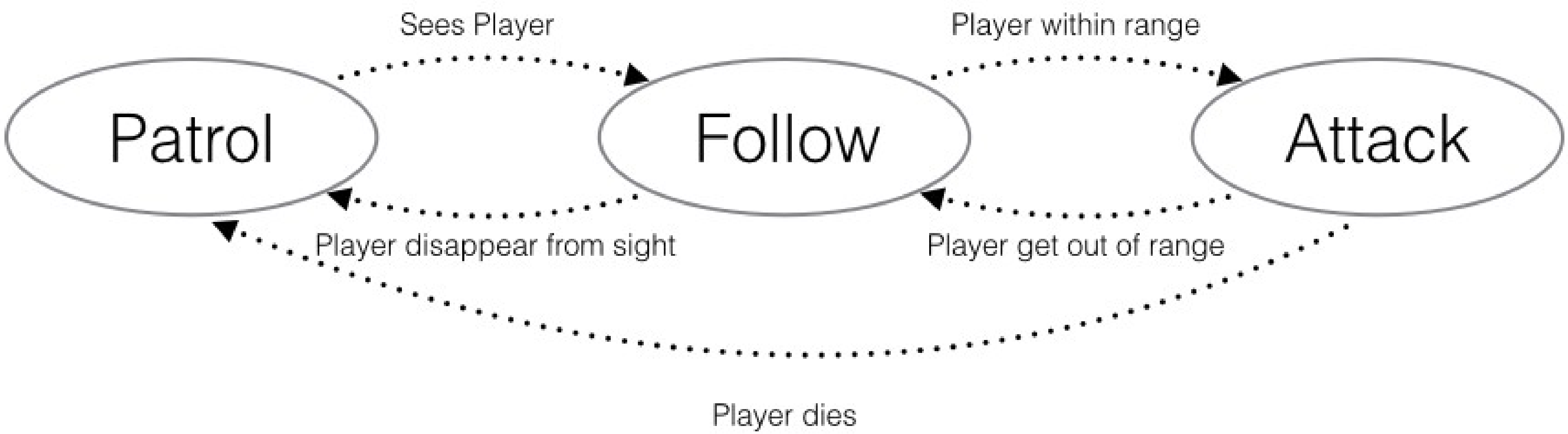
$x_t - x_a = -1.0$
$y_t - y_a = -1.0$

Following vs Avoid Behavior



How should we balance following the “fish” with avoiding the “shark”?

One solution: A finite state machine



One solution: A finite state machine

What would this look in code?

Any alternatives?

Homework 4: Prerequisites

- ROS tutorial on launch files (#8):

  http://wiki.ros.org/ROS/Tutorials/UsingRqtconsoleRoslaunch

- ROS tutorial on services (#14)
- Turtlesim video tutorial:

  http://wiki.ros.org/turtlesim/Tutorials#Video_Tutorials

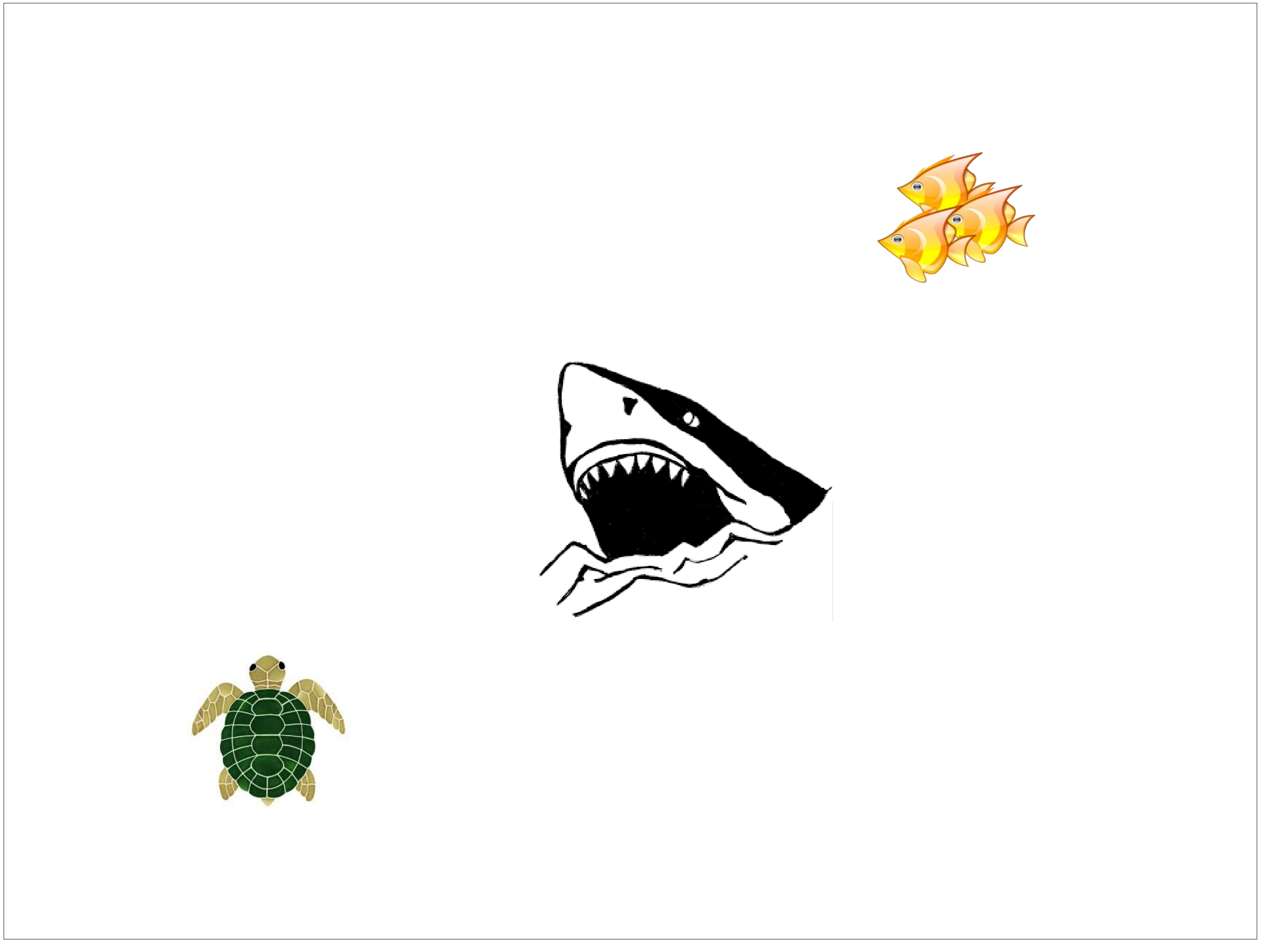
Homework 4: Part 1

- Create a new package called “cs378_<eid>_hw4”
- The package's dependencies should include the *turtlesim* package

Homework 4: Part 1

- For part 1, the task is to write a ROS node which adds a new turtle to the simulator
- After adding the new turtle, it should follow turtle1
- Include a launch file called "hw4_part1.launch" which should launch the simulator, your node and the keyboard teleop node to control turtle1

Homework 4: Part 2



Homework 4: Part 2

- For Part 2, you should implement three different ROS nodes, with each corresponding to the “turtle”, the “shark”, and the “fish”.
- Behavior:
  - “fish” should move randomly with low velocity
  - “shark” should follow the turtle
  - “turtle” should avoid the shark but try to get to the fish

Homework 4: Part 2

- For Part 2, you should implement three different ROS nodes, with each corresponding to the “turtle”, the “shark”, and the “fish”.
- Behavior:
  - “fish” should move randomly with low velocity
  - “shark” should follow the turtle
  - “turtle” should avoid the shark but try to get to the fish

Homework 4: Part 2

- A single launch titled “hw4_part2.launch” should launch all 3 nodes along with the turtlesim simulator
- 2 of the 3 nodes, the “fish”, and the “shark” should make a client call to the simulator to add a turtle that will represent them

Homework 4: Part 2

- Due Friday March 4th
- What to turn in:
  - A zip of your package as it is in the catkin_ws/src folder
  - A README file inside the package describing how you solved the problem and whether any extra credit was completed

THE END