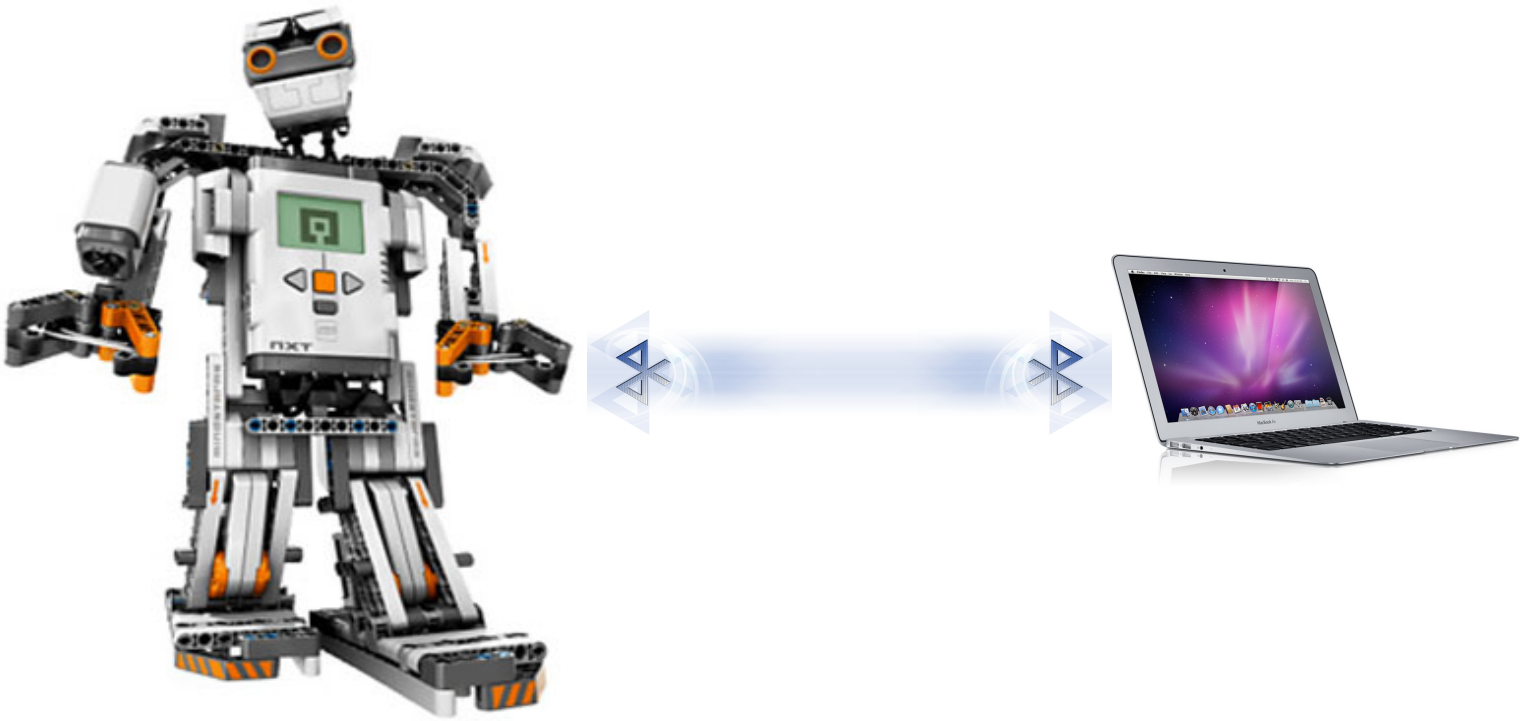
itemis

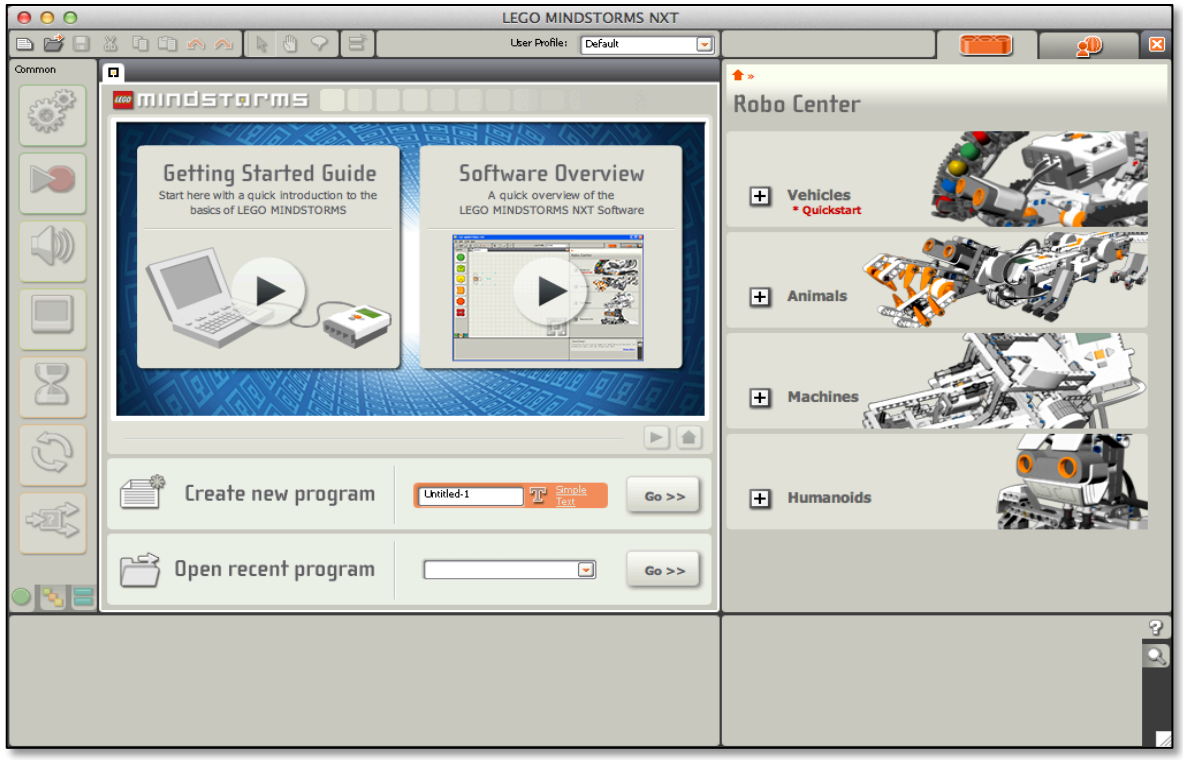


Programming & Control Robots with DSLs

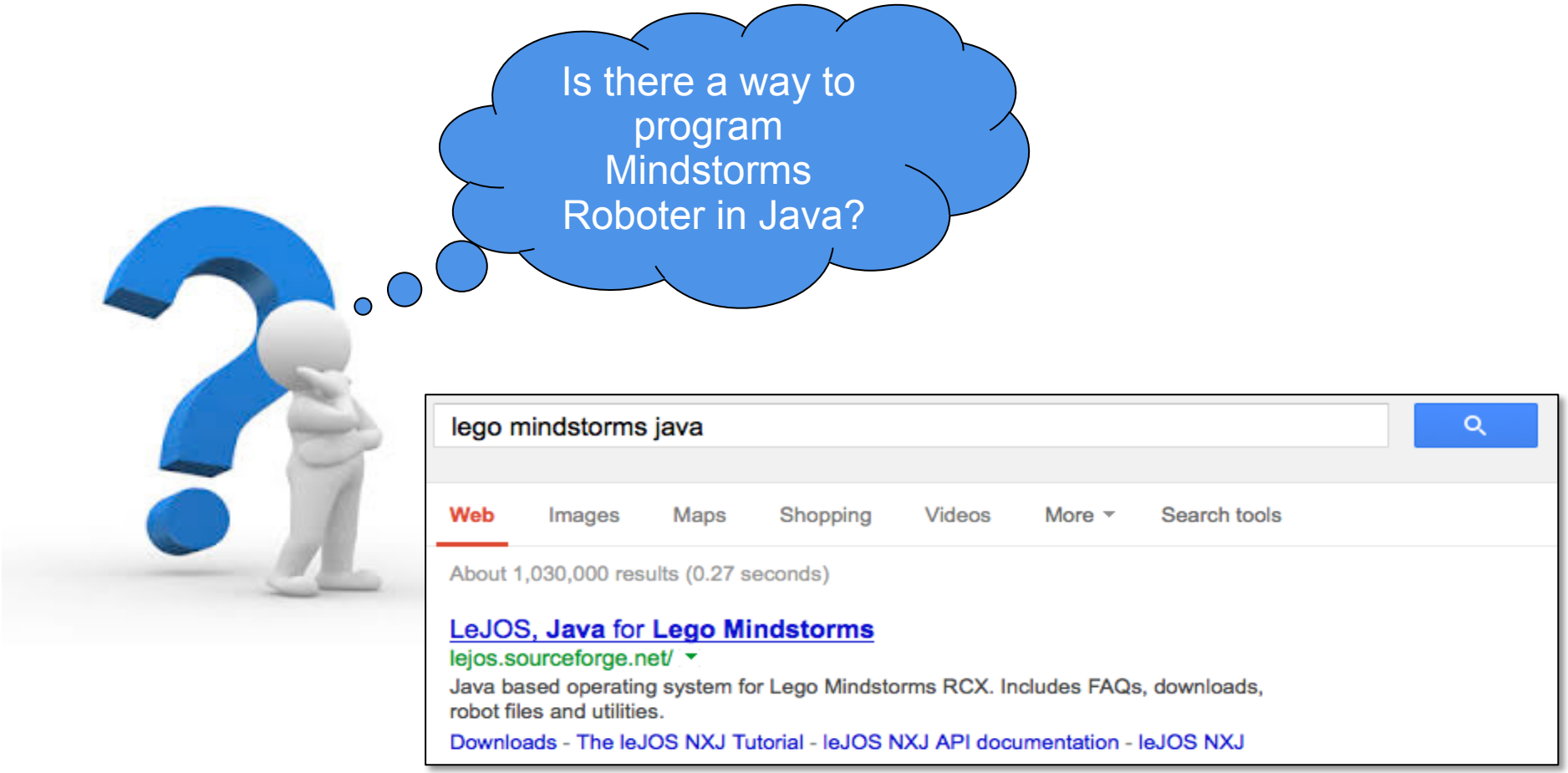
Eclipse DemoCamp – Zurich / 06-2013

Serano Colameo

Visual Programming with Lego Mindstorms NXT



A real Programming Language API would be nice…

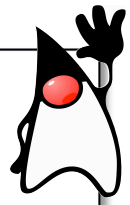


LeJOS - Java for Lego Mindstorms Roboter

```
package ch.itemis.examples.xtend;
import lejos.nxt.Motor;

public class NXTJava {

    public static void main(String [] args) throws Exception {
        NXTConnector conn = new NXTConnector();

        conn.addLogListener(new NXTCommLogListener() {
            public void logEvent(String message) {
                System.out.println(message);
            }

            public void logEvent(Throwable throwable) {
                System.err.println(throwable.getMessage());
            }
        });

        conn.setDebug(true);

        if (!conn.connectTo("btspp://NXT", NXTComm.LCP)) {
            System.err.println("Failed to connect");
            System.exit(1);
        }

        NXTCommandConnector.setNXTCommand(new NXTCommand(conn.getNXTComm()));

        System.out.println("Tachometer A: " + Motor.A.getTachoCount());
        System.out.println("Tachometer C: " + Motor.C.getTachoCount());

        Motor.A.rotate(5000);
        Motor.C.rotate(-5000);

        Thread.sleep(10000);

        Sound.playTone(1000, 1000);

        System.out.println("Tachometer A: " + Motor.A.getTachoCount());
        System.out.println("Tachometer C: " + Motor.C.getTachoCount());

        conn.close();
    }
}
```

LEJOS
Java for LEGO Mindstorms

Build with Xtend an internal DSL for LeJOS



```
package ch.itemis.examples.xtend;
import lejos.nxt.Motor;

public class NXTJava {

    public static void main(String [] args) throws Exception {
        NXTConnector conn = new NXTConnector();

        conn.addLogListener(new NXTCommLogListener() {
            public void logEvent(String message) {
                System.out.println(message);
            }

            public void logEvent(Throwable throwable) {
                System.err.println(throwable.getMessage());
            }
        });

        conn.setDebug(true);

        if (!conn.connectTo("btspp://NXT", NXTComm.LCP)) {
            System.err.println("Failed to connect");
            System.exit(1);
        }

        NXTCommandConnector.setNXTCommand(new NXTCommand(conn.getNXTComm()));

        System.out.println("Tachometer A: " + Motor.A.getTachoCount());
        System.out.println("Tachometer C: " + Motor.C.getTachoCount());

        Motor.A.rotate(5000);
        Motor.C.rotate(-5000);

        Thread.sleep(10000);

        Sound.playTone(1000, 1000);

        System.out.println("Tachometer A: " + Motor.A.getTachoCount());
        System.out.println("Tachometer C: " + Motor.C.getTachoCount());

        conn.close();
    }
}
```

Xtend

```
package ch.itemis.examples.xtend

import lejos.nxt.Motor

class NXTend1 {

    def static void main(String[] args) {
        val NXTConnector conn = new NXTConnector()
        if (!conn.connectTo("btspp://NXT", NXTComm::LCP)) {
            System::out.println("Failed to connect")
            System::exit(1)
        }
        NXTCommandConnector::setNXTCommand(new NXTCommand(conn.getNXTComm()))
        System::out.println("Tachometer A: " + Motor::A.getTachoCount())
        System::out.println("Tachometer C: " + Motor::C.getTachoCount())
        Motor::A.rotate(5000);
```

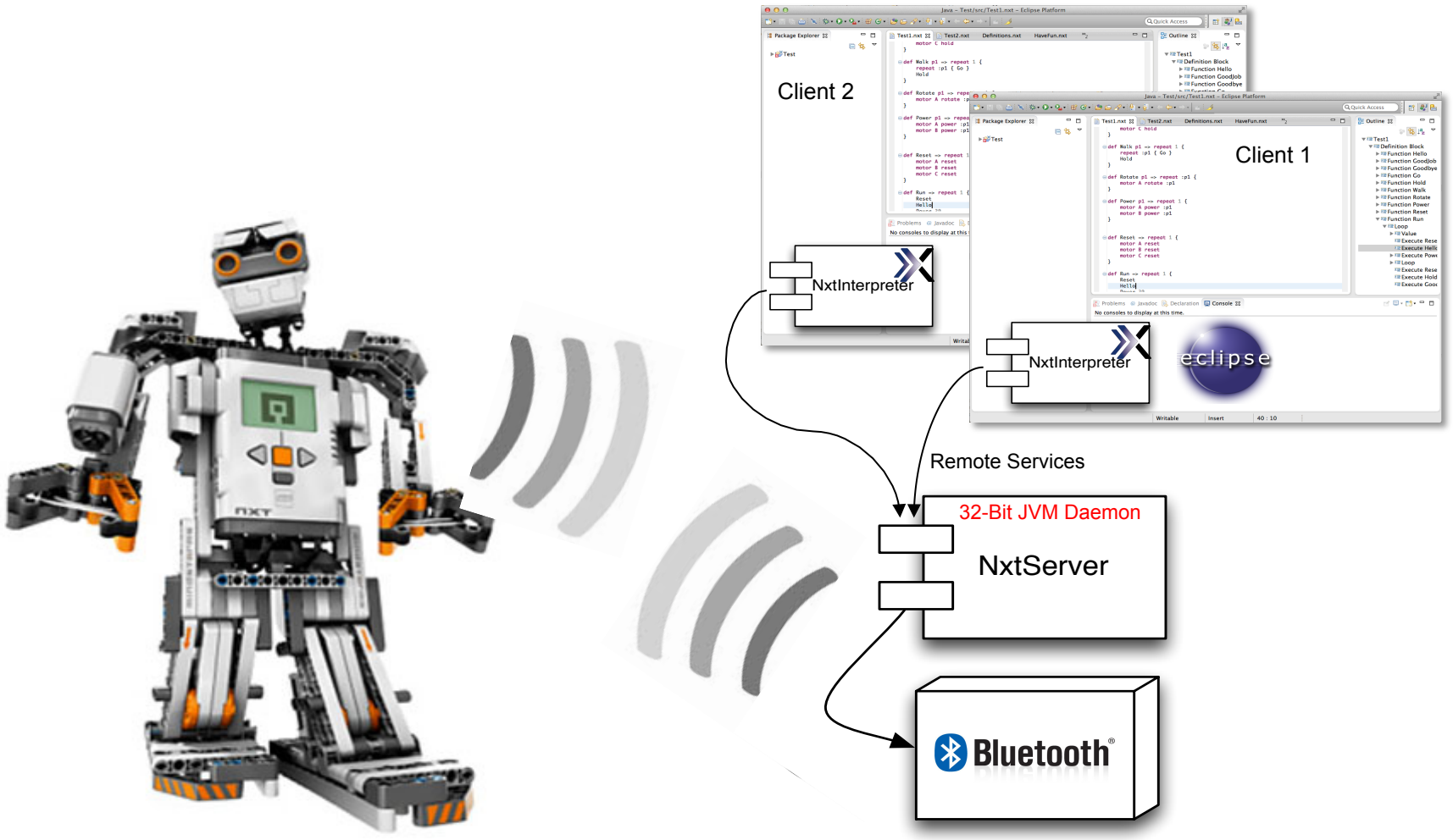
```
package ch.itemis.examples.xtend

import static extension ch.itemis.examples.xtend.NXTendBuilder.*

class NXTend3 {
    def static void main(String[] args) {
        NXT.connect
        sayHello
        MotorA.showTachoCounter
        MotorC.showTachoCounter
        MotorA.forward = 500
        MotorB.forward = 500
        MotorC.backward = 500
```

```
package ch.itemis.examples.xtend

import static extension ch.itemis.examples.xtend.NXTendBuilder.*

class NXTend3 {
    def static void main(String[] args) {
        NXT => [
            val motors = #{MotorA, MotorC}
            connect
                sayHello
                motors.forEach[ showTachoCounter ]
                motors.forEach[ forward = 500 ]
                playTone = 1000 -> 2000
                motors.forEach[ showTachoCounter ]
            disconnect
        ]
    }
}
```

"Exactly the same behaviour
but with
less language noise!"

Why not develop a DSL for the Lego Roboter?

Client / Server Architecture



Language Concept

„Functions & Function Blocks like Lego Bricks“

- Single Statement Functions

```
def Hello => playSound 'Hello.rso'

def Go => motor A forward

def Connect => device NXT
```

- Function Blocks

```
def Go => block {
    motor A forward
    motor B forward
    motor C forward }

def Reset => block {
    motor A reset
    motor B reset
    motor C reset }

def Hold => block {
    motor A hold
    motor B hold
    motor C hold }

def Walk p1 => repeat 1 {
   repeat :p1 { Go }
   Hold

}
```

```
def Run p1 => repeat :p1 {
      Connect
      Hello
      repeat 10 {
            Reset
            Walk 1
      }
      Hold
      Goodbye
}
```

Test1.nxt | Test2.nxt

```
Run 2
// Ok
```

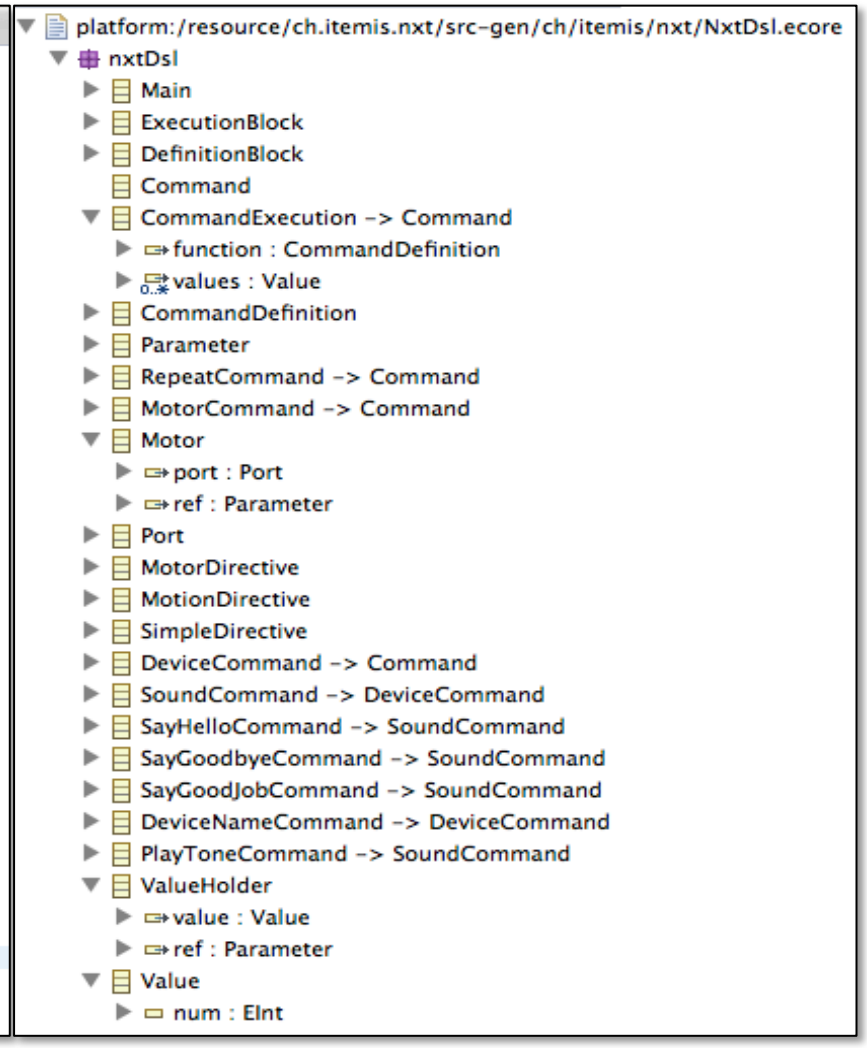
The programming editor is also a **shell** to execute functions…

How to write an Interpreter

“Navigate through the AST tree and `dispatch/evaluate` elements (nodes)”

NxtDslInterpreter.xtend

```
/**
 * Copyright (c) by itemis Schweiz GmbH
 *
 * @author Serano Colameo
 */
package ch.itemis.nxt.ui.interpreter

import ch.itemis.nxt.nxtDsl.Command

class NxtDslInterpreter extends NxtClient {

    def interpret(Resource resource) {
        resource?.main?.run
    }

    def run(Main it) {
        switch (block) {
            ExecutionBlock : block.evaluate
            default : println('Nothing to do!')
        }
    }

    def dispatch void evaluate(ExecutionBlock it) {
        commands.evaluate
    }

    def dispatch void evaluate(Iterable<CommandExecution> commands) {
        commands.forEach(c|c.evaluate)
    }

    def dispatch void evaluate(CommandExecution it) {
        function?.command?.evaluate(values)
    }

    def dispatch void evaluate(CommandExecution it, List<Value> values) {
        evaluate
    }

    def dispatch void evaluate(PlayToneCommand it, List<Value> values) {
        setValues(duration, values)
        setValues(freq, values)
        playTone(freq.value, duration.value)
    }
```



Demo – „Roboter in Action“

Serano Colameo

Phone: +41 (0)56 442 68 63

Email: serano.colameo@itemis.ch

itemis Schweiz GmbH | Dorfstrasse 69 | CH-5210 Windisch | www.itemis-schweiz.ch