

# Learning how to talk robot.

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# What is the most important language in robotics?

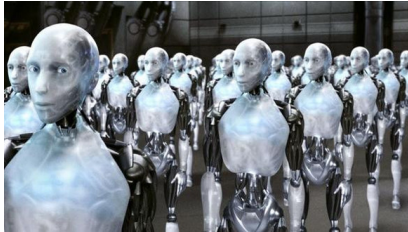
- C++?
- Java?
- Python?
- Lisp?
- Assembly?

# What is the most important language in robotics?



## English!

# So what is the most important skills of a roboticist?



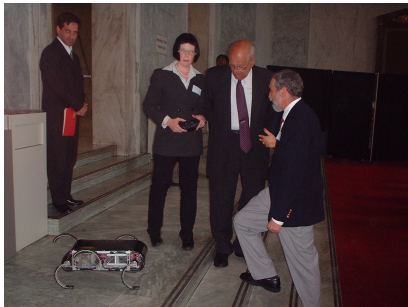
- Mechanical Engineering?
- Electrical Engineering?
- Computer Science?
- Management?
- Protecting humans from the robot forthcoming robot apocalypse?

# So what is the most important skills of a roboticist?



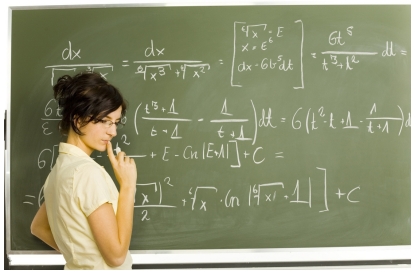
- Asking the right question in the correct way.
- Finding and reading about a solution.
- Not being afraid to give it a shot.

# What I've learned.



- Words have **specific** meaning. Learn the meaning.
- With these words you can ask (google) better questions.
- These words encode scientific papers that you can read.
- You start to sound like a pro. People will respect your opinion.

# What I've learned... about math



- **Learn to skim scientific papers.**
- Math is just another language. Learn the symbols to unlock the meaning.
- Remember, you don't have to do the math (proof, derivation, etc), you just need to translate it to code or English.

# And another thing!



- **DO NOT PANIC**
- **RTFM** READ THE FRAKING MANUAL. Really read it. Twice.
- Break problems/solutions/papers down to the individual words, and work back up.
- Ask for help.



I brought my friend tapsterbot to help us.



- Tapsterbot is a free and open-source parallel robot.
- These types of robots are used for sorting tasks.
- Tapsterbot is used to automatically test smart phones.
- Cheap and easy to build. Just an arduino and a few servos.

# All Robots Have Three Basic Parts

- **Sensors**

- Sense the world around the robot.
- Just like your eyes, ears, nose, and skin.

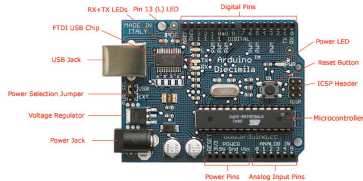
- **Actuators**

- Move the robot around. Motors, gears, levers, cams, etc.
- Just like your muscles and bones.

- **Controllers**

- Take input from sensors, reason about it, and decide what to do.
- Just like your brain.

# Let's look at tapsterbot



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- **Sensors**

- Eventually a camera on top.
- Each servo has an encoder.

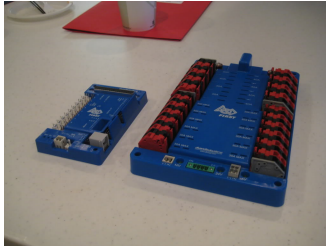
- **Actuators**

- Hobby servos (servos have built in sensors).

- **Controllers**

- Arduino connected to my computer.

# Other things robots usually have...



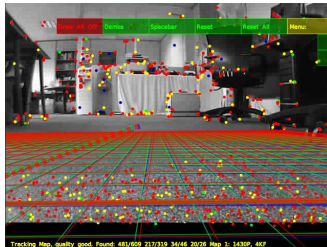
- **Power Distribution**
  - Different parts take different voltages, current but come from one battery.
- **Digital IO**
  - This board usually translates (talks) in different digital and analog formats.
- **Communications**
  - How do we control the robot remotely. Usually wifi.
- On tapsterbot the Arduino does most of this stuff.

# Common Sensors



- **Encoders** - count how far something has moved (wheels).
- **Cameras** - see the world, stereo cameras give depth.
- **LIDAR** - Laser RADAR high fidelity 2D/3D maps.
- **Limit Switch** - Just a switch. Off or On.
- **Accelerometer** - Measures motion, can find gravity (down).
- **Gyroscope** - Measure rotation.
- **Magnetometers** - Can find North, metal stuff.

# Sensor Concepts



- **SLAM** - imultaneous localization and mapping. Where am I?
- **Pose Tracking** - Figure out x,y,z location and orientation.
- **Sample Rate** - How fast? Measured in hertz (Hz).
- **State** - What is the current pose of the robot.
- **Format** - What language does the sensor talk.
- **Calibration** - Does the sensor value match the real world.

# Types of Actuators



- **Things that look like motors**

- **Motor** - A regular motor, might add an encoder.
- **Stepper** - A motor with an encoder that let's you do precise rotation.
- **Servo** - A motor with an encoder that turns a set number of degrees.

- **Linear Actuator** - Motor that moves in a straight line.

- **Pneumatics** - Linear actuators that move with air.
- **Hydraulics** - Linear actuators that move with oil or water.

# The End – GO HAVE FUN!