

When Java™ meets Lego™



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Agenda

- Lego Mindstorm Overview
- LeJOS Java Based Firmware for Lego
- Demo

Put a Java™ Brain into
your Mindstorms Lego™ Robot
(and show some cool demos)

What is Lego Mindstorms ?



Lego Mindstorms



Many others

- Compass
- Accelerometer
- RFID
- Anything (provided you can solder)

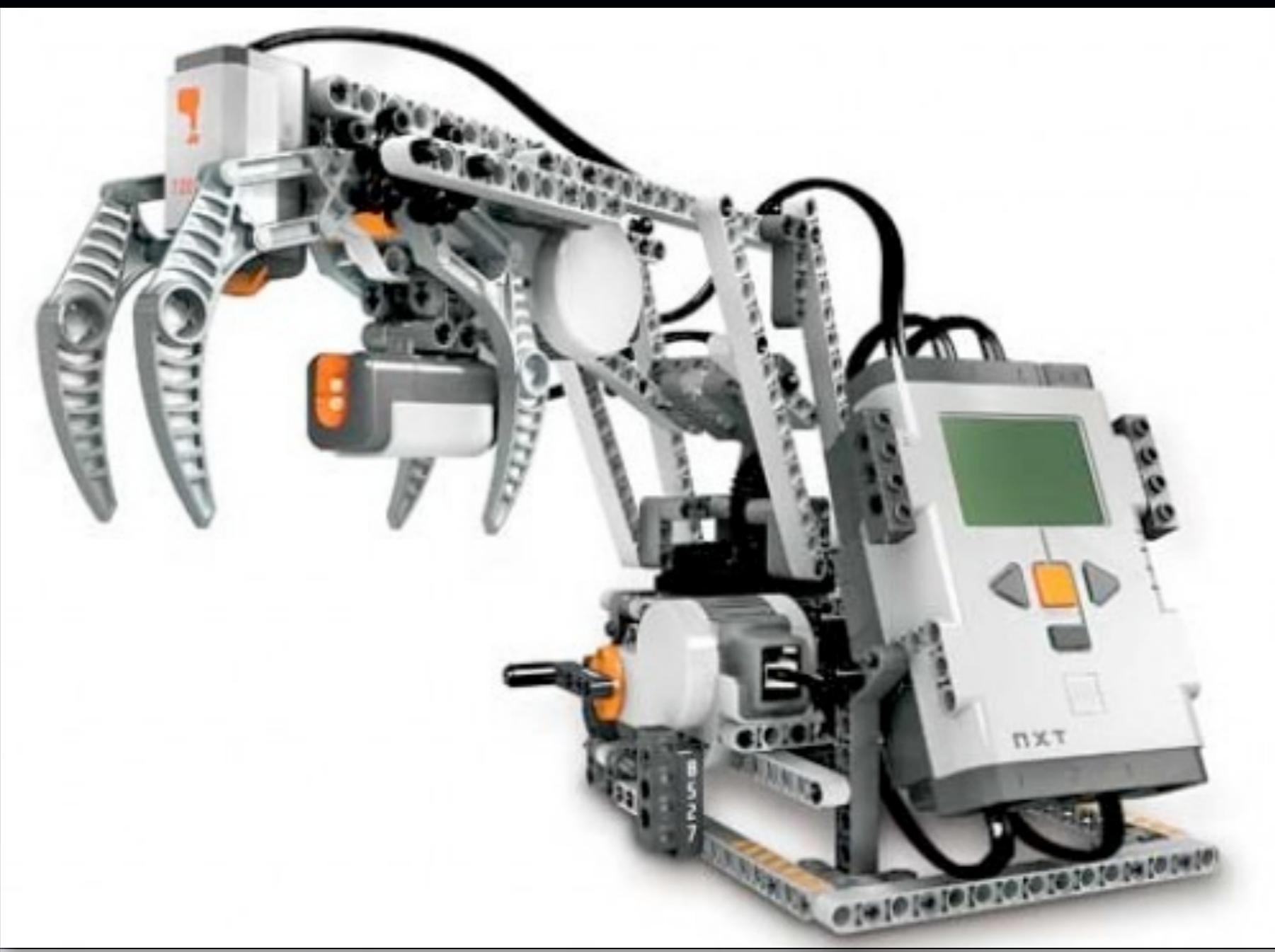
Simple Robots



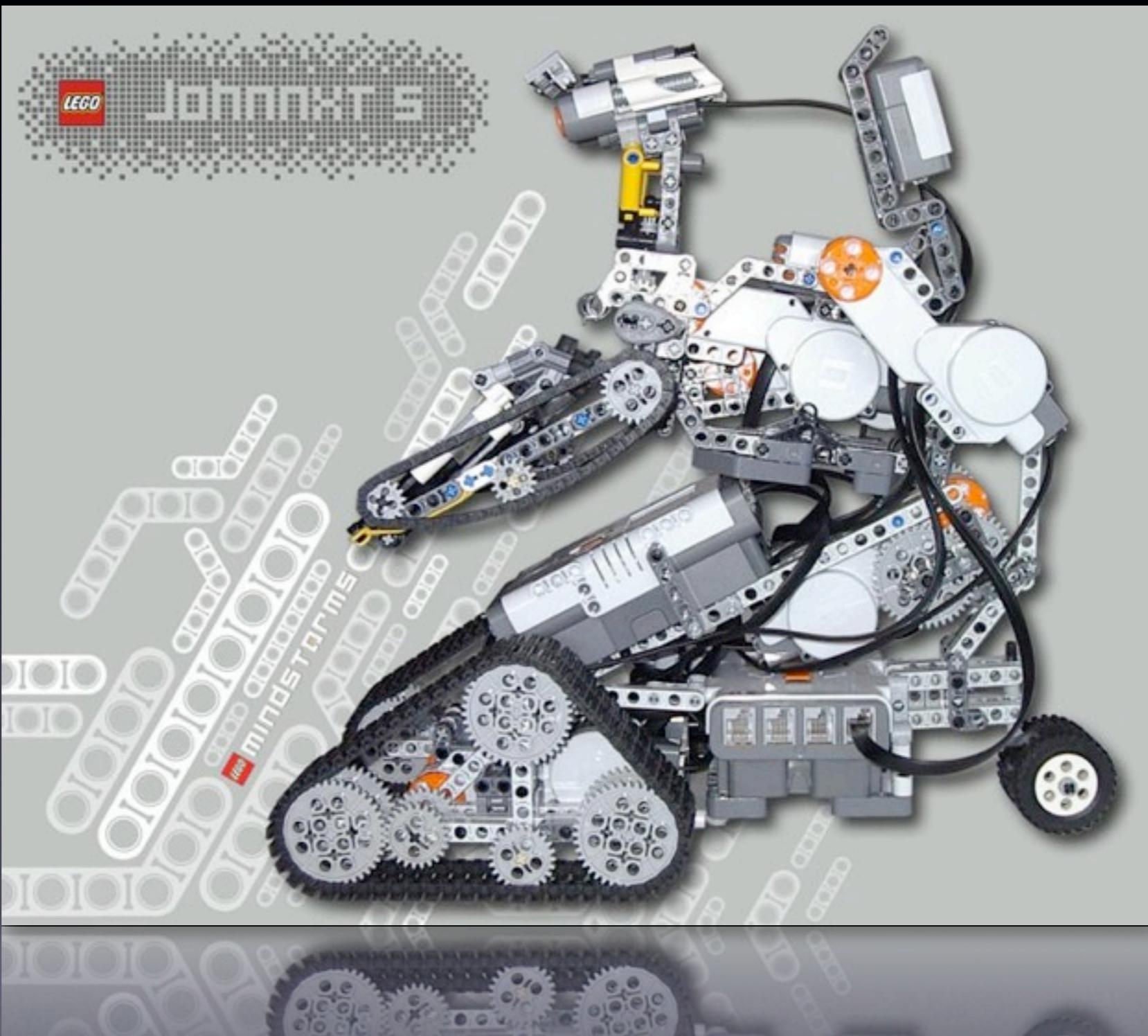
Simple Robots



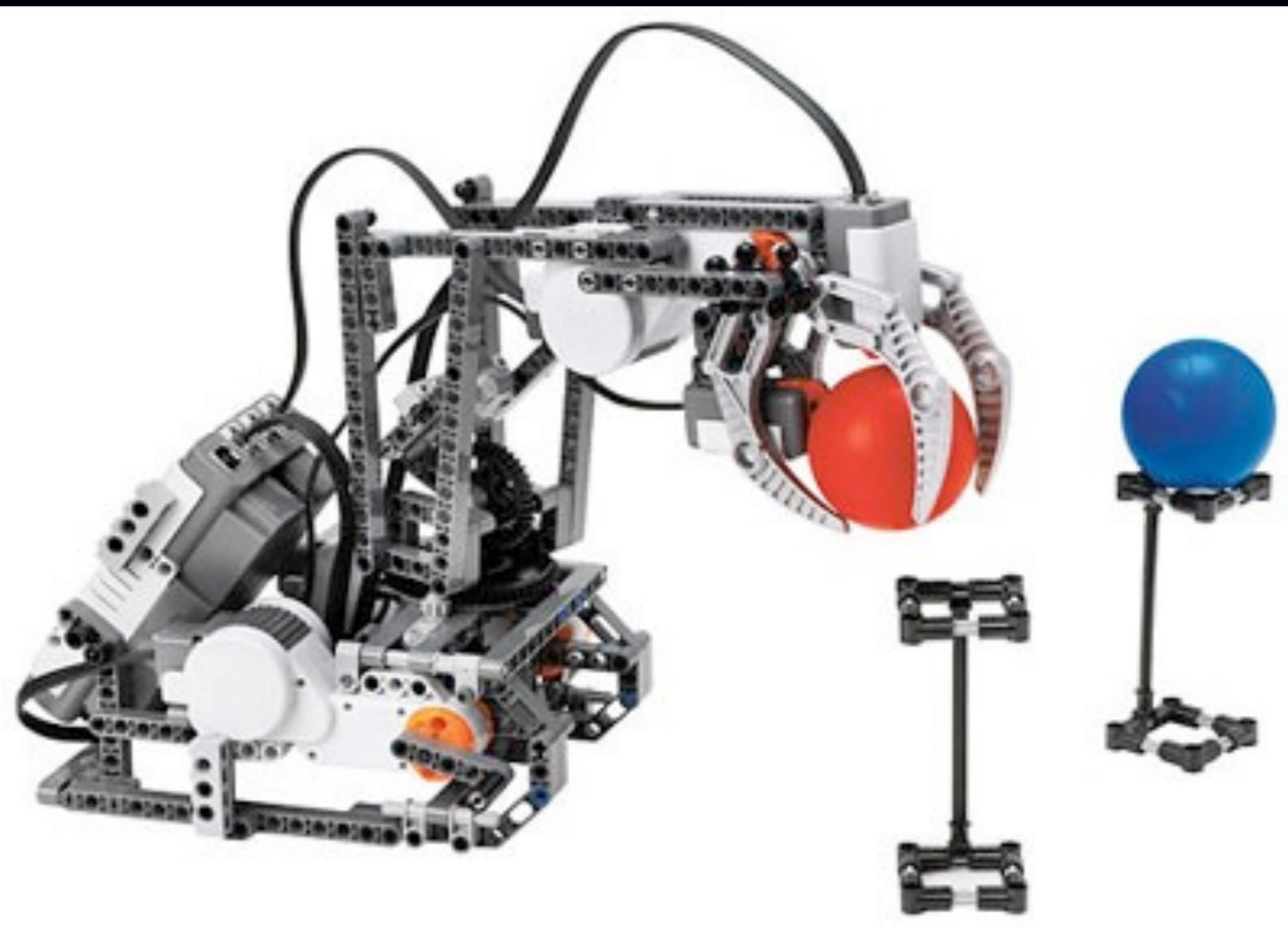
Simple Robots



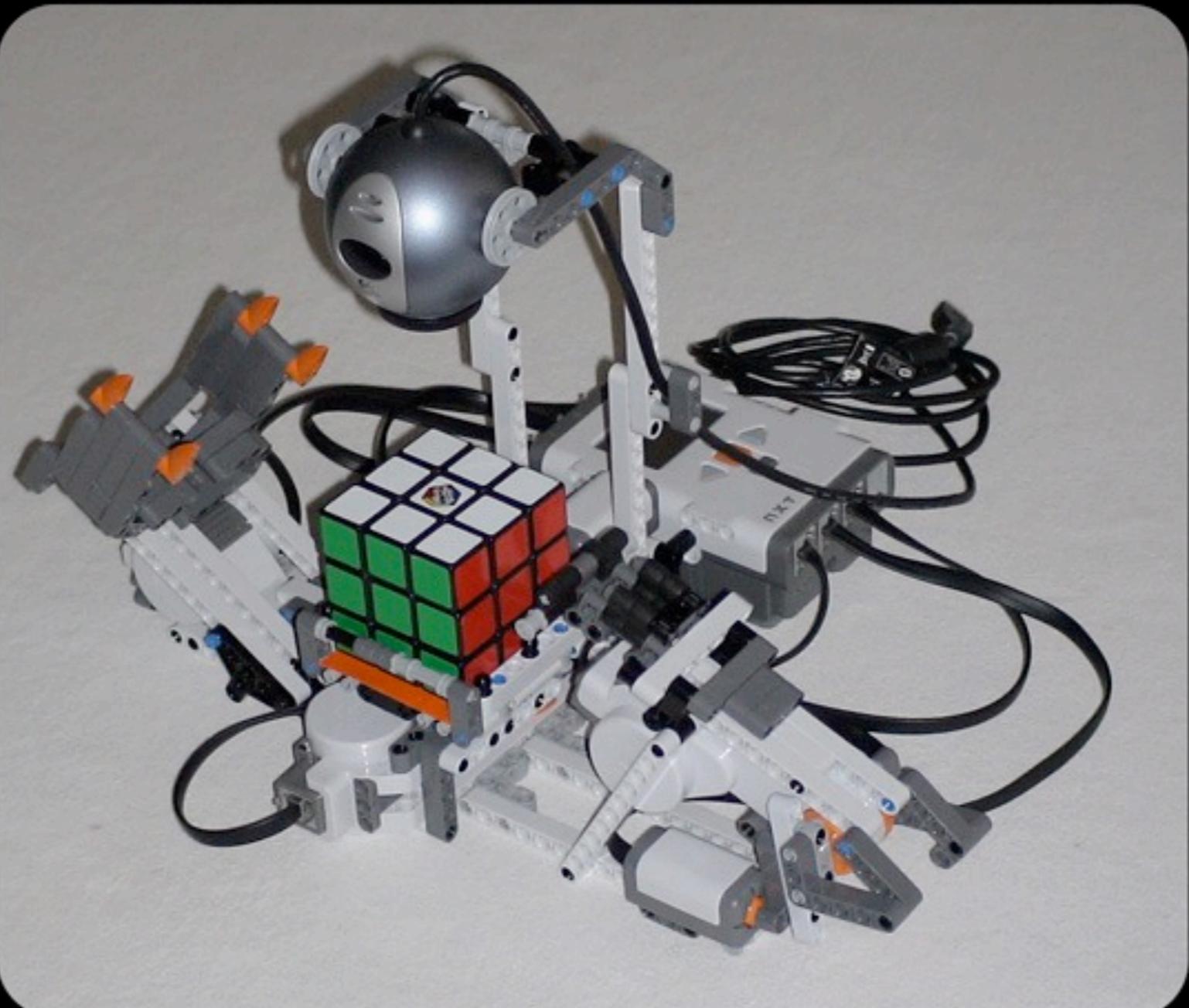
Complex Machinery



Complex Machinery

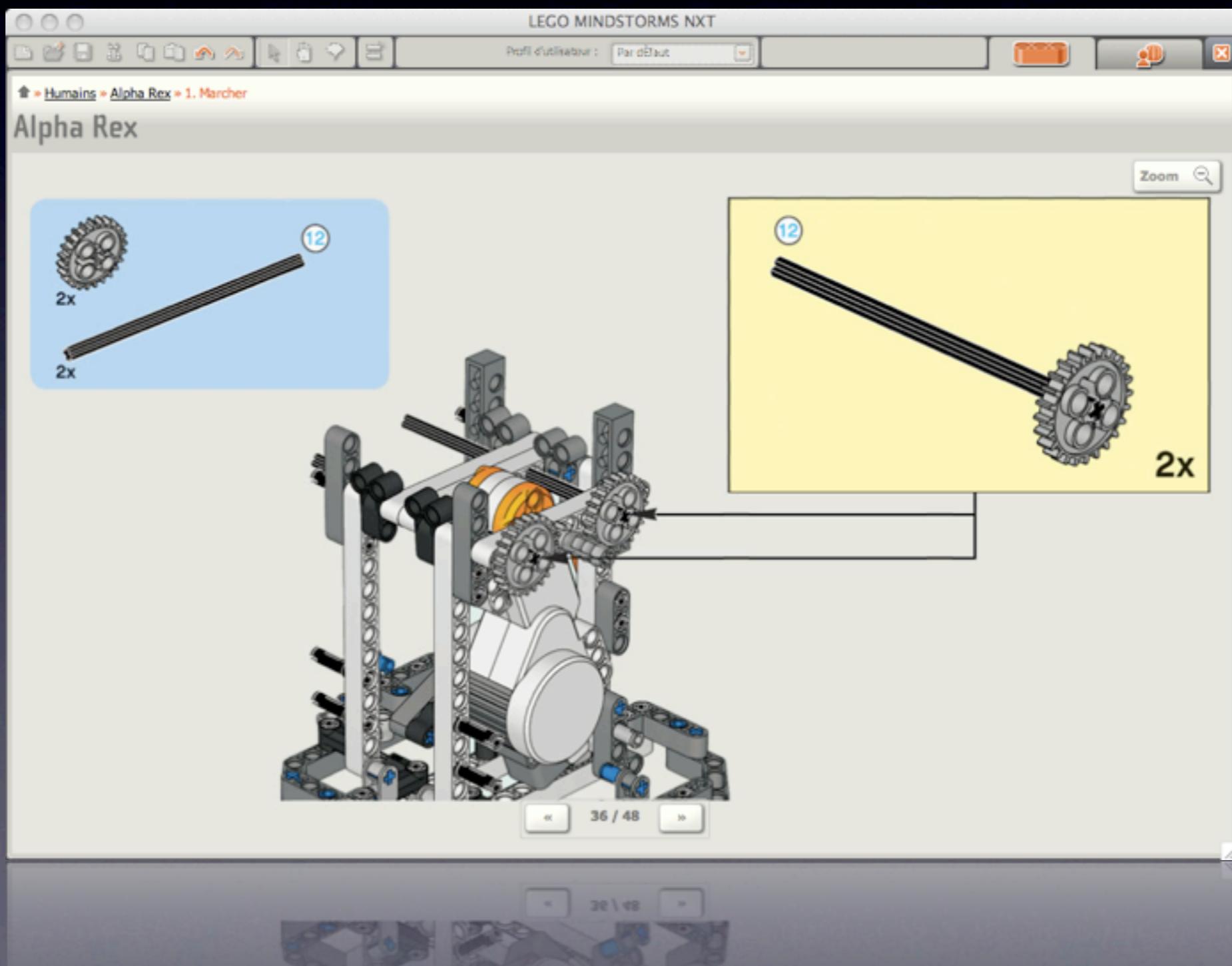


Complex Machinery

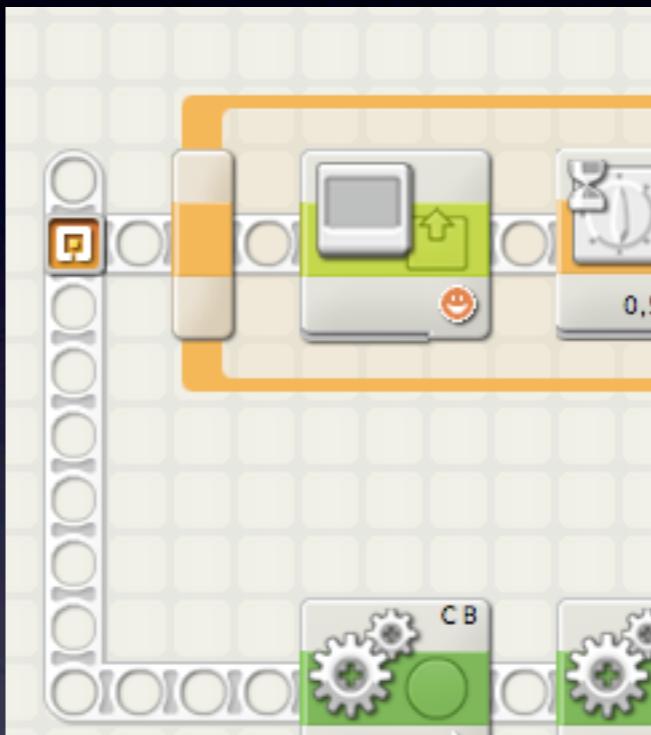
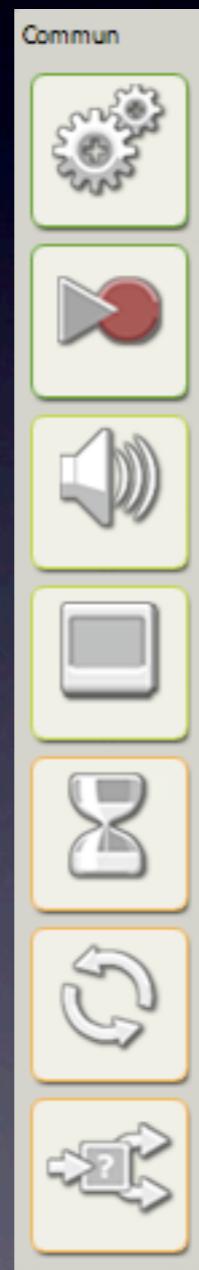




Step #1 : Assemble



Step #2 : Program



PC/MAC

Lego Mindstorms
NXT Software GUI

Compiler

Communication
protocol

BT OS
interface

BT
driver

BT
dongle

USB
driver

NXT

Embedded system
firmware

USB driver

BT HW
driver



Open Platform

- Lego Communication Protocol
- RobotC
- NXC
- LeJOS

LeJOS



Java™

LeJOS



LeJOS Tour

Dans les slides qui suivent, je fais le choix de faire un focus sur 3-4 aspects important de LeJOS, pas toute la feature list

- A Virtual Machine
- A Java API
- A Linker to create Virtual Machine byte code
- PC Tools to flash, upload apps etc ...
- A PC Communication API

Develop on any platform



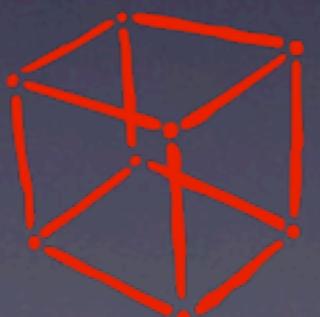
Develop on any platform



With any IDE



With any IDE



NetBeans



LeJOS Virtual Machine

- Based on TinyVM, but improved
- Around 50kb
- Fully preemptive, multi threaded
- Garbage Collection
- Bluetooth, USB, I2C & RS485 communication
- Most of `java.lang.*`, `java.util.*`, `java.io.*`

PC Comm API

Java programming from
the PC.
Working both with the
original firmware and
LeJOS

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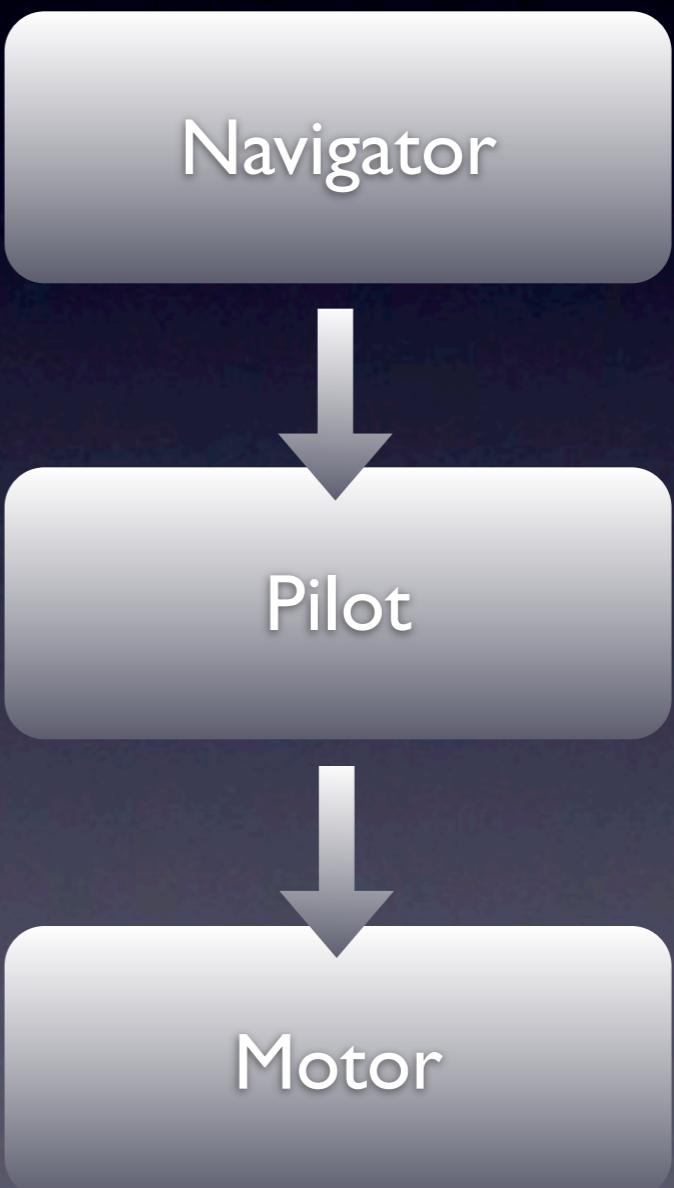
LCP - Lego Communication Protocol

Advanced Control

- Individual Motor Control
- Pilot Java Classes
- Navigator Java Classes

Advanced Control

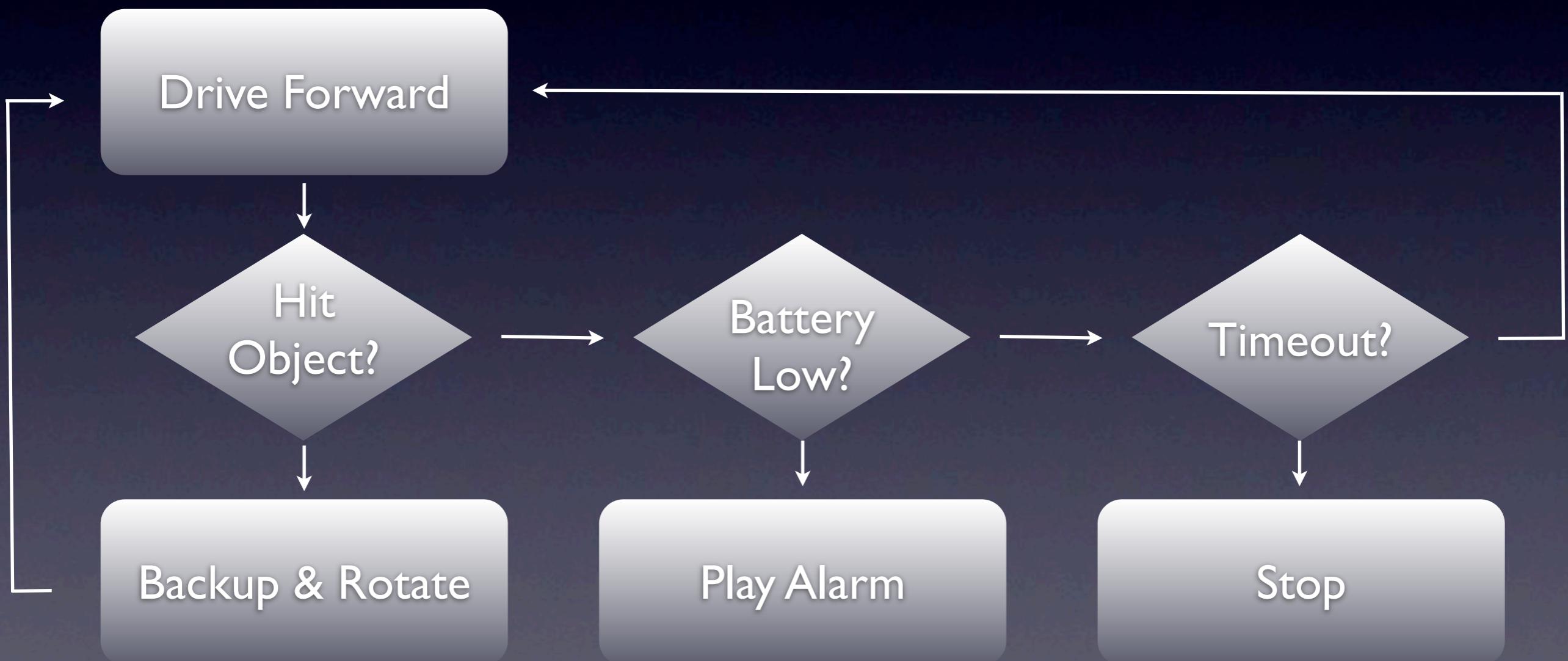
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- Pilot Java Classes
- Navigator Java Classes



Advanced Behavior



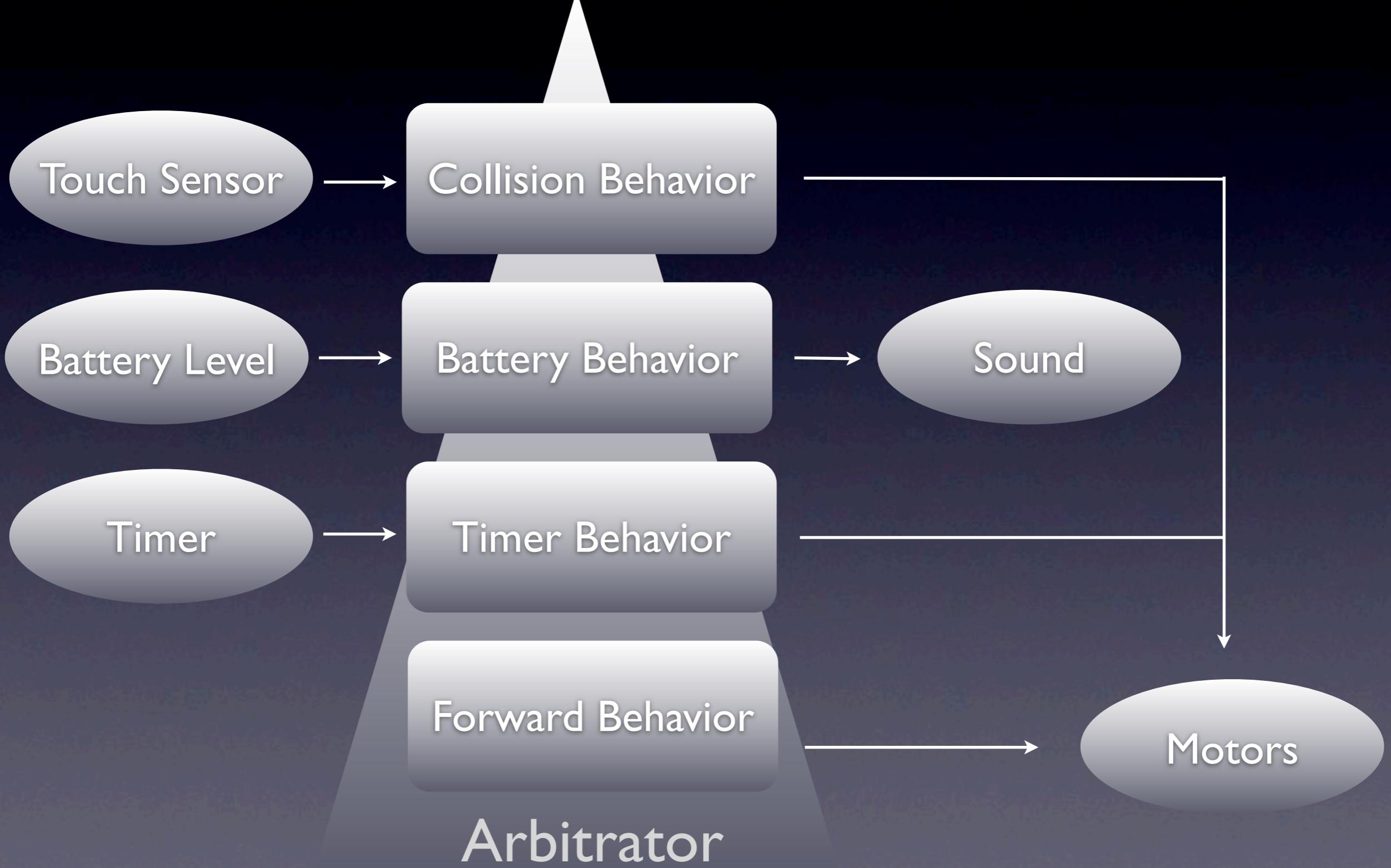
Advanced Behavior



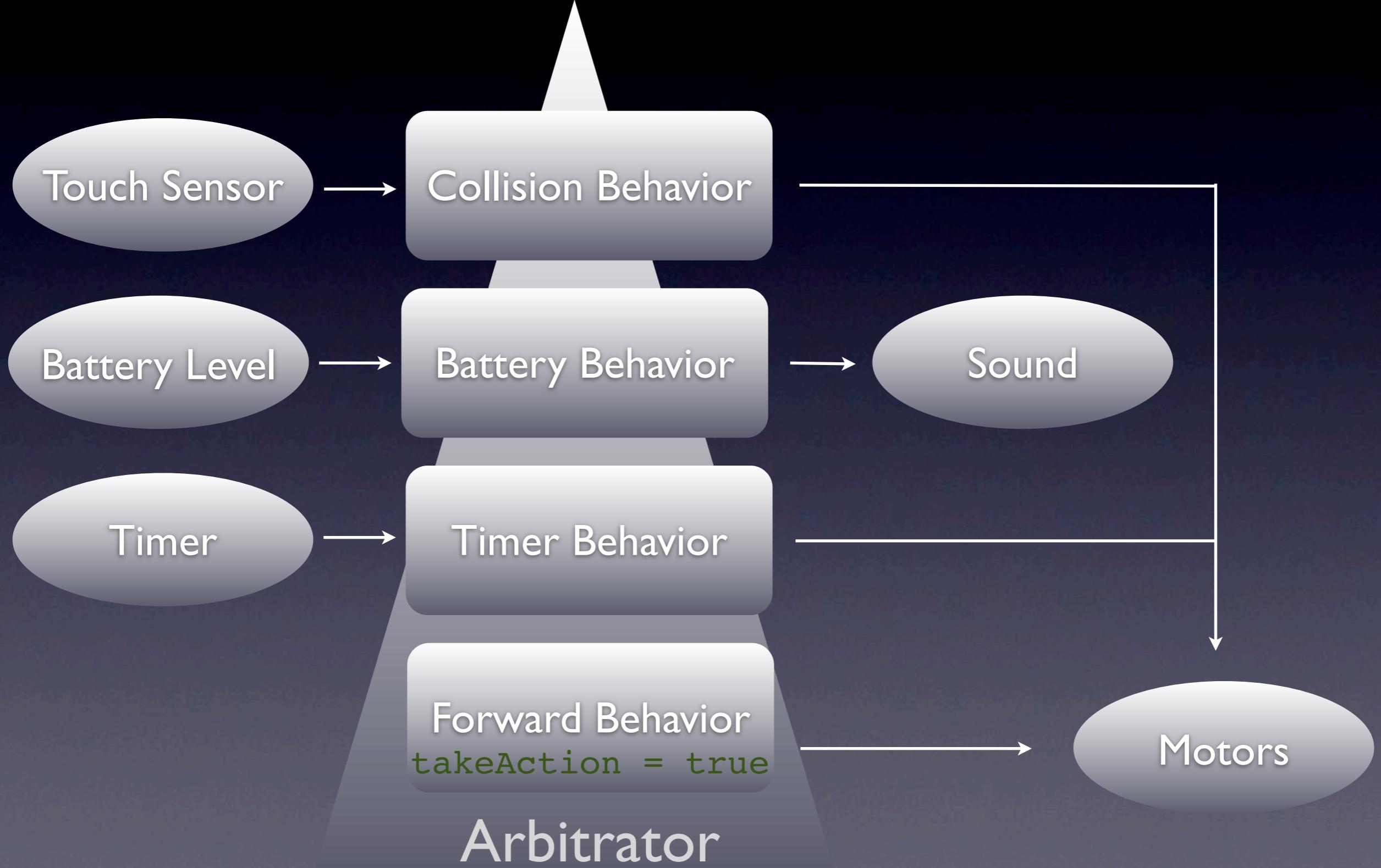
Advanced Behavior



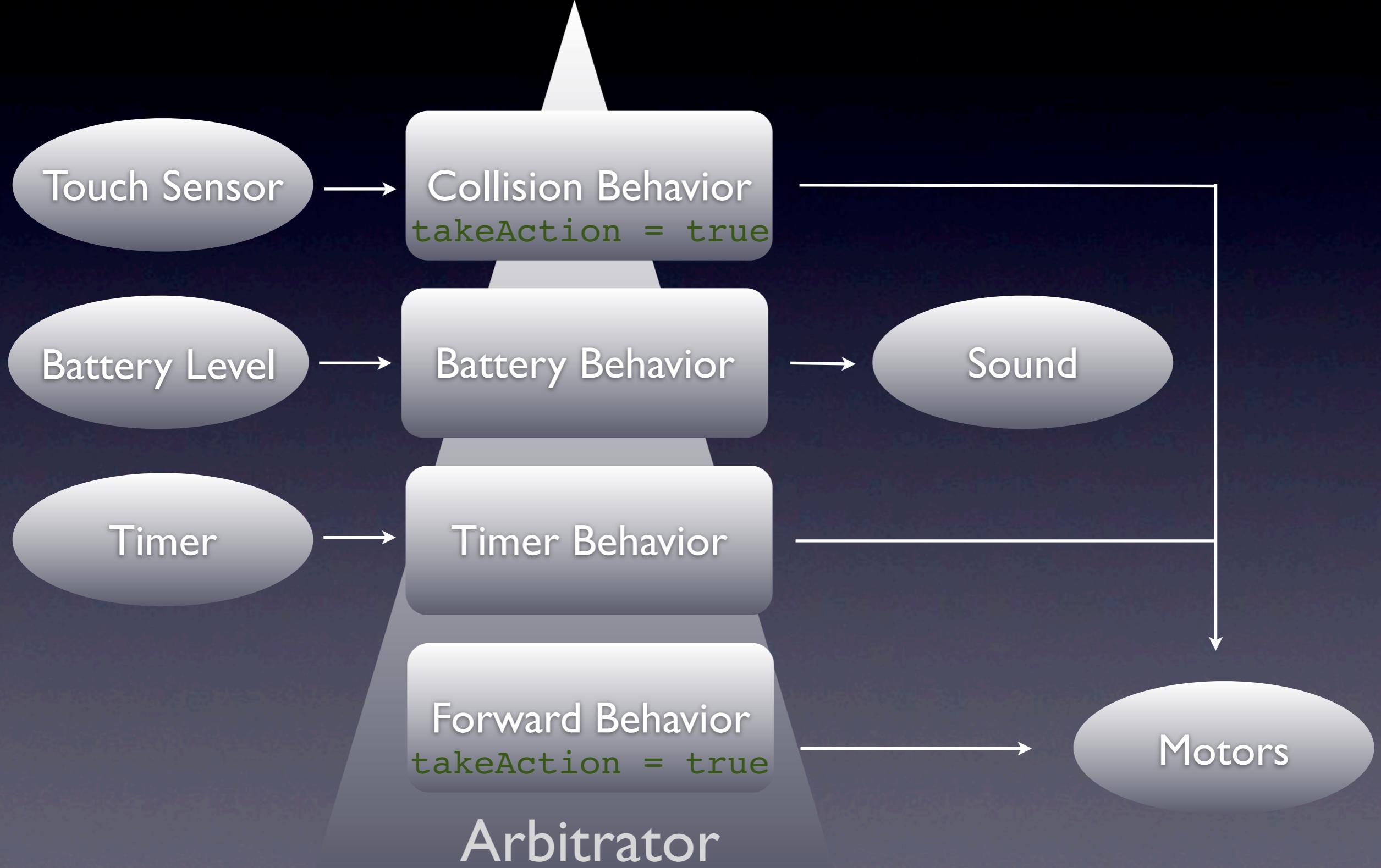
Advanced Behavior



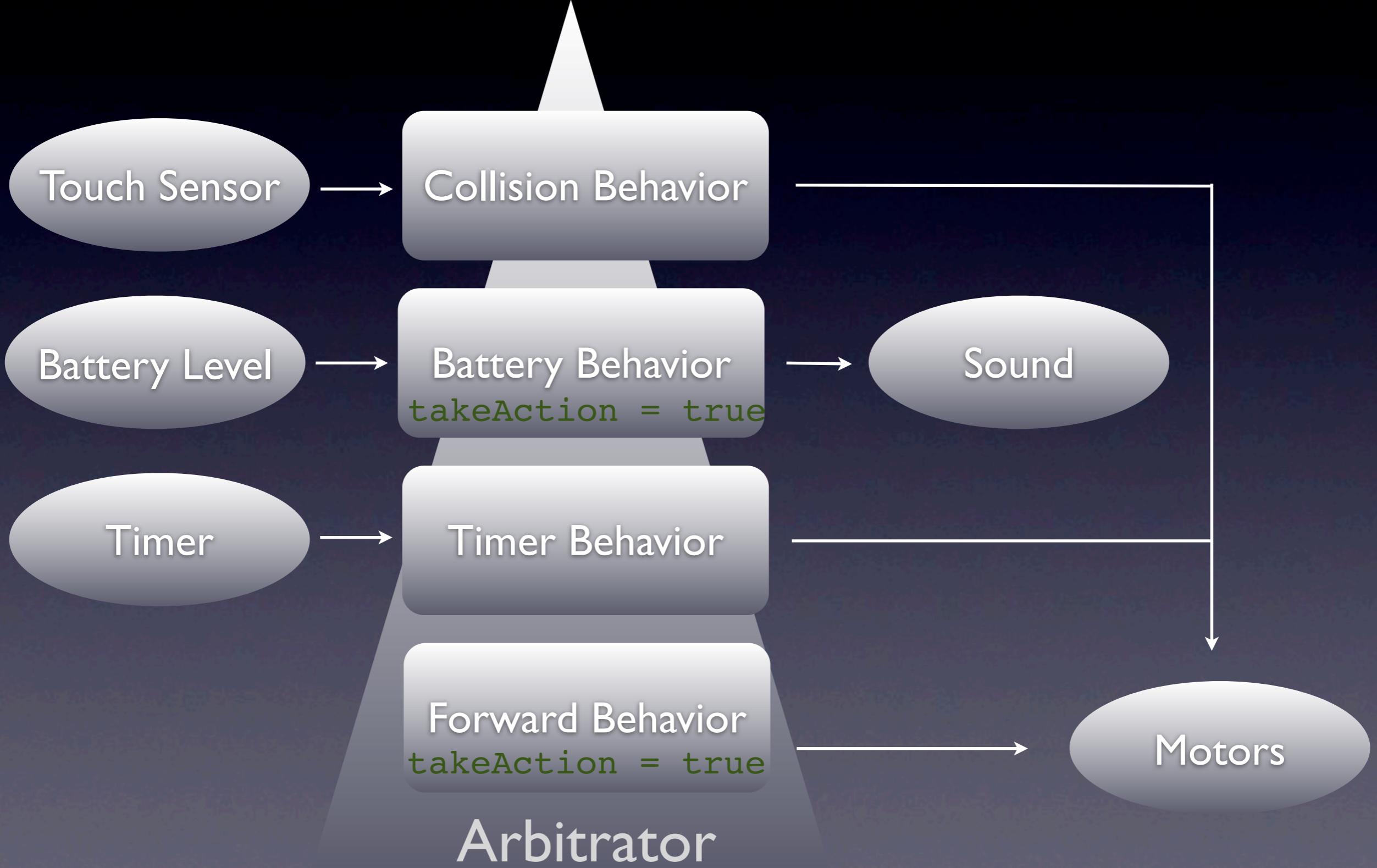
Advanced Behavior



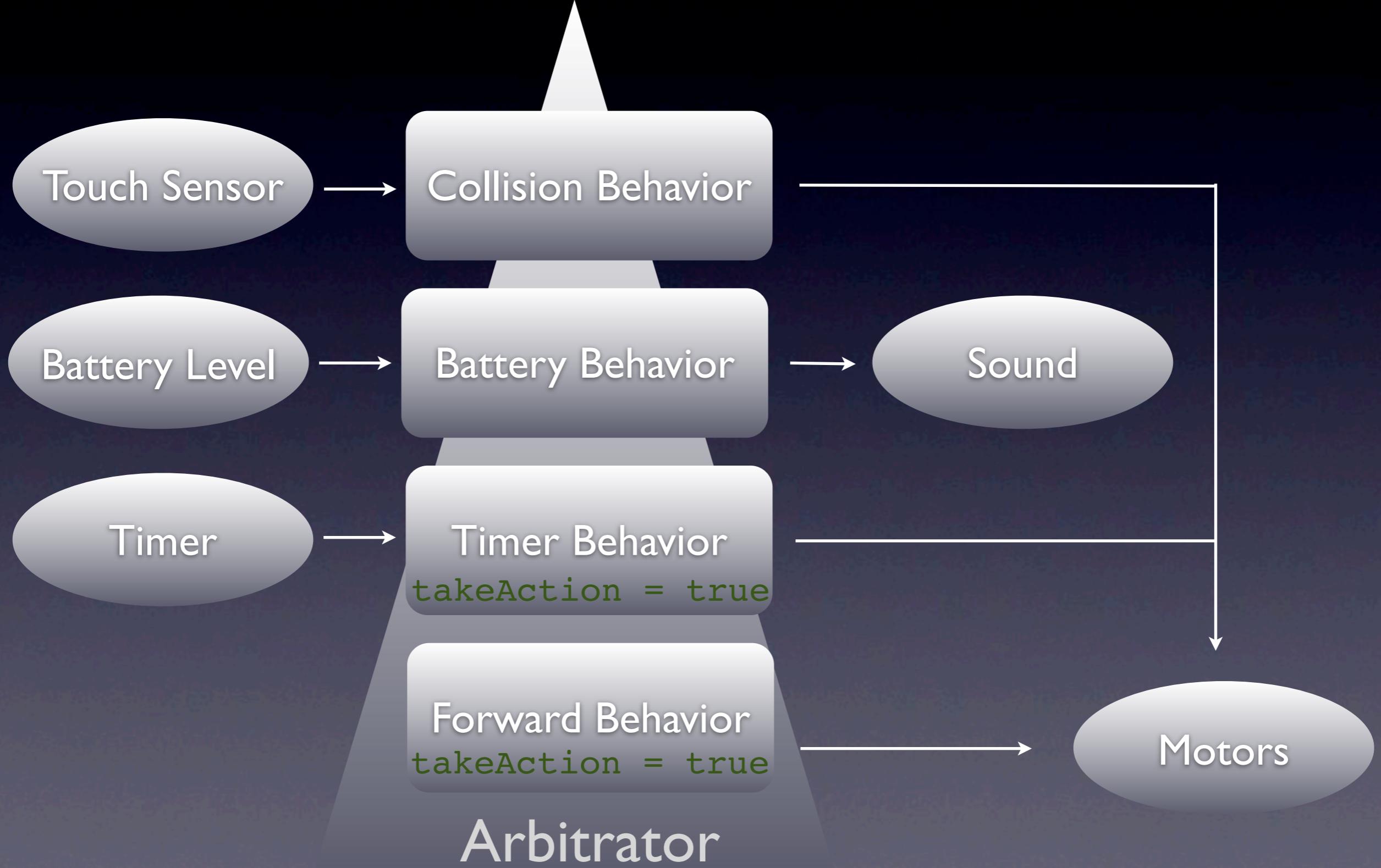
Advanced Behavior



Advanced Behavior



Advanced Behavior



Cool Demos

REST API in GlassFish



REST API in GlassFish



REST API in GlassFish



REST API in GlassFish



LCP - Lego Communication Protocol

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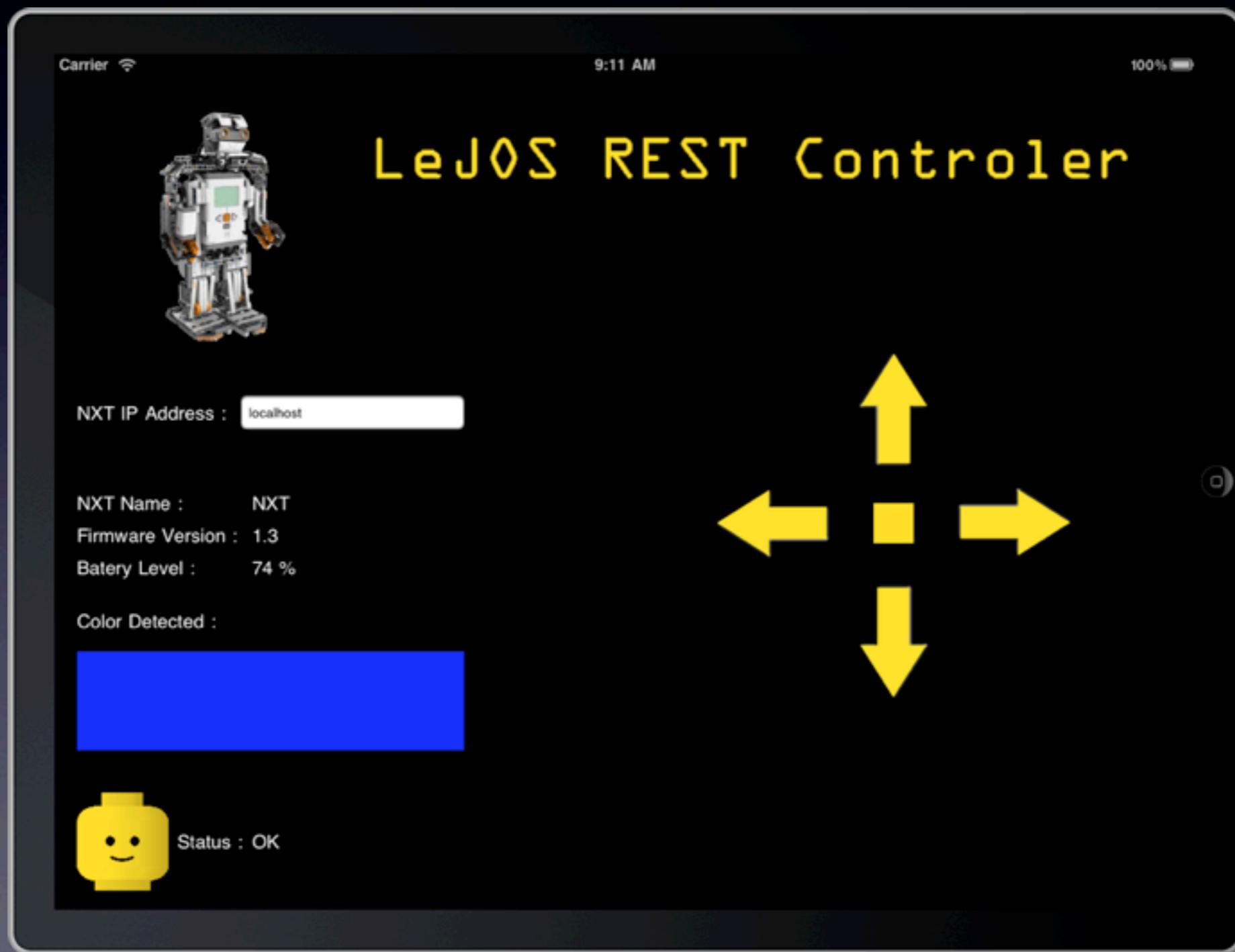
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REST API in GlassFish



Extending Mindstorms

Lego Mindstorms



New sensors

- I²C
 - Inter-Integrated Circuit
 - Low speed master-slaves serial protocol
 - Lego Mindstorms Hardware Developer Guide
- Arduino
 - Hardware prototyping platform
 - Open source

“My sensor”

Nxt
Sensor
Port

Port 3: Gnd	—————	Gnd
Port 4: 4,3v	—————	+5v
Port 5: SCL	: : :	Analog 5
Port 6: SDA	—————	Analog 4

Arduino

“My sensor”

```
import lejos.nxt.I2CPort;
import lejos.nxt.I2CSensor;

I2CSensor Arduino = new I2CSensor(SensorPort.S1);
Arduino.setAddress(1); // set slave address

...
Arduino.sendData(0, bufOut, bufOut.length);

...
Arduino.getData(0, readData, readData.length);
```

“My sensor”

```
#include <Wire.h>

void setup() {
    Wire.begin(1); // Join I2C bus as slave 1
    Wire.onRequest(requestEvent); // define callbacks
    Wire.onReceive(receiveEvent);
}

void receiveEvent(int len) { // data in
    while( 0 < Wire.available() ) {
        char c = Wire.receive();
    }
}

void requestEvent() { // data out
    Wire.send("Arduino to Mindstorms");
}
```

Demo



