CSCI 1108
Introduction to Experimental Robotics

Intro to the course format

Robotics Overview

My video collection:

Asimo https://www.youtube.com/watch?v=OvgLJTpoVc0

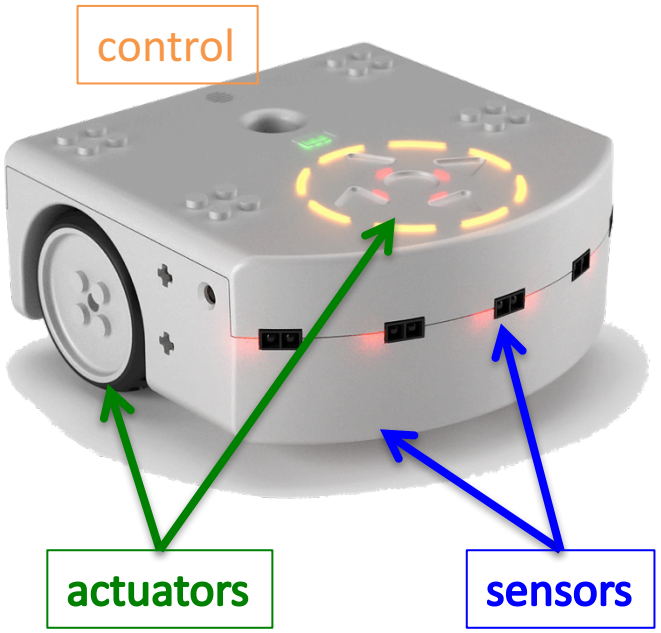
Boston Dynamic Big Dog: https://www.youtube.com/watch?v=QDl6_V697mk

Starfish https://www.youtube.com/watch?v=ehno85yI-sA

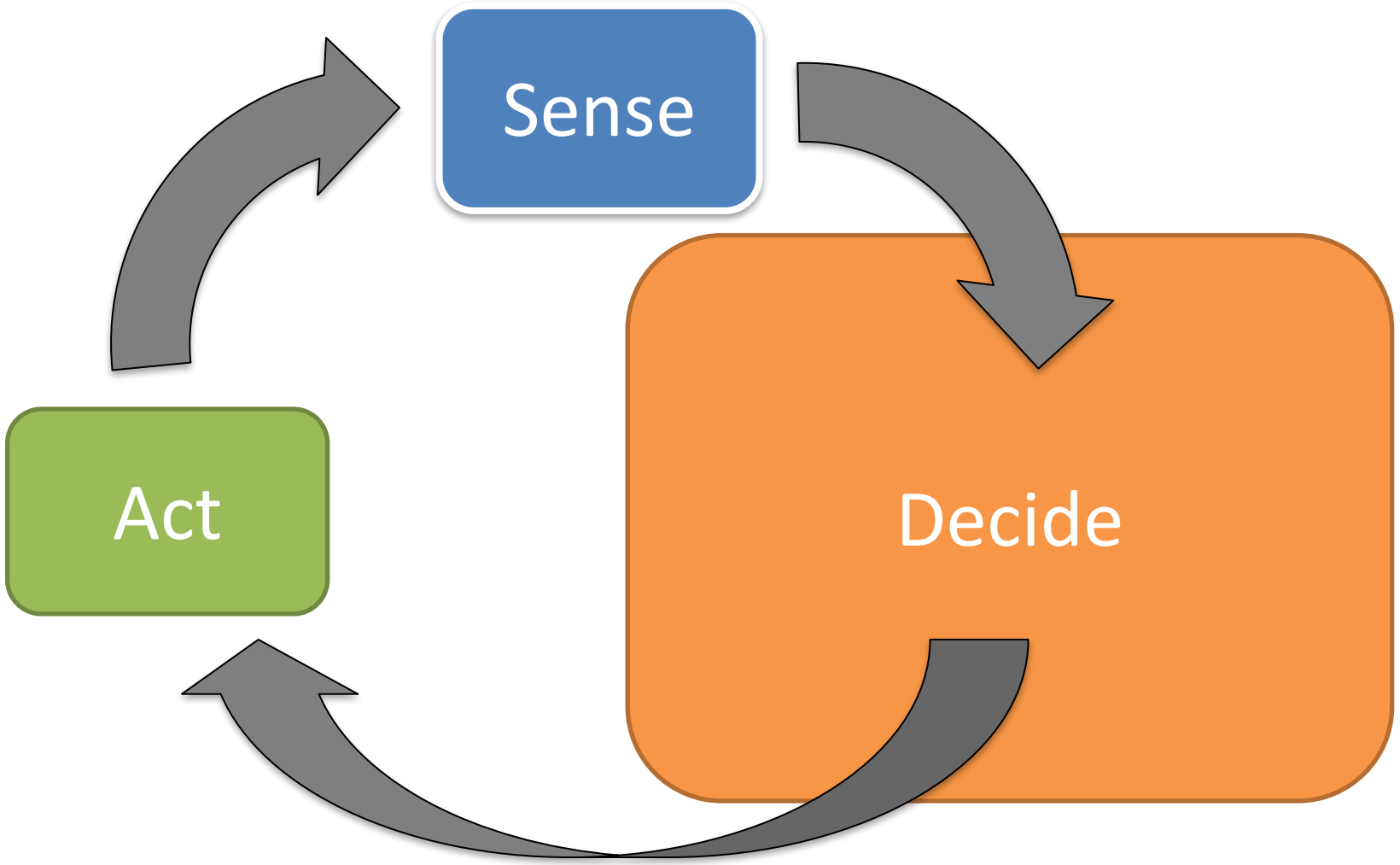
Thrun
https://www.ted.com/talks/sebastian_thrun_google_s_driverless_car?language=en

Anatomy of a Robot

- Thymio II robot
  - https://aseba.wikidot.com
- Components:
  - Sensors
  - Actuators
  - Controller



The Sense-Decide-Act Framework

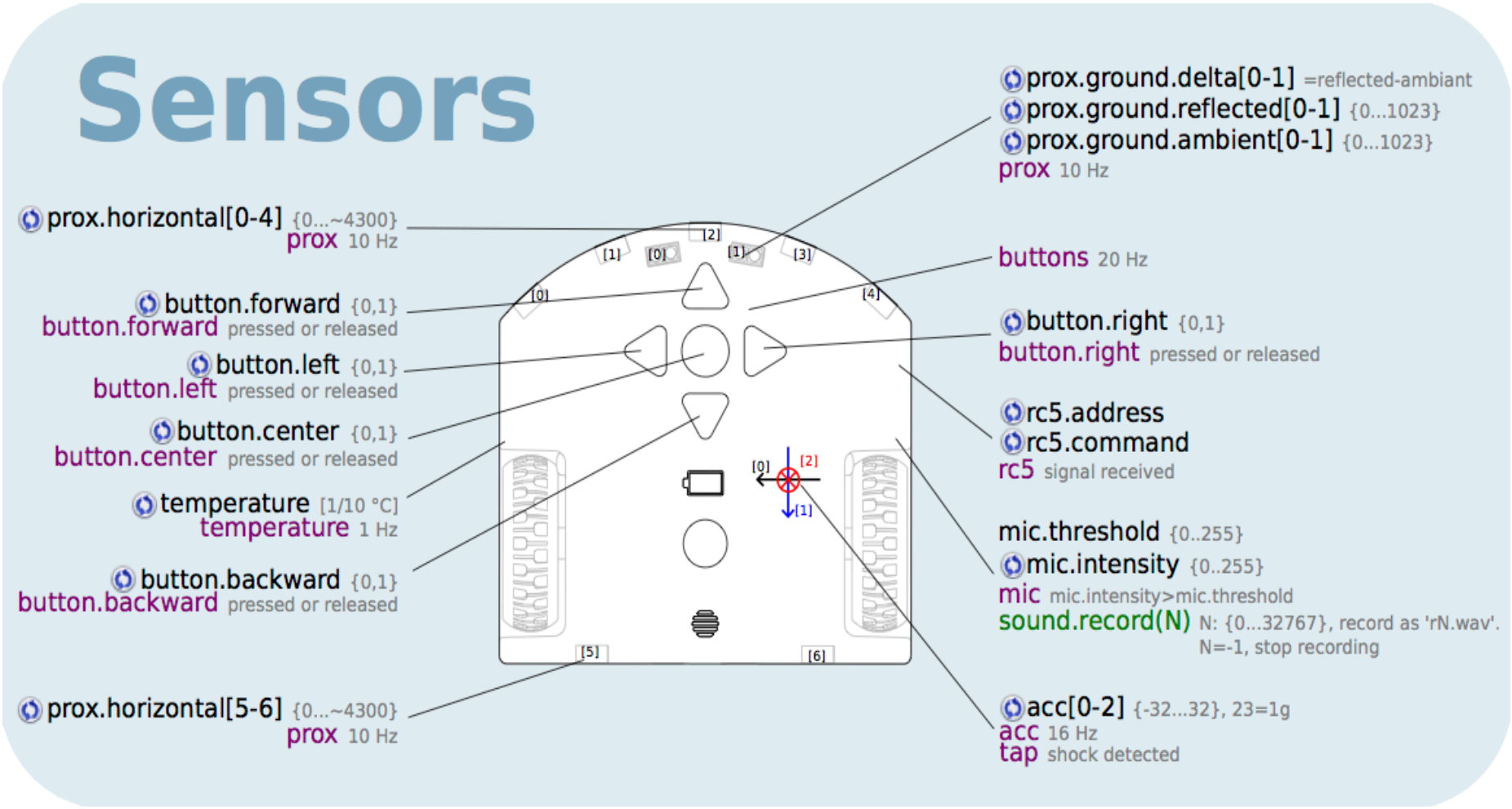


Controller:

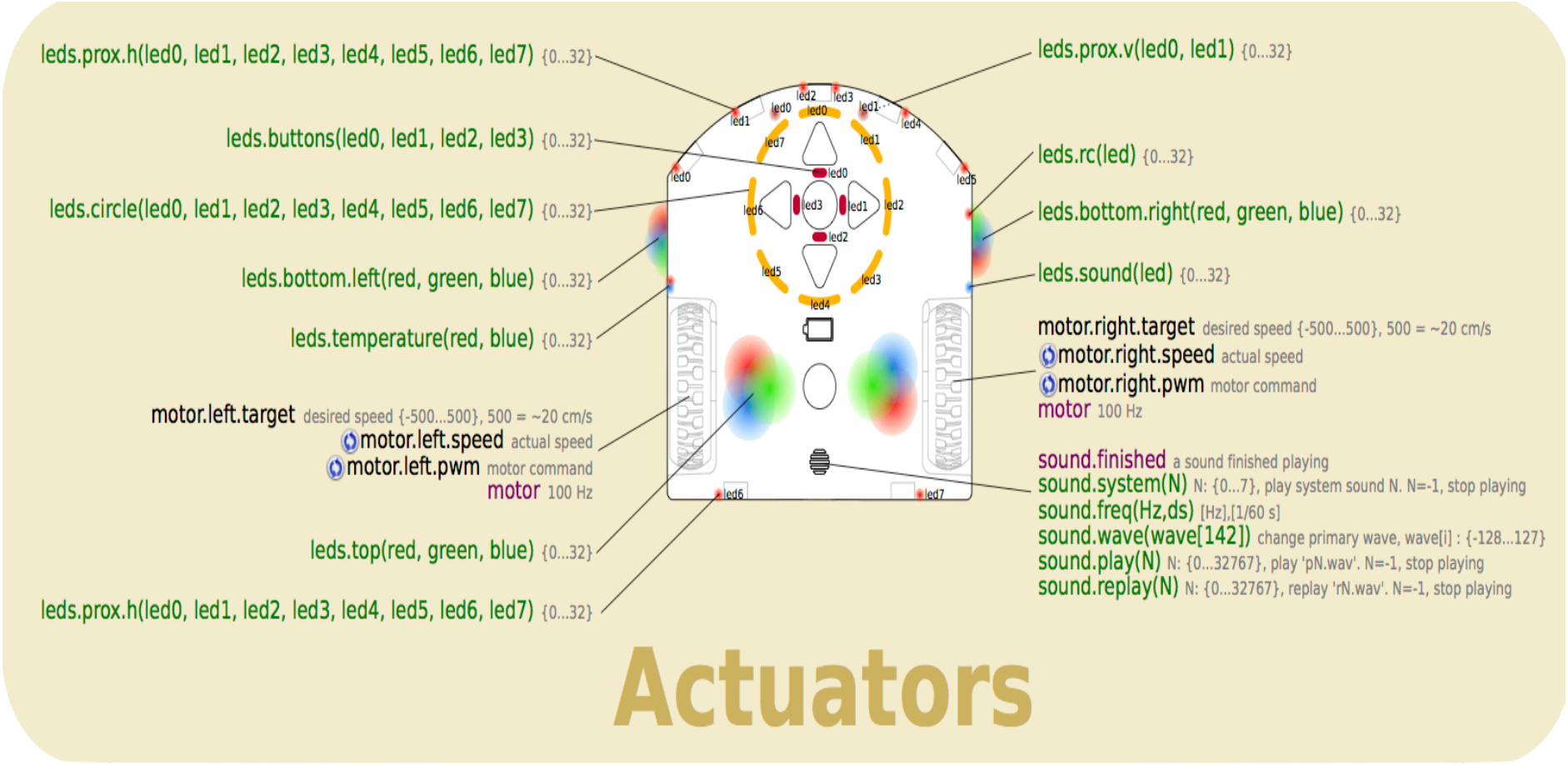
A controller decides what action to take based on input from sensors. Our task is to write a control program for the Thymio II.

This is done in a special programming language called ASEBA

Sensors


Sensors
prox.horizontal[0-4] {0...~4300}
prox 10 Hz
button.forward {0,1}
button.forward pressed or released
button.left {0,1}
button.left pressed or released
button.center {0,1}
button.center pressed or released
temperature [1/10 °C]
temperature 1 Hz
button.backward {0,1}
button.backward pressed or released
prox.horizontal[5-6] {0...~4300}
prox 10 Hz
prox.ground.delta[0-1] =reflected-ambiant
prox.ground.reflected[0-1] {0...1023}
prox.ground.ambient[0-1] {0...1023}
prox 10 Hz
buttons 20 Hz
button.right {0,1}
button.right pressed or released
rc5.address
rc5.command
rc5 signal received
mic.threshold {0..255}
mic.intensity {0..255}
mic mic.intensity>mic.threshold
sound.record(N) N: {0...32767}, record as 'rN.wav'.
N=-1, stop recording
acc[0-2] {-32...32}, 23=1g
acc 16 Hz
tap shock detected

Actuators

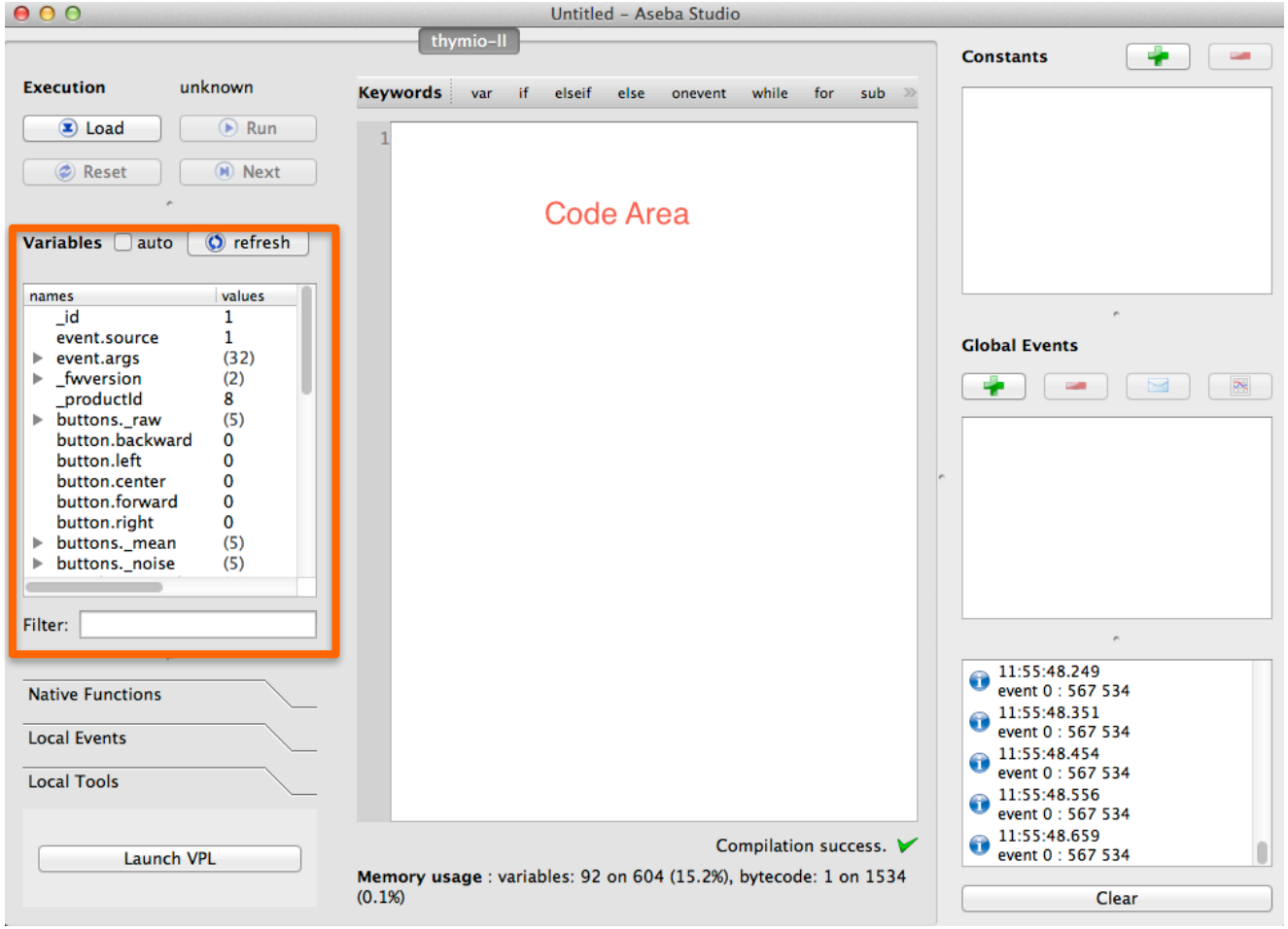

leds.prox.h(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}
leds.buttons(led0, led1, led2, led3) {0...32}
leds.circle(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}
leds.bottom.left(red, green, blue) {0...32}
leds.temperature(red, blue) {0...32}
motor.left.target desired speed {-500...500}, 500 = ~20 cm/s
motor.left.speed actual speed
motor.left.pwm motor command
motor 100 Hz
leds.top(red, green, blue) {0...32}
leds.prox.h(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}
leds.prox.v(led0, led1) {0...32}
leds.rc(led) {0...32}
leds.bottom.right(red, green, blue) {0...32}
leds.sound(led) {0...32}
motor.right.target desired speed {-500...500}, 500 = ~20 cm/s
motor.right.speed actual speed
motor.right.pwm motor command
motor 100 Hz
sound.finished a sound finished playing
sound.system(N) N: {0...7}, play system sound N. N=-1, stop playing
sound.freq(Hz,ds) [Hz],[1/60 s]
sound.wave(wave[142]) change primary wave, wave[i] : {-128...127}
sound.play(N) N: {0...32767}, play 'pN.wav'. N=-1, stop playing
sound.replay(N) N: {0...32767}, replay 'rN.wav'. N=-1, stop playing
Actuators

A Sample Program

```
var speed = 100


motor.left.target = 0
motor.right.target = 0


onevent button.forward
  motor.left.target = speed
  motor.right.target = speed

onevent button.backward
  motor.left.target = 0
  motor.right.target = 0

onevent button.left
  motor.left.target = -speed
  motor.right.target = speed

onevent button.right
  motor.left.target = speed
  motor.right.target = -speed
```

Key Idea: Actuators are controlled by setting variables that represent them

Aseba Studio



https://aseba.wikidot.com/en:thymioapi

Classic Robotics themes

Actuators and movements:

Kinematics –basic movement geometry

Differential movements - change in position (Jacobian)

Dynamics –movement mechanics with forces

Sensor and object recognition:

Computer Vision

Localization:

Bayes (Kalman) filtering, SLAM, etc

Motion planning

A*, tangent bug, obstacle avoidance, etc

Objective of this course

- To learn about robotics
- To learn about computing in the real world
- To learn about working in a team
- To learn about project management
- …
- and to have fun

Format:

- The course is to be highly interactive
- Some lectures in the first half of the course
- Tutorials with guided exercises
- Tutorial time and lecture time for project work

See details on web page:

https://projects.cs.dal.ca/hallab/CSCI1108_(2016)

Working Together