# Robot programming introduction and program for today

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# Plan for today

- Introduction
  - what is a robot?
  - what's so special about robot programming
- Lego Mindstorms EV3
  - The brick, sensors and motors
- The fundamental paradigm: Behaviour-based robot programming
- Our programming tool LeJOS
  - Java API for programming Lego Mindstorms
  - JVM and OS for the EV3 brick
- Install and get familiar with the software

# Why take this course?

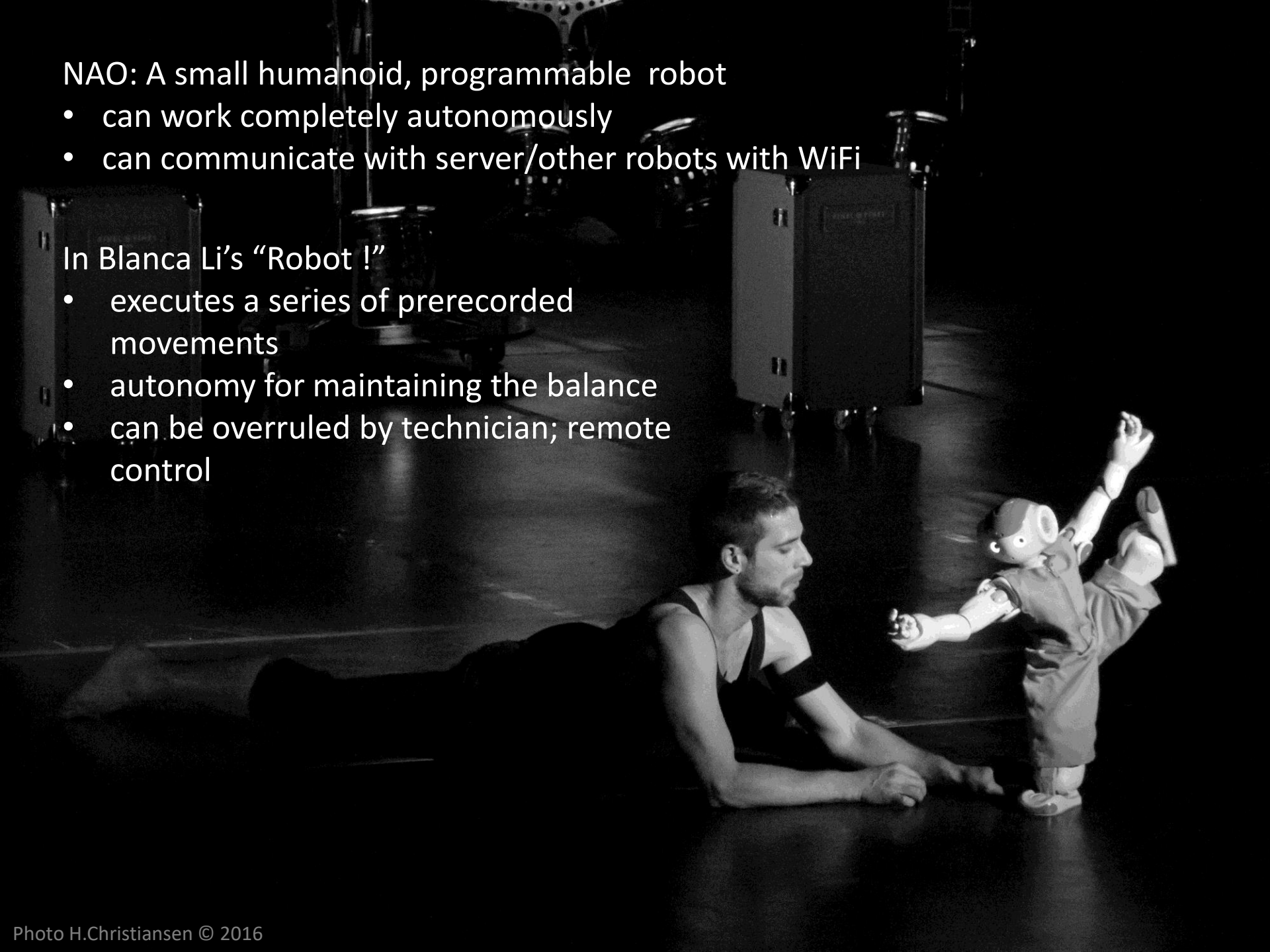
- A fun and exciting way of learning more about programming
- Become familiar with a technology that becomes more and more important
- Prepare yourself for exciting projects / theses combining with performance design, health studies, industrial appl. ..., programming technology
- Technology and programming style relevant in many other systems, e.g., interactive installation, autonomous cars and driving assistants, OS, mobile apps...

# What is a robot?

- A (more or less) autonomous artifact or agent
- Controlled by a program running on a computer (built into the artifact)
- ***Situated*** in a physical reality (opposed to a webcrawler, print queue manager, NPC)
- Registers reality using (limited) ***sensors***, affects reality through actuators, e.g., ***motors***
- A tendency that most things called “robots” can move

# Stretching the definition

- "... more or less autonomous ..."?
- 100% remote controlled devices such as "Rullemarie" is often called a robot
  - not our business
- Often a combination of autonomy and directives from a server or person
  - Ex. NASA's Mars Rover
  - My favourite example .... <next slide>
  - (also our business)



NAO: A small humanoid, programmable robot

- can work completely autonomously
- can communicate with server/other robots with WiFi

In Blanca Li's "Robot !"

- executes a series of prerecorded movements
- autonomy for maintaining the balance
- can be overruled by technician; remote control

# What is so special about programming a robot?

- Reality is unreliable
- “move 10 cm direction North” may bring you 9.87 cm direction NNV ☹
- Other actors can make trouble
- Immediate reaction may be vital for the robot and also choosing the *right* action from limited knowledge

# This course is about programming and not so much applications (nor ethics)

However, in the final assignment we foresee possible application areas

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- Robots finding way in a labyrinth: using a map; route finding; adapt to changes; ...
  - Relevant for self-driving cars; rescue robots

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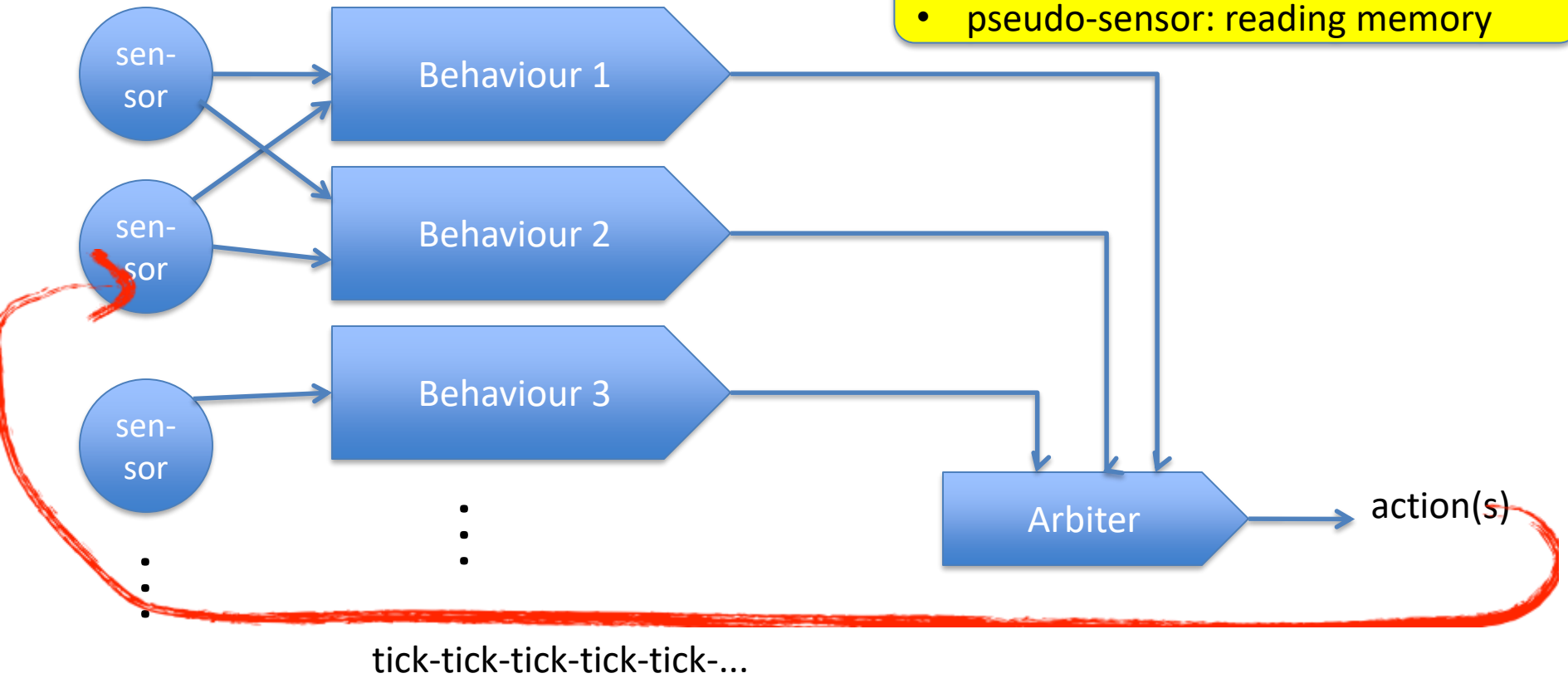
- Dancing robots: read and interpret other robot's (or persons's) movements by camera
  - Relevant for Robots in performances; personal care robots; service robots; ...

# The fundamental paradigm: Behaviour-based robots

In one picture:

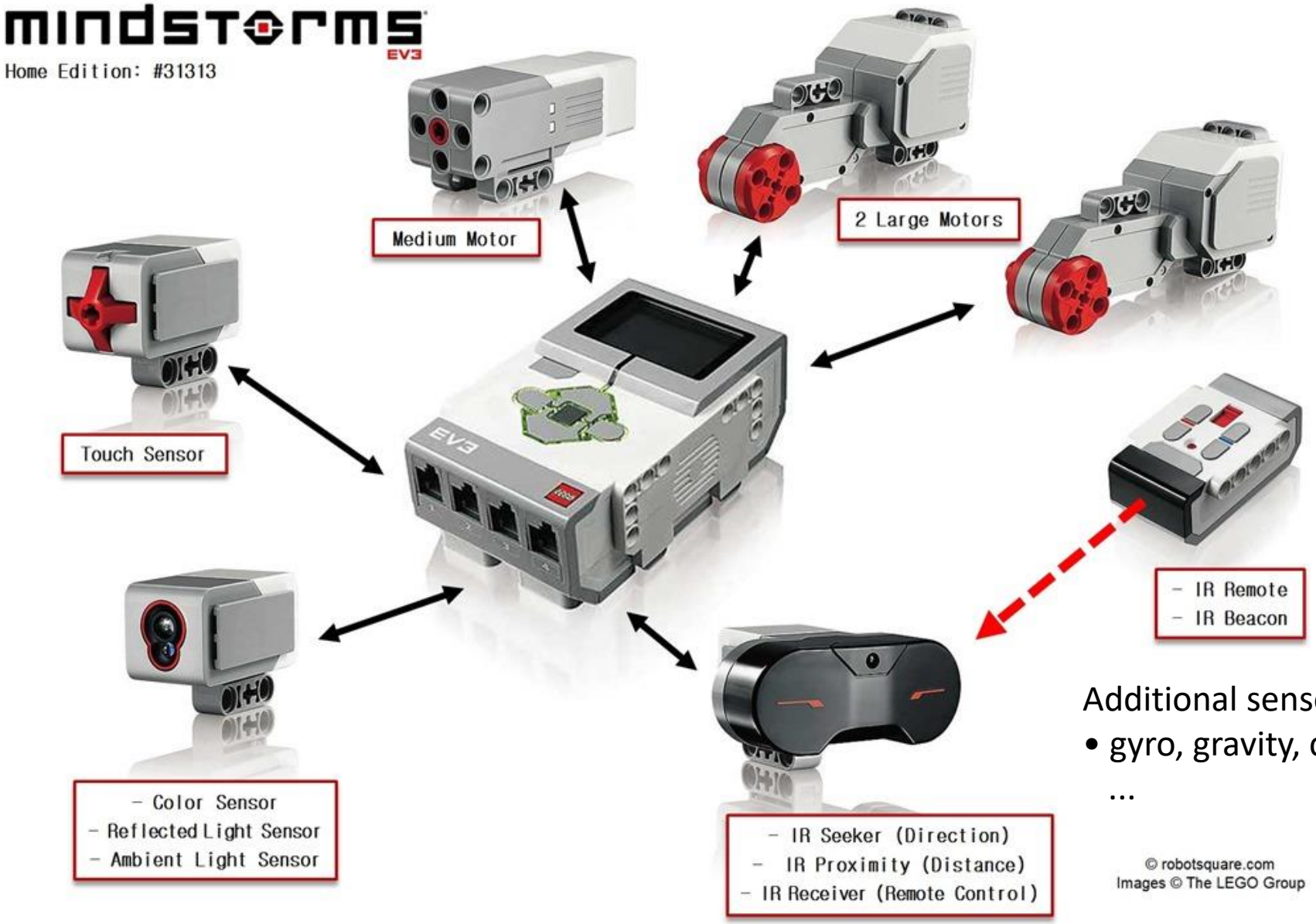
Variations:
- behaviours may be complex
- complex beh. may be interrupted
- a beh. may update memory
- pseudo-sensor: reading memory



# Programming themes

- Behaviour based ....
- Threads
- Distributed programming (e.g. server+robot)
- Protocols for communication
- Understand video (simple version!)
- Taking noise into account: Kalman filters
- Planning algorithms (e.g. Dijkstra)

# Lego Mindstorms EV3

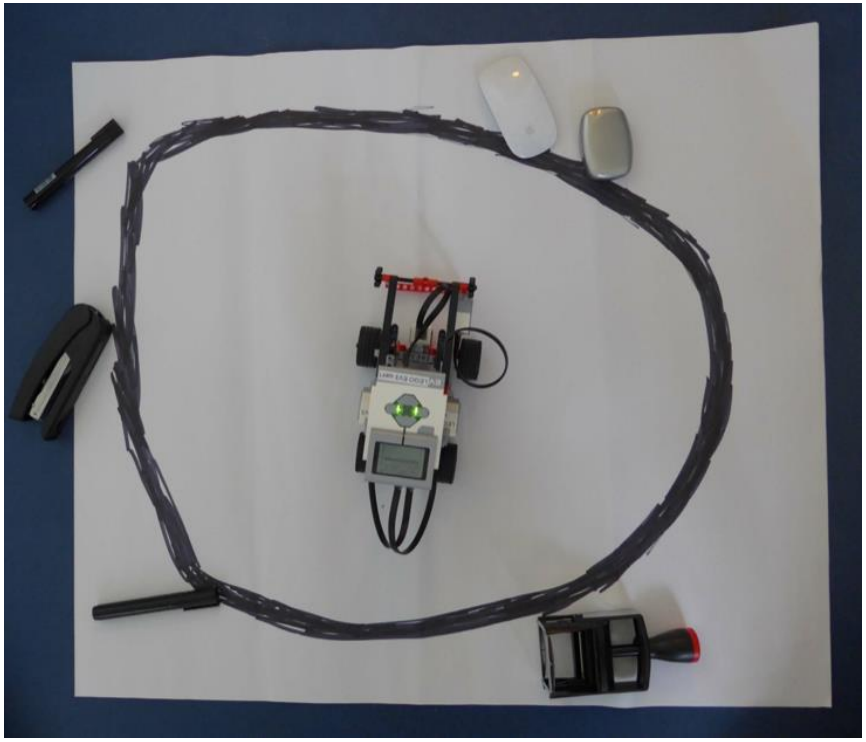


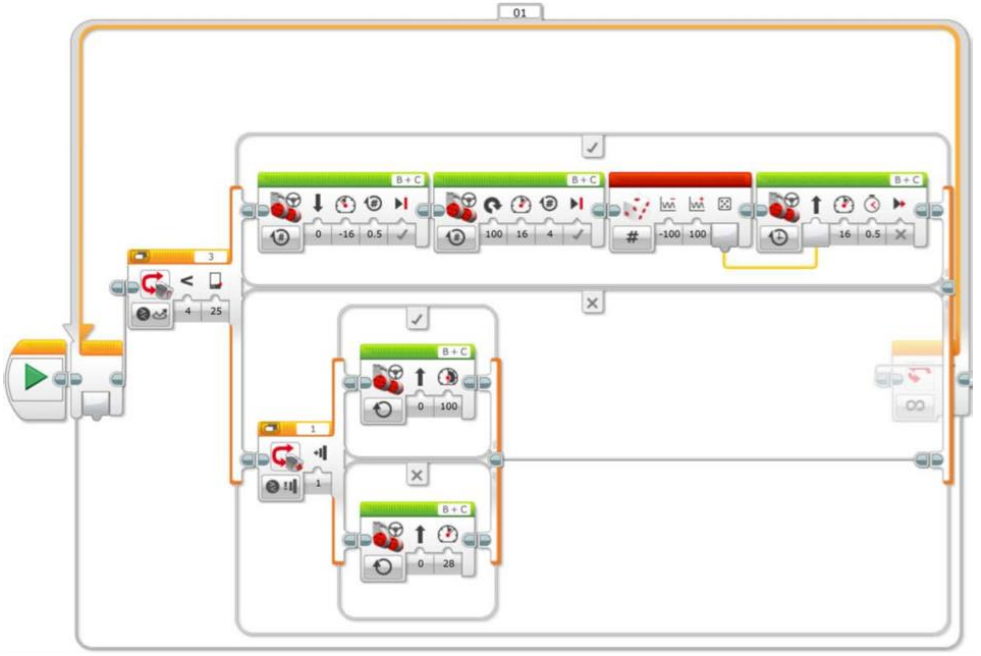

Additional sensors:

- gyro, gravity, camera ...

# Lego Mindstorms comes with a graphical programming language – ***that is not allowed in this course*** ;-)

- Ex: A cleaning robot





# We use LeJOS

- Java API for programming Lego Mindstorms
  - facilities for behaviours
  - facilities to access sensors and control motors
- JVM and OS for the EV3 brick
  - Insert microSD card into EV3 brick and it boots from it, ignoring Lego's own firmware
  - Smart, eh?

# Rest of today – and homework if you do not succeed

Find exercises on moodle

- Get Eclipse and the LeJOS plug-in installed on your computer
- Install LeJOS on EV3; set up Bluetooth connection (or use USB cable if necessary)
- Hello world
- Experiment with sensors on EV3
- Write program that connects a sensor with a motor