

LEGO NXT with JAVA

Adrian Dabrowski

HTL Spengergasse

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Schedule

- 9:30 Introduction Linefollowing (Balogh)
- 10:00 Introduction to NXT (Dabrowski, Hammerl)
- 11:00 First experiments, teamwork (Petrovic)
- 12:00 Lunch
- 13:00 Teamwork
- 14:00 Competition
- 15:25 Train back (Wien Süd)

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Rules for today

- No eating and drinking in the lab
- Don't mix the LEGO Sets
- Keep the Sets together
- Use a Login only once

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The LEGO “Brick”

- 32 bit ARM CPU, 48 Mhz, 256kb flash, 64kb RAM, USB, Bluetooth
- 100x64 LCD, 3 Motor Ports, 4 Sensor Ports
 - Analogue and I2C
- Graphical Programming Language (LabView)
- 3rd party firmware (C, JAVA, ...)
- LeJOS (JAVA Micromachine)

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Port A,B,C: Motors



Port 1,2,3,4: Sensors

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JAVA Micromachine

- Similar to JAVA on mobile Phones
- Preemptive threads & Synchronization
- Arrays, including multi-dimensional
- Recursion
- Exceptions
- Java types including float, long, and String
- Most of the java.lang, java.util and java.io classes
- A Well-documented Robotics API

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LeJOS

- Motors
- LCD
- Buttons
- Bluetooth
- Sound (Wave)
- Sensors
 - Touch
 - Ultrasonic
 - Reflection
 - Color
 - GPS
 - Compass
 - Accelerometer
 - I2C

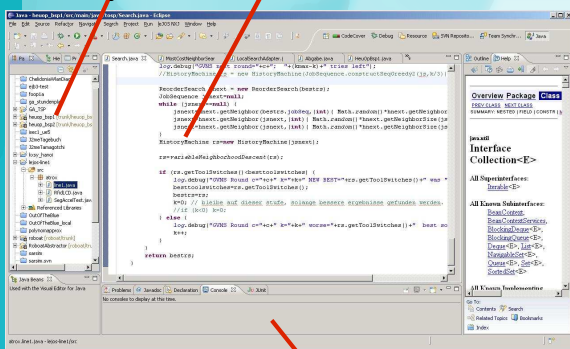
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LeJOS & Eclipse

- C:\SCRATCH\JAVA-LEGO
 - start.bat
- Eclipse GUI

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Projects & Files Source View

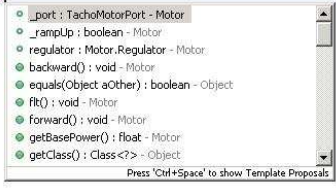


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Auto-Proposals

- While Typing or by pressing CTRL-Space

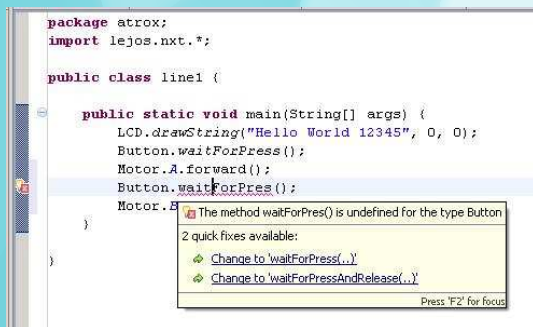
```
public static void main(String[] args) {  
    LCD.drawString("Hello World 12345", 0, 0);  
    Button.waitForPress();  
    Motor.A.  
}
```



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Errors

```
package atrox;  
import lejos.nxt.*;  
  
public class line1 {  
  
    public static void main(String[] args) {  
        LCD.drawString("Hello World 12345", 0, 0);  
        Button.waitForPress();  
        Motor.A.forward();  
        Button.waitForPres();  
        Motor.B.  
    }  
}
```



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JAVA in 15 Minutes

- Object Oriented
 - Static methods and classes
 - Create instances with
var = new Classname();
 - Method / function Call
var.doSomething(param);
returnValue=var.getValue();
- Program Start at
main(...)

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Types

- Numeric:
 - int
 - long
 - float / double
- String
 - String
- Boolean
 - boolean
- Belong to (Scope)
 - Class
 - Method
 - Block

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Block

```
{  
    Statement;  
    Statement;  
}
```

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Methods

```
public int addNumbers (int x, int y) {  
    int z;  
    z=x+y;  
    return z;  
}
```

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Control Structures

```
while (expression) {  
    Statement(s);  
}
```

```
do {  
    Statements;  
} while (expression);
```

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Control Structures

```
for ( initialisation ; termination ; increment ) {  
    ....  
}
```

```
for (int i=0; i<5; i=i+1) {  
    .....  
}
```

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Control Structures

```
if ( expr ) {  
    DoSomething();  
} else {  
    DoSomethingElse();  
}
```

```
if (a<0) a=0;
```

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Boolean (Logic) Expressions

- Equal `a==b`
 - `a=b` is an assignment (!)
- Unequal `a!=b`
- Not `!a`
- And `a&&b`
- Or `a||b`
- Example:
 - `If ( (a<5) || (a>10) ) { ... }`

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Numeric Operations

- Add/Subtract `+` `-`
- Multiply / Divide `*` `/`
- Modulo `%`
- Shortcuts:
 - `a = a+1;`
 - `a += 1;`
 - `a++;`

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HelloWorld.java

```
import lejos.nxt.*;

public class HelloWorld {

    public static void main(String[] args) {
        System.out.println("Hello World");
        Button.waitForPress();
    }
}
```

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NXT Motors

- Control by
 - **Power** or **Speed** or **Angle**

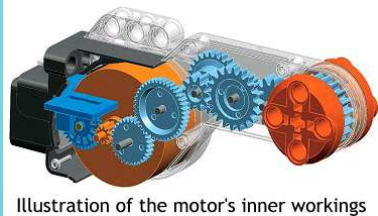


Illustration of the motor's inner workings

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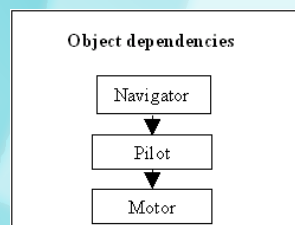
Motor.X.... (x=A..C)

- Motor.X.forward()
- Motor.X.backward()
- Motor.X.stop()
- Motor.X.flt()
- Motor.X.setSpeed(speed)

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Advanced Movement

- For wheeled devices
- Pilot keeps track of movement
 - Distance
 - Orientation
- Navigator keeps track of position



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Buttons

- Blocking
 - waitForPress()
- For all Buttons
- For a specific Button
 - ENTER
 - ESCAPE
 - LEFT
 - RIGHT
- Non Blocking
 - IsPressed()

```
Button.waitForPress();  
Button.ENTER.waitForPress();  
while ( !Button.ENTER.isPressed() ) {}
```

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Buttons



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LCD

- 0
- x
- y
- LCD.drawString(String str,int x, int y, boolean invert)
 - LCD.drawChar(char c, int x, int y, boolean invert)
 - LCD.drawLine(int i, int x, int y)
 - LCD.setPixel(int rgbColor, int x, int y)

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Sensors

- Sensor-Objects have to be created using the "new" operator

```
int var1;
LightSensor left = new LightSensor(SensorPort.S1);
LightSensor mid = new LightSensor(SensorPort.S2);
LightSensor right = new LightSensor(SensorPort.S3);

var1=left.readValue();

LCD.drawString("Left: "+var1,0,0);
```

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Light Sensors

- Only light and dark
- Light, dark and Color



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```
import lejos.nxt.*;

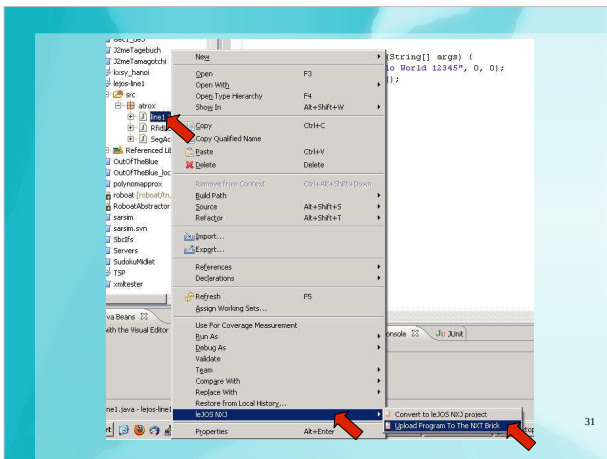
public class MyFirstProgram {

    LightSensor light;

    public static void main(String[] args) {
        MyFirstProgram hu2=new MyFirstProgram();
        try {
            hu2.run();
        } catch (InterruptedException e) {}
    }

    public MyFirstProgram() {
        light=new LightSensor(SensorPort.S1);
    }

    public void run() throws InterruptedException {
        int i=0; // some variable
        // repeat while the ENTER Button is NOT pressed
        while ( !Button.ENTER.isPressed() ) {
            if (Button.LEFT.isPressed()) { // when the left button is pressed, decrement i
                i=i-1;
            }
            if (Button.RIGHT.isPressed()) { // when the right button is pressed, increase i
                i=i+1;
            }
            LCD.clearDisplay();
            LCD.drawInt(i,i,1);
            Thread.sleep(250); // sleep 250 ms = 1/4 sec
        } // end of while
    }
}
```



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