Lessons Learned: Teaching a Robot

Juan F. Rueda
Central New Mexico Community College

Emery Sutherland
Southwestern Indian Polytechnic Institute

Swarm Robotics

Simple Robots x Swarm = Significant Impact

Programmed to respond to stimuli without having to wait for a centralized command.

Swarmathon

Funded by: NASA

Organized: University of New Mexico

Program robots for resource gathering in outer space

Low cost robots

Ant gatherer

Swarmie

.GPS

.Webcam

.Ultrasonics

.IMU

.Odometer

.Claw

Swarmie Default Software

Robotic Operating System (ROS)

Default Communication

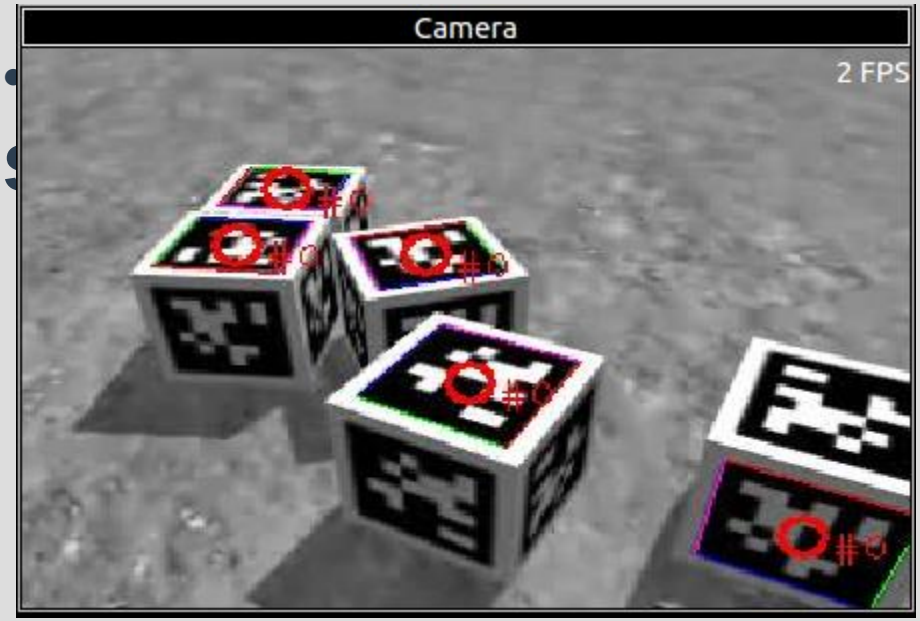
Subsumption Architecture

Strategies - Code

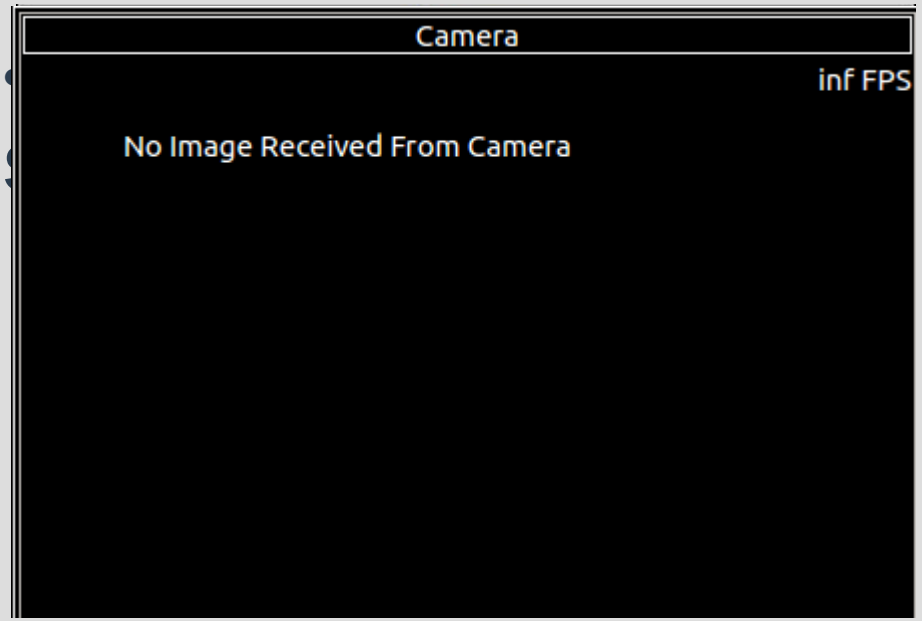
Simplify

Rewrote Drop Off and Pick Up to state machine

Strategies - Webcam



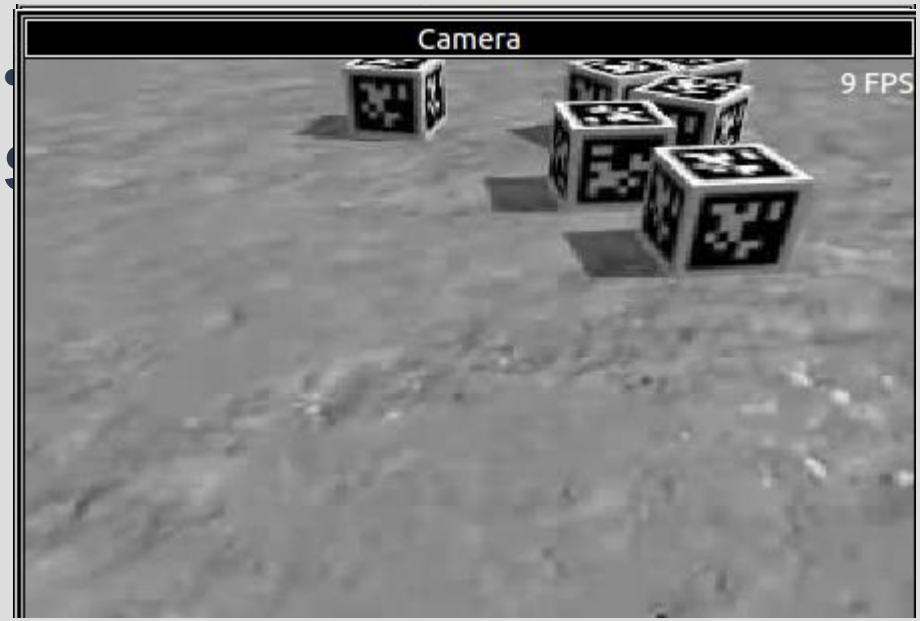
Strategies - Webcam



Strategies - Webcam

.Swarmie moved too fast

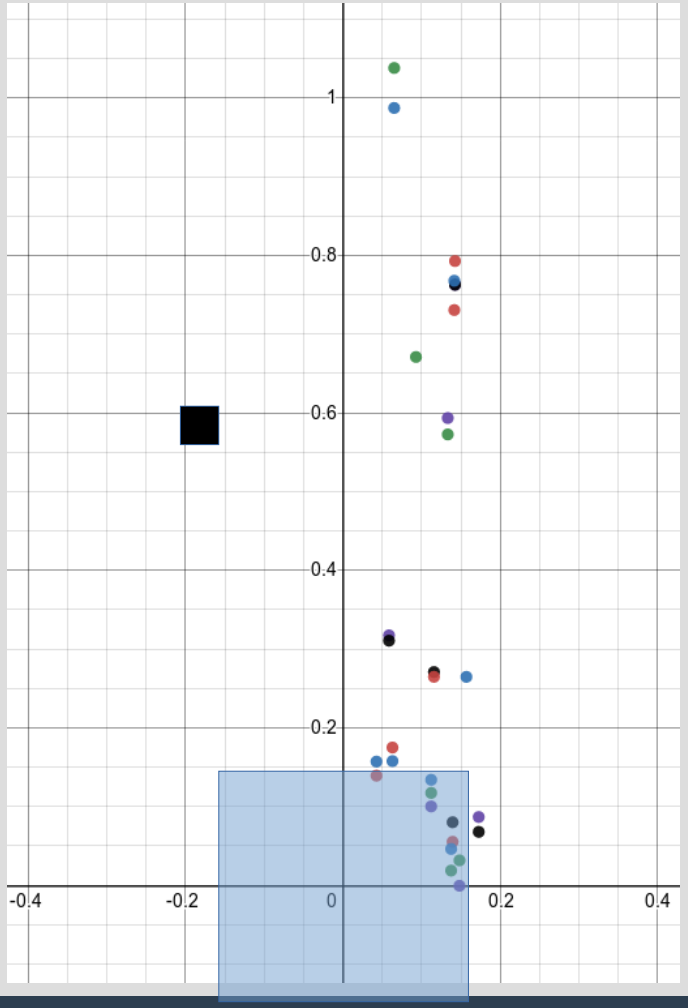
.Slowed rotation



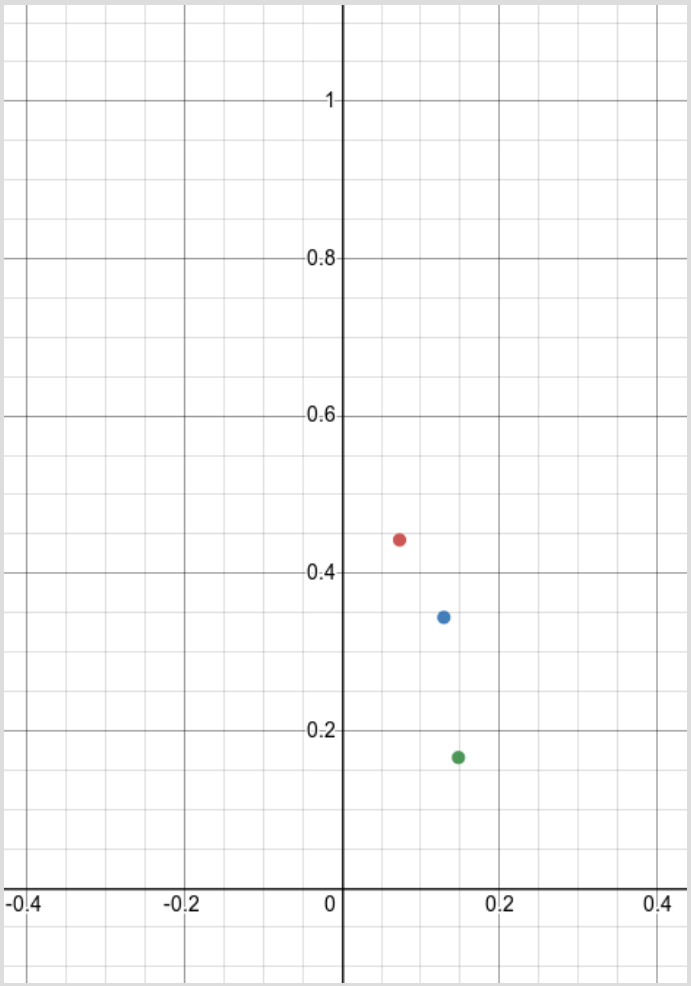
Understand the Limitations of the robot

Strategies - GPS

.Raw data

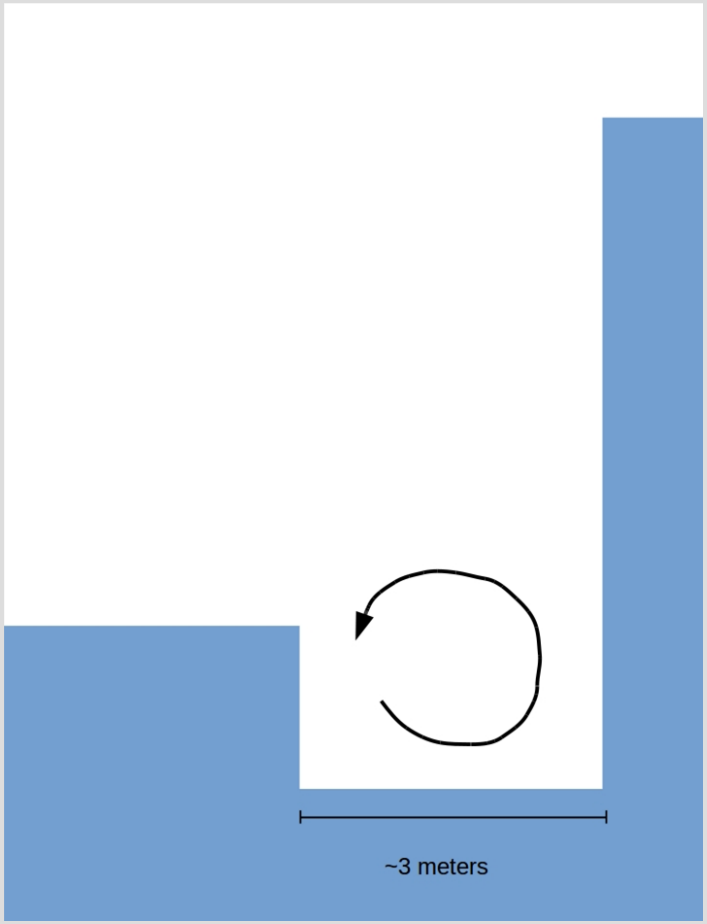


.Filtered data

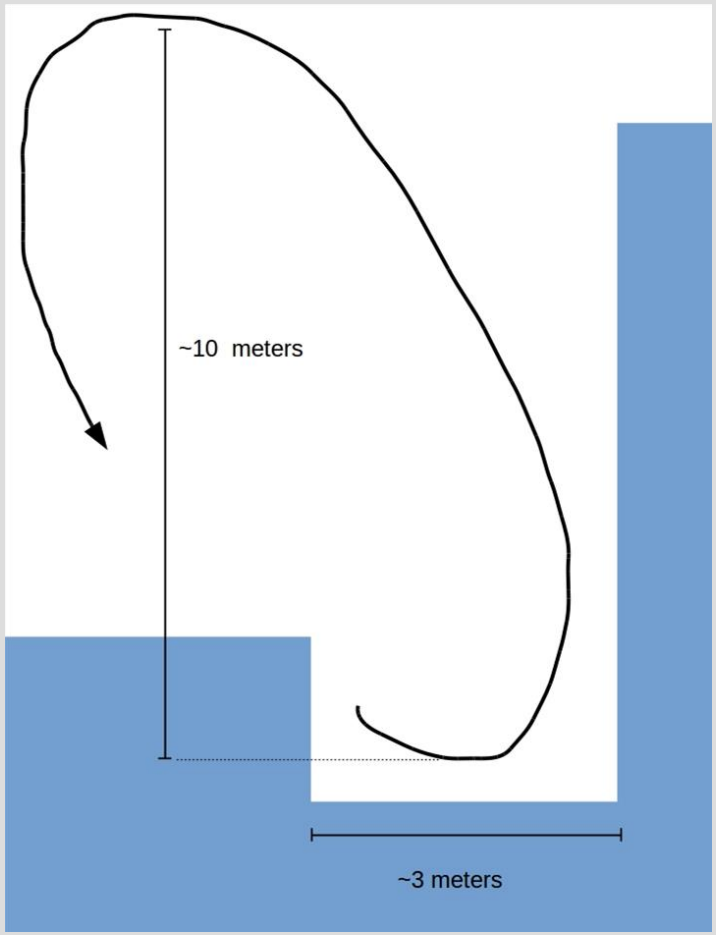


Strategies - GPS

.Test Run



.Same Test Run



Strategies - GPS

Not reliable for a small unit

Filter if possible

Or do not use

Strategies - Communication

- Previous use
- Conference Room
  - Depends on the order of signing on

.Swarmie A → 1

.Swarmie A → 2

.Swarmie B → 1

.Swarmie A → 3

.Swarmie B → 2

.Swarmie C → 1

Strategies - Communications

Default communications provided key

Called all swarmies to location

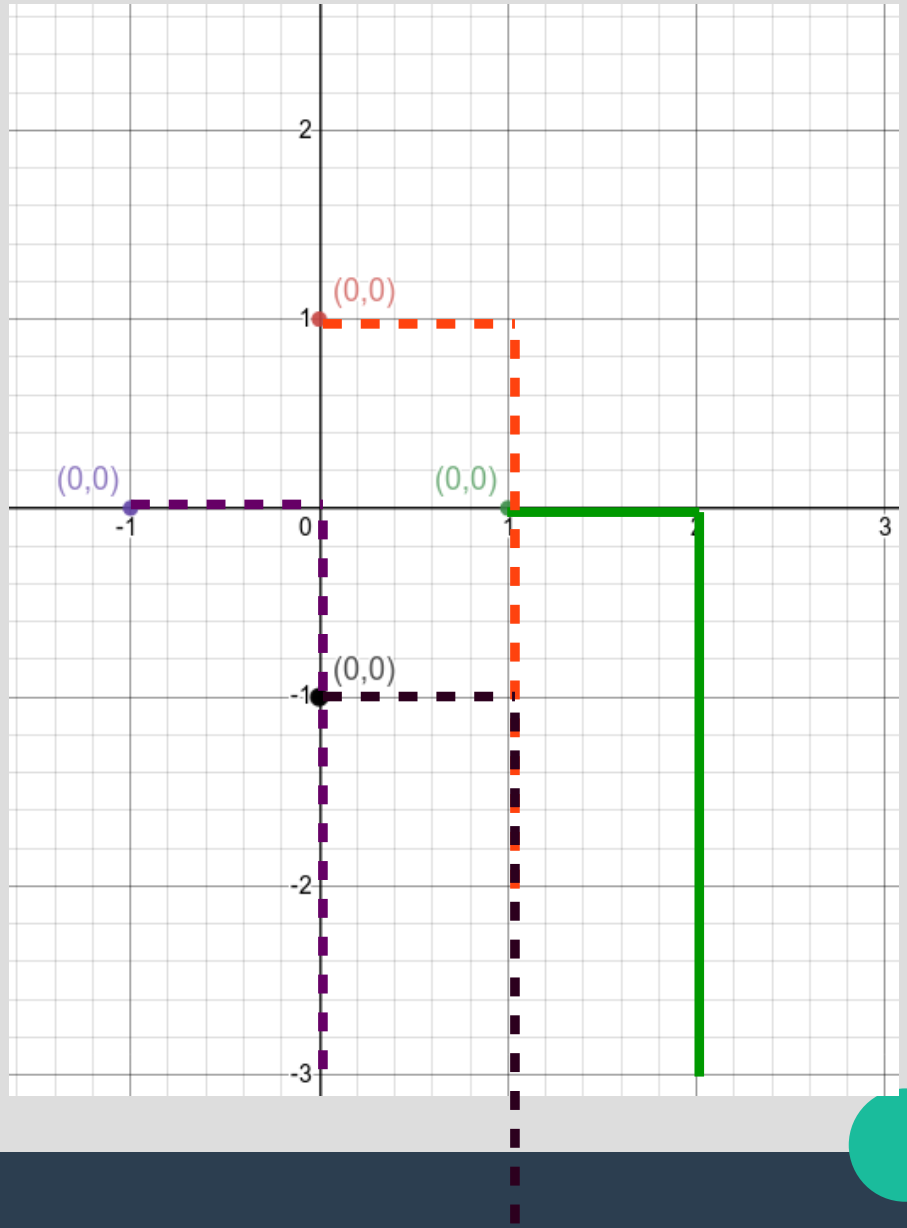
Strategies - Communications

- Only call when 2m away from home
- Only respond when within 10m from caller
- Only call when 2m away from cluster

Translating Coordinates

.Each swarmie has its own (0,0)

.Think for the Swarmie

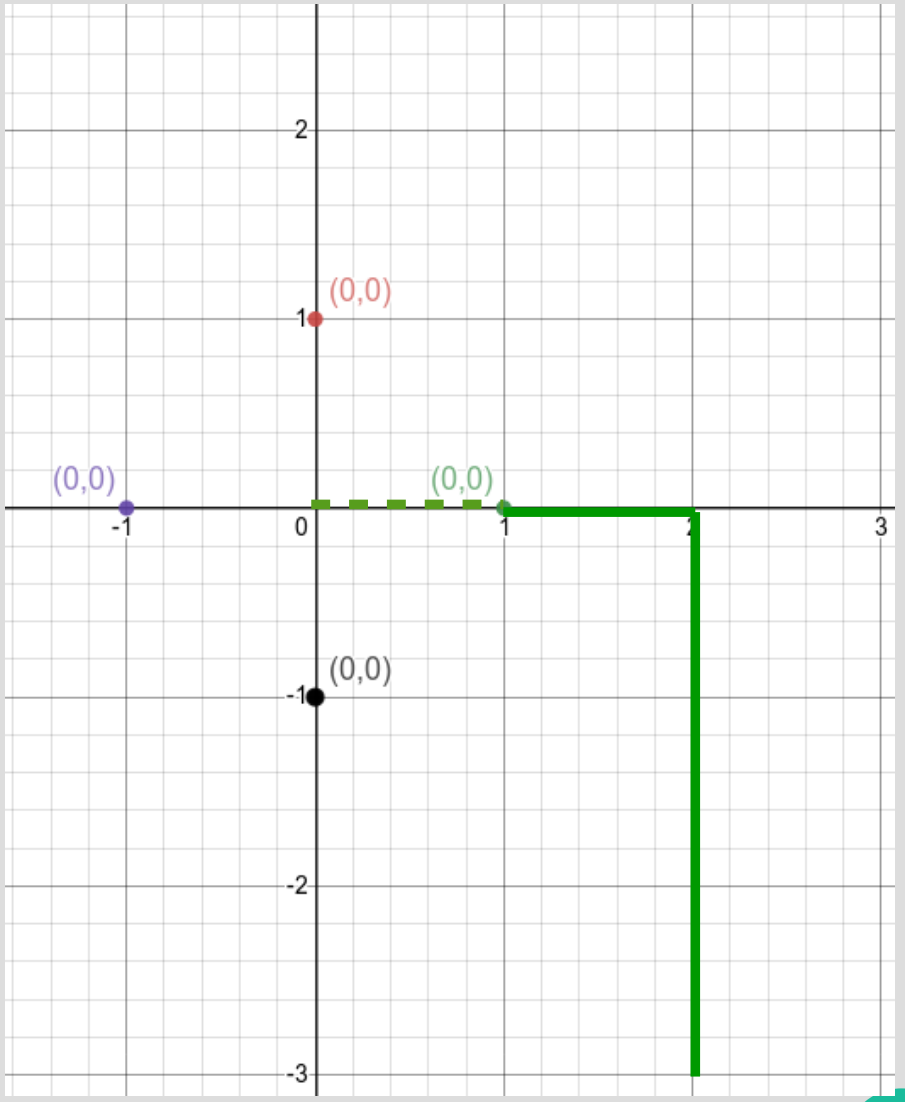


Translating Coordinates

.Green is (1,0) from home

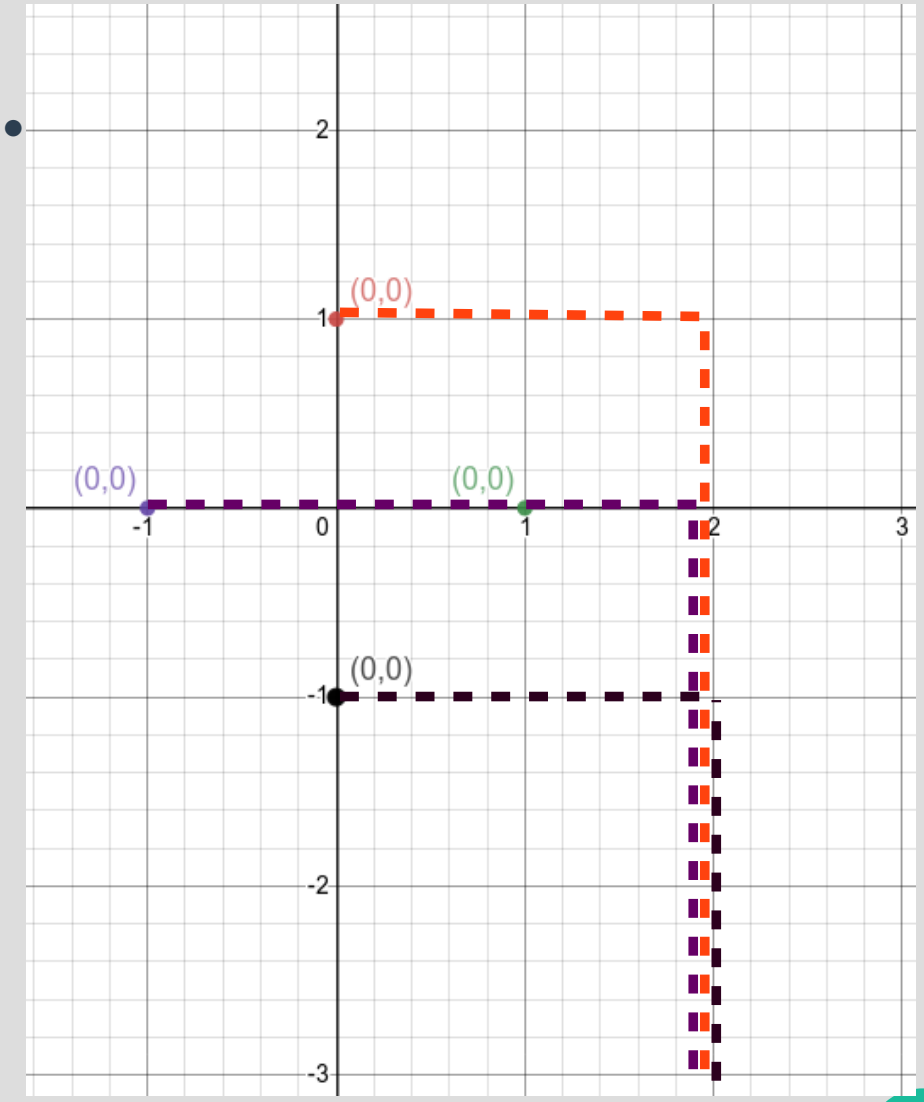
.Cluster for Green is (1,-3)

.Home to cluster (2,-3)



Translating Coordinates

- .Subtract swarmie to home
- .(2,-3) – (0,1) = (2,-4)
- .(2,-3) - (-1,0) = (3,-3)
- .(2,-3) – (0,-1) = (2,-2)



Strategies - Communications

Understanding the flow of logic enables strategic insertions of code for desired behaviors

Summary

- GPS – filter or do not use
- Webcam – slowed rotation
- Ultrasonics – subject to wind
- IMU – made accelerometer inert
- Odometer – skid steering
- Claw – tinkered with timing

Future Goals

- Mapping – based on probability
- More Communication
- Heartbeat
- Role assignment
- Process more on arduino

Final Thoughts

Working on existing code a good experience

Next move, build something simpler.