

# Experiences with Tutorial Programs for Simulated Robots

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# The Motto

Understanding emerges by doing:

- The best way to understand robotics is to program robots.
- But experiments with real robots are difficult and expensive.
- Alternative: Simulated robots in simulated environments.

# A Simulation Environment

RoboCup 3D simulator SimSpark  
with simulated humanoid robots.

Physical simulation by Open Dynamic Engine (ODE)  
for body dynamics of robot Nao and the soccer environment.

Users can program own robot controls  
as “agents” which communicate with  
SimSpark by messages containing  
sensory information  
resp. action commands



# SimSpark

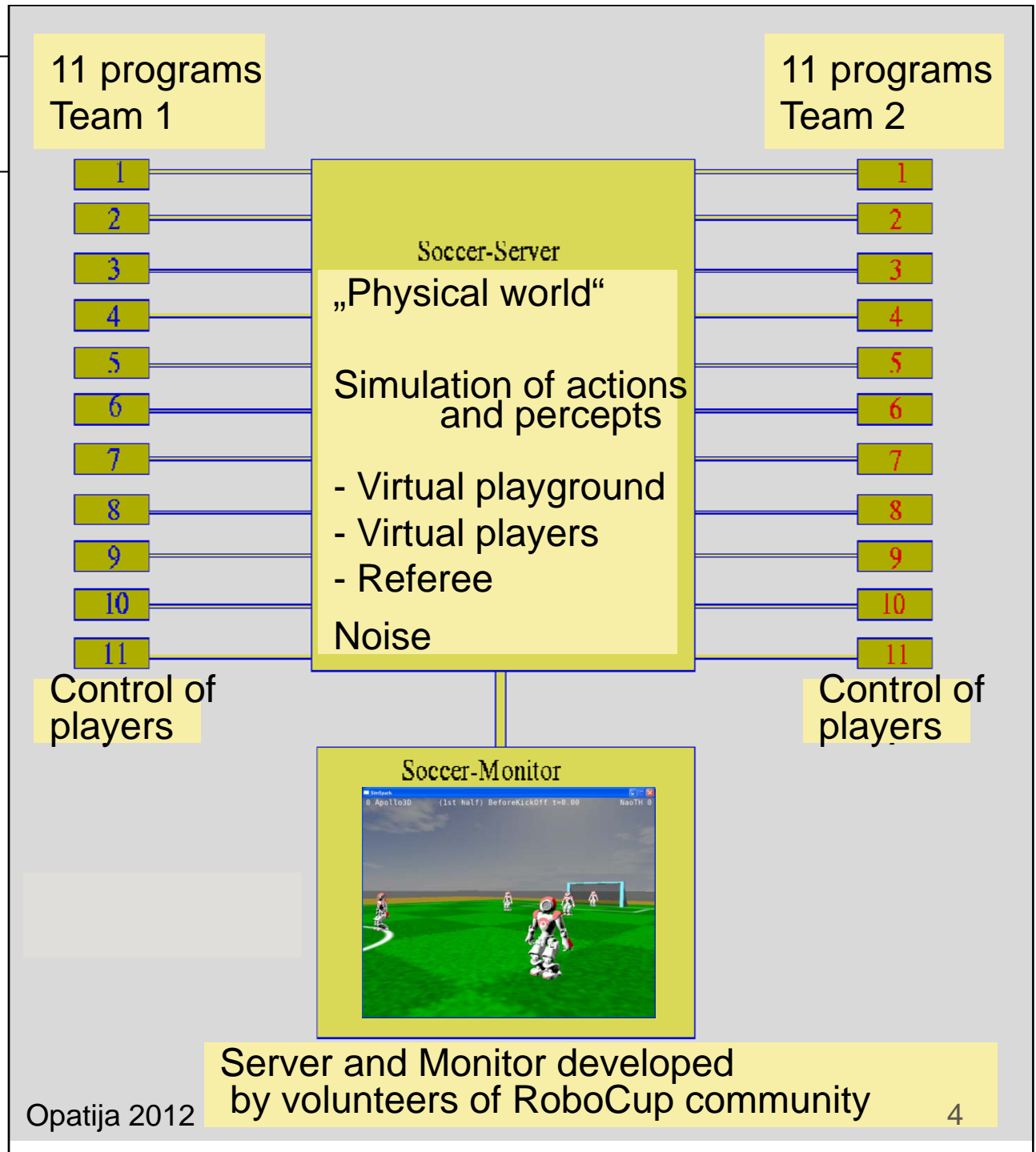
Communication  
via protocols (TCP)

Effector messages

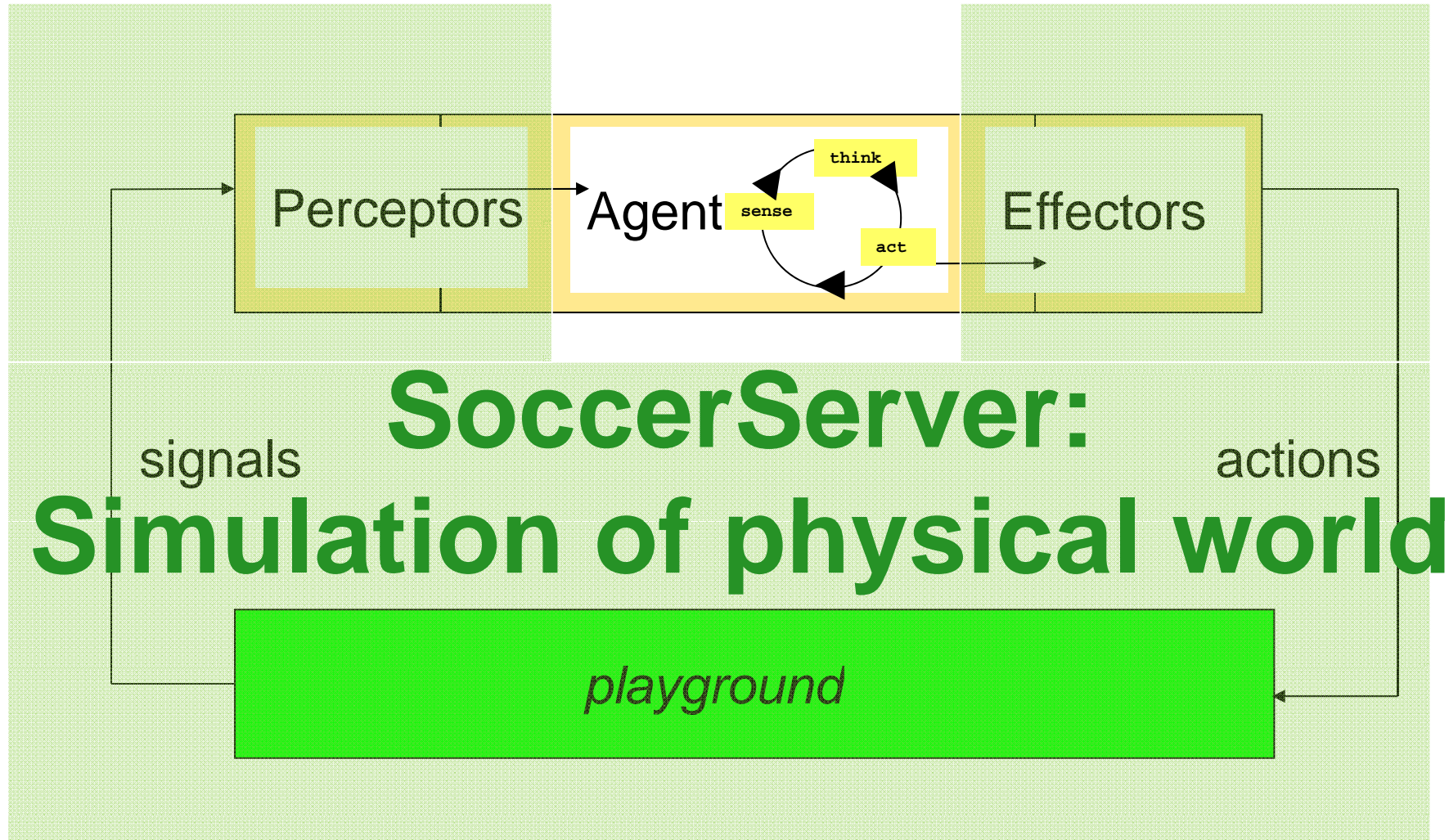
Motor commands  
similar to real robot

Perceptor messages

Vision, acoustic, inertial,  
.....

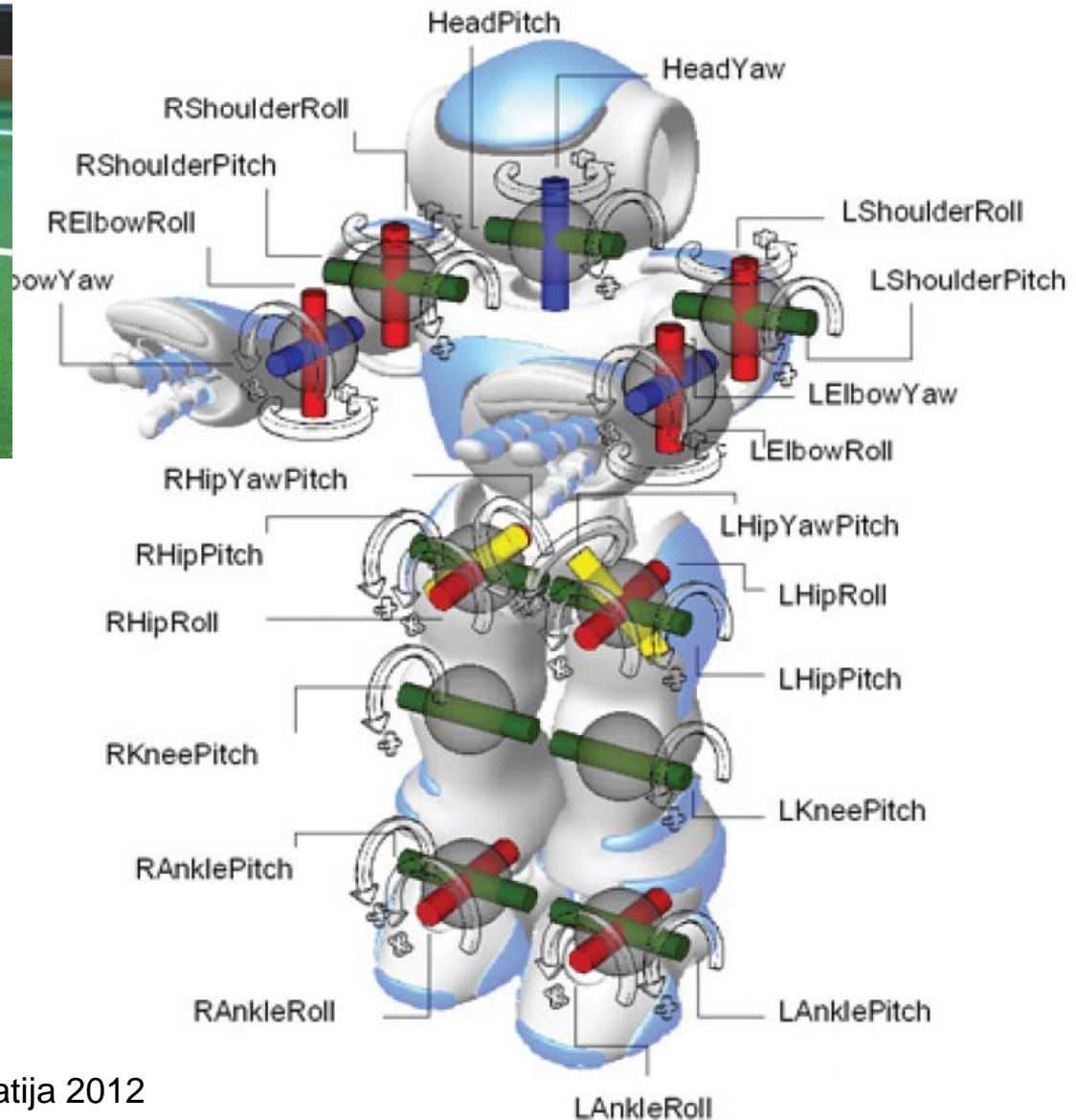


# Agent in Simulation





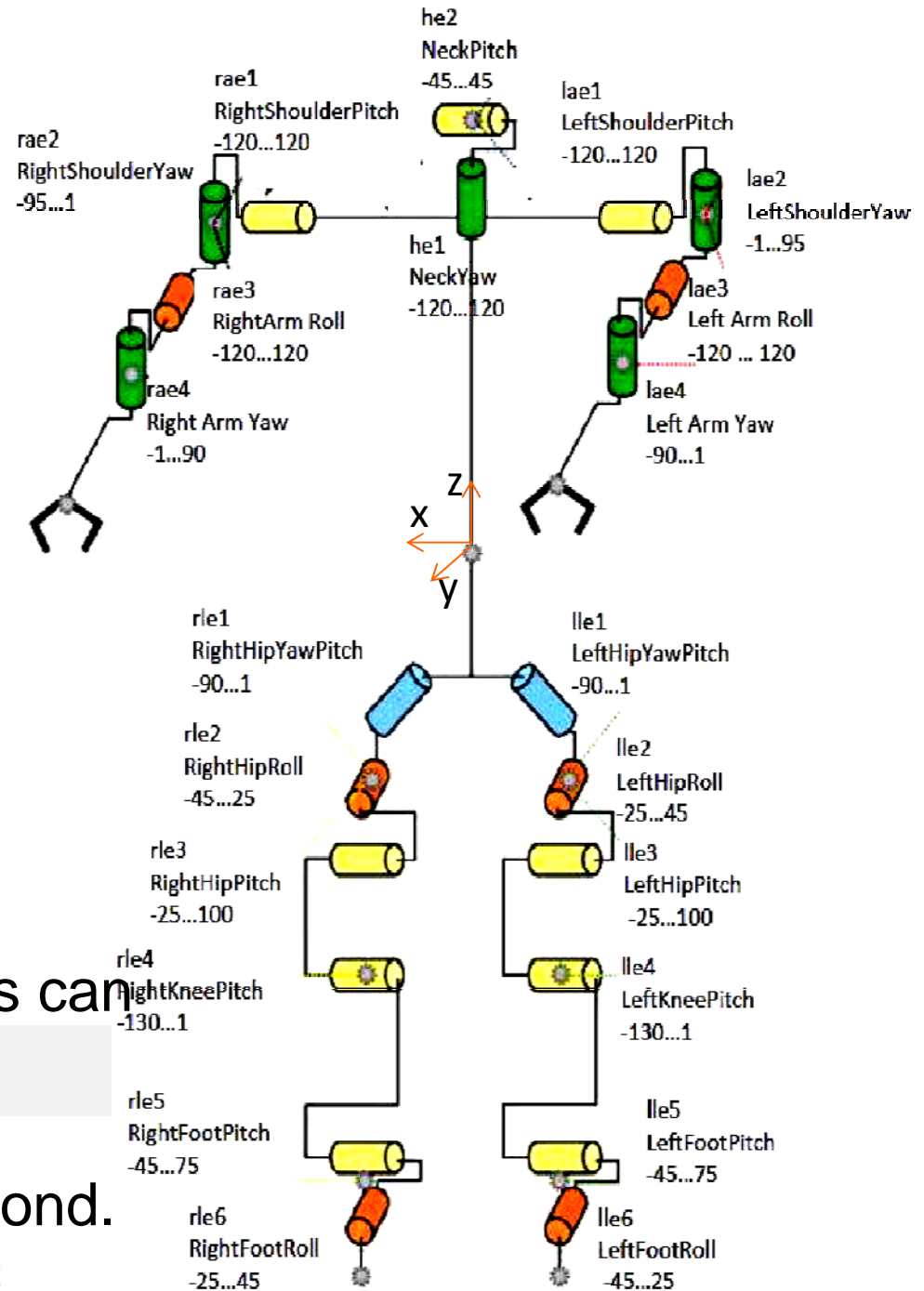
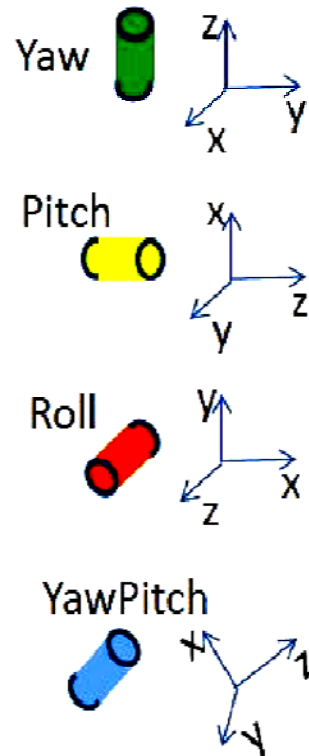
# Joints of Robot Nao from Aldebaran



## 21 Servo-Motors:

- 2 head
- 4 per arm
- 5 per leg
- 1 hip

# Nao in Simulation: The joints



Example: (rae 2.3).

Motor commands: Messages can be sent every 20 msec.

i.e. 1100 commands per second.

# Motion Editor for designing keyframes

MotionNet Editor

File Help

MotionNet Joints

3D

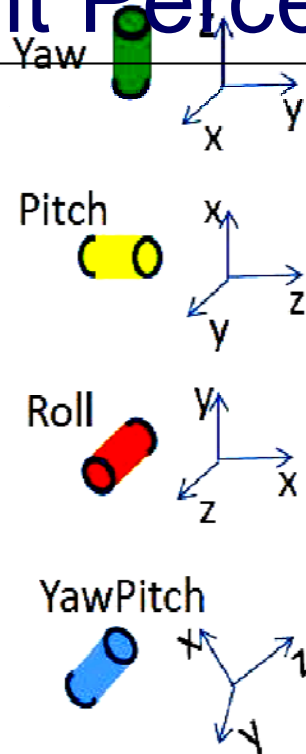
nothing selected

Joint	Parameter	Value	Range	
Head	Yaw	-28	-120.0	
	Pitch	23	-45.0	
Shoulder	Pitch left	-97	-120.0	
	Pitch right	-120	-120.0	
	Yaw left	37	-1.0	
	Yaw right	-34	-95.0	
	Roll left	-82	-120.0	
Arm	Roll right	119	-120.0	
	Yaw left	-80	-90.0	
	Yaw right	89	-1.0	
	Hip	YawPitch left	-58	-90.0
		YawPitch right	-58	-90.0
Pitch left		-21	-25.0	
Pitch right		51	-25.0	
Roll left		45	-25.0	
Roll right		18	-45.0	
Knee	Pitch left	-63	-130.0	
	Pitch right	-63	-130.0	
Ankle	Pitch left	-9	-45.0	
	Pitch right	17	-45.0	
	Roll left	4	-45.0	
	Roll right	-25	-25.0	

Keyframe:  
Set of angles for special poses.

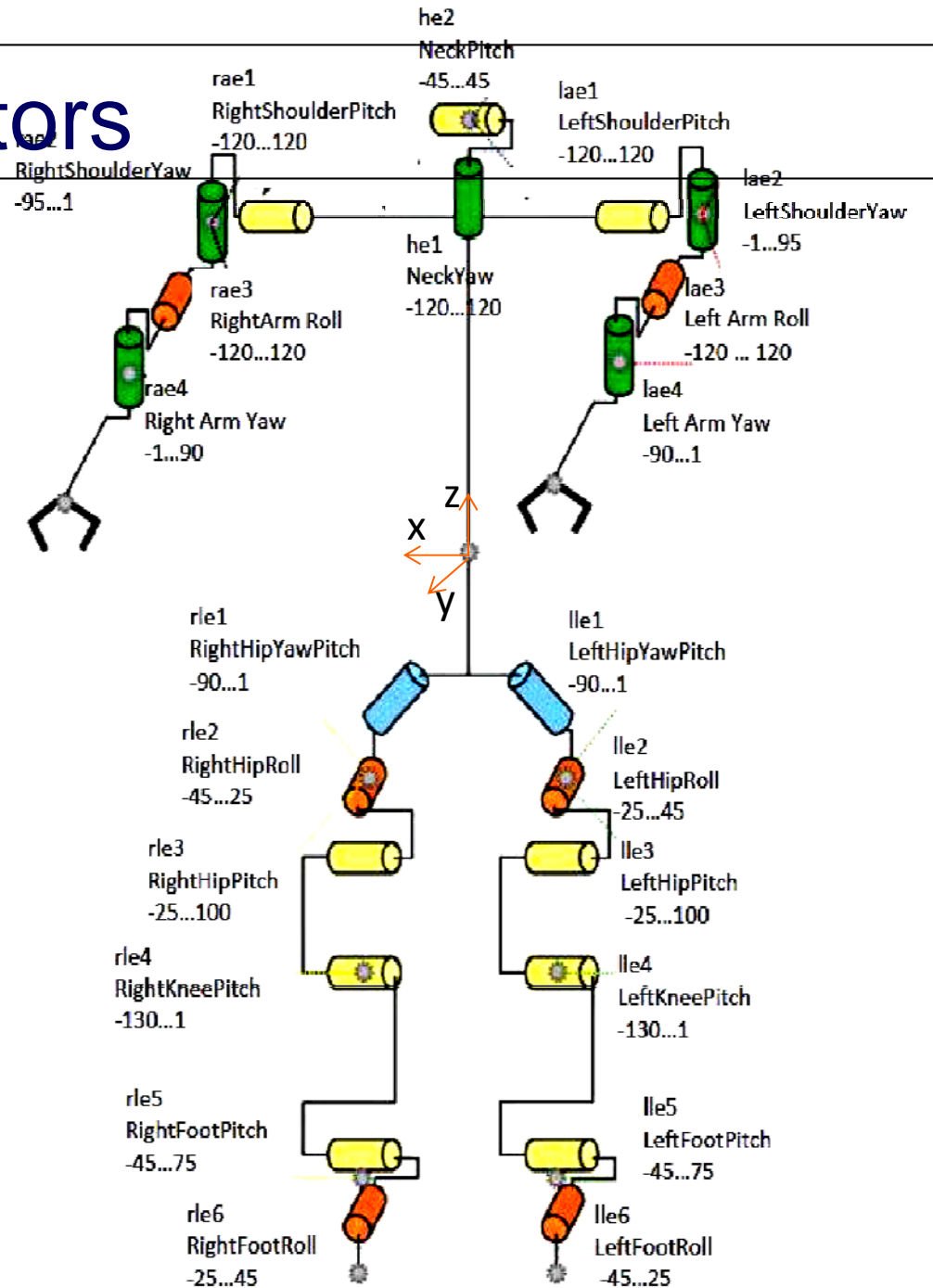


# Hinge Joint Perceptors



Information about actual angles at the joints.

Example:  
(HJ (n laj3) (ax -1.02))



# Further Perceptors

- Gyrometer
- Accelerometer
- Force Resistance Perceptor at the feet
- Vision Perceptor
- Hear Perceptor
- Game State Perceptor

# Problems with SimSpark

- Difficult usage for inexperienced people.
- Large efforts for communication and message parsing.
- Existing programs too complicated or with “hidden” details (cf. our previous SimpleSoccer Project).

Beginners must handle all problems at once, can not concentrate on single aspects like "only reading perceptor values" or "only developing motions".

# The RoboNewbie Project

Diploma Thesis Monika Domanska

Framework where user can concentrate on robotics aspects:

- Direct access to sensor/perceptor data.
- Easy understandable structure (sense-think-act).
- Basic motion skills.
- Simple examples/exercises for introduction.
- Open for challenging extensions including Machine Learning.

Usage by anybody interested in Robotics,  
especially for High Schools and Universities.  
Suited for e-learning.

Programs written in Java.

# Experiences with RoboNewbie up to now

First tests with parts of the program:

- Anna-Seghers High School Berlin May 2012
- 2 Lectures in Novi Sad in June 2012

Test with full program:

- DAAD INTENSIVE COURSE “Robotics and Mathematics”  
12-18 August, 2012, Ohrid, Macedonia



DAAD—Project in the framework of the Stability Pact for South East Europe

Center of excellences for applications of mathematics

Intensive course

# Robotics and Mathematics

12-18 August, 2012

**Arrival and registration on**  
12<sup>th</sup> August at 1PM

**Lectures start on**  
12<sup>th</sup> August 3PM.

**Departure on**  
18<sup>th</sup> August AM or PM

**Accommodation will be provided by the organizers**

## Lecturers

**Hans-Dieter Burkhard**, Institute of Computer Science, Faculty of Mathematics and Natural Sciences, Humboldt University of Berlin, Germany

**Nevena Ackovska**, Institute of Intelligent Systems, Faculty of Computer Science and Engineering, University St. Cyril and Methodius, Macedonia

## Program

6 lecture days, maximum 4 classes per day including robotic exercises, sun and lake in the afternoons

## Themes

- Engineering aspects of Robotics (N. Ackovska)
- Motion control, cinematics (H.D. Burkhard)
- Sensors, perception (H.D. Burkhard)
- Behavior and control (H.D. Burkhard)
- Image processing, world model (H.D. Burkhard)
- Bio-inspired Robotics, Emotions and Robotics (N. Ackovska)





# The Participants

1. Montenegro 3
2. Bosnia and Hercegovina 1
3. Serbia 6
4. Macedonia 5
5. Romania 1
6. Croatia 3
7. Bulgaria 3)
8. Kosovo 1



# The Preparation

Participants were supposed to have their own laptops.

Prerequisites for the exercises:

1. Java Netbeans 7.1.1
2. SimSpark (Soccerserver) for Windows XP or 7 .
3. RoboNewbie010.
4. Java 3D.
5. Motion Editor

Introductory materials for:

- a) Installation
- b) Simspark
- c) RoboNewbie
- d) Motion Editor

# RoboNewbie

Programs and materials could be downloaded from a website before the workshop.

*Please note that the framework is still under development. There should be no links from this page so far (so please do not make any external link to the page).*



The RoboNewbie Agent is a basic framework for the development of simulated robots.

It is implemented to serve as an inspiration for beginners and it provides room for many challenge experiments. It runs in the simulation environment of the official RoboCup 3D simulator, where

# Lectures

ca. 20 hours

Computer engineering aspects of Robotics (Nevena Ackovska)

Motion control, kinematics (Hans-Dieter Burkhard)

Sensors, perception (Hans-Dieter Burkhard)

Image processing, world model (H.-D. Burkhard)

Bio-inspired Robotics, Emotions and Robotics

(Nevena Ackovska)

+ exercise on emotional aspects of speech

(Vesna Kirandziska)

“Behavior and control” (H.D. Burkhard)  
was omitted to have  
more time for exercises.





# Practical Exercises with RoboNewbie

held by Monika Domanska  
("Nika")

ca. 10 hours  
+ individual work for  
up to 20 hours more



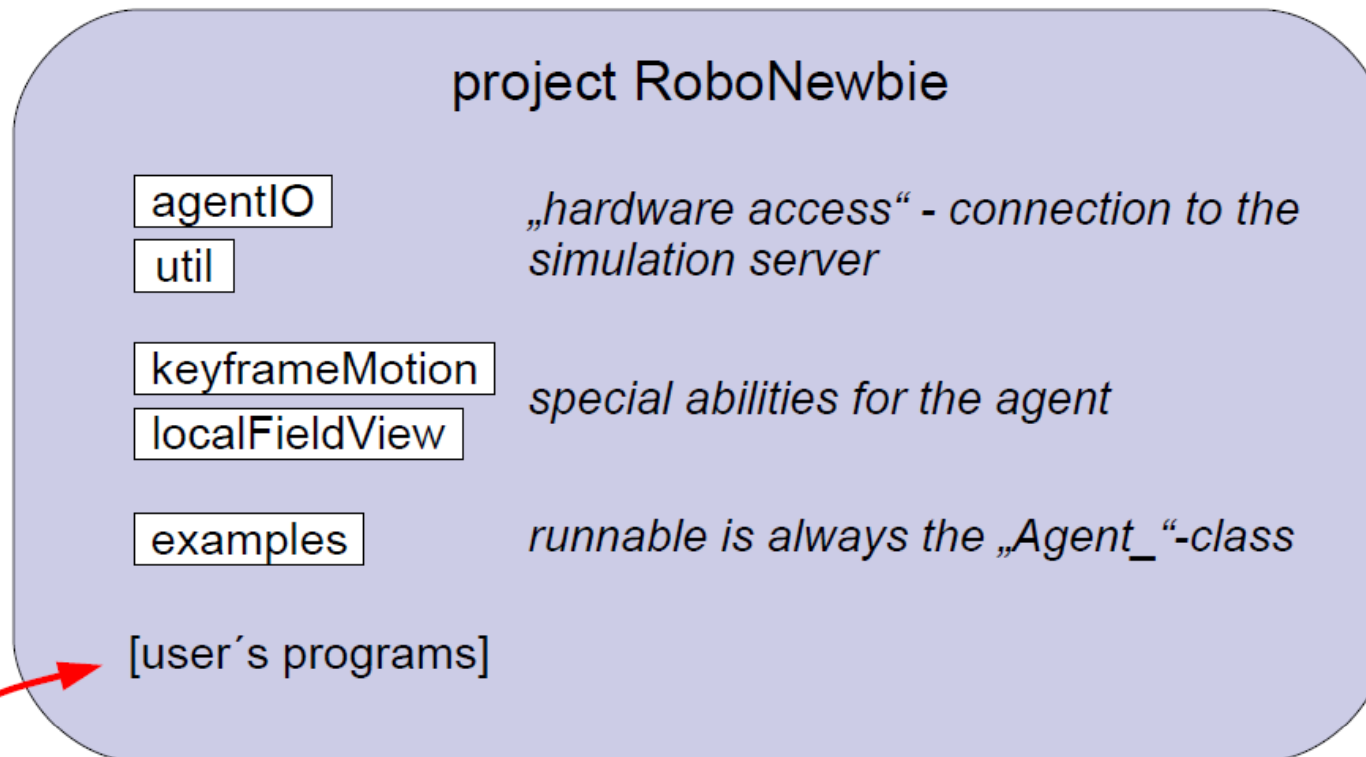
# Practical Exercises with RoboNewbie





## Structure overview

Java package structure:



Create your own programs here inside the RoboNewbie project, because of data and library dependencies.

## Debugging agent code

### **Problem:**

Using debug messages printed on *System.out* need too much time, and the agent can not synchronize with the 20ms-cycle of the simulation server.

This causes different strange behaviours of the controlled robot, e.g. it does not execute motor commands as expected.

### **Solution:**

1. Use the class `util.Logger` (syntax is shown in the examples) and print the debug output after the agent program has finished.
2. Use the „Agent synchronized mode“ (Sync-mode) of the simulation server and print the output during the runtime of your agent program.

# Practical Exercises with RoboNewbie

## Exercises

for understanding the usage of RoboNewbie:

Exercise 1: Try out changing Agent\_BasicStructure

Exercise 2: Recognize another agent (raise arms)

Exercise 3: Walk avoiding an obstacle

Exercise 4: Design a motion for kicking the ball

## Classes for using perceptors

Exercise 2: Show, where the other agent is.

Implement an agent, which lifts the robots arm, when it senses another robot and moves the arm down, when it does not sense any robot. If the other robot is on the left side of your own one, lift the left arm, and the right arm for the right side.

(Limits for lifting and dropping the arms are not important, just set the effectors to move into the correct direction.)

Instructions:

Change a copy of `Agent_TestLocalFieldView`. Define:

```
id = „0“
```

```
team = „simpleSoccer“
```

```
Beam coordinates: X=-1, Y=-1, Rot=90.
```

Use `Agent_SimpleSoccer` as the target. Start it at different initial positions.

# Workshop Competition (Exercise 5)

Become the Soccer Champion of the Fast Scoring Competition of Ohrid!

The example agent SimpleSoccer pushes the ball towards the goal. During 10 minutes it almost reaches the goal with the ball. You can use this program as an inspiration for your task.

You can modify and extend it with new motions, better perception and more intelligent behavior. You can even program a team of up to 4 robots which cooperatively perform the task.

The winner is the team with shortest time to score.

Or: Closest distance to opponent goal after 3 (!) minutes

# Teams at Workshop Competition

Become the Soccer Champion of the  
Fast Scoring Competition of Ohrid!

6 Teams with of up to 4 members.

Comparable qualification levels for all teams.  
(Skills in JAVA, Robotics, Mathematics by self judgements)

Internationally mixed teams were required.



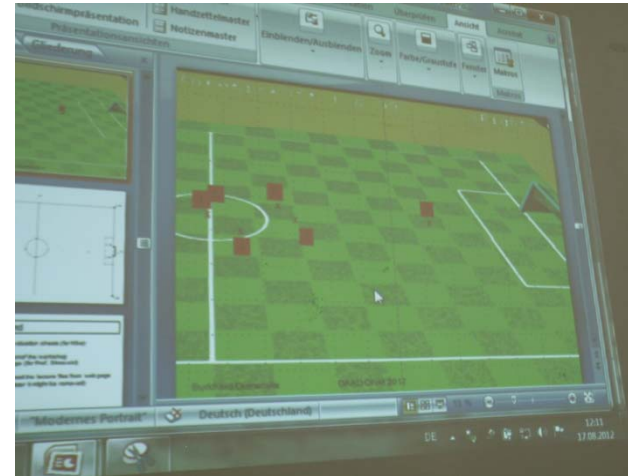
Milica Adzic	Podgorica
Petre Lameski	Skopje
Desislava Stoyanova	Plovdiv
Antonia Grbic	Zagreb



# Team Work



# The Competition

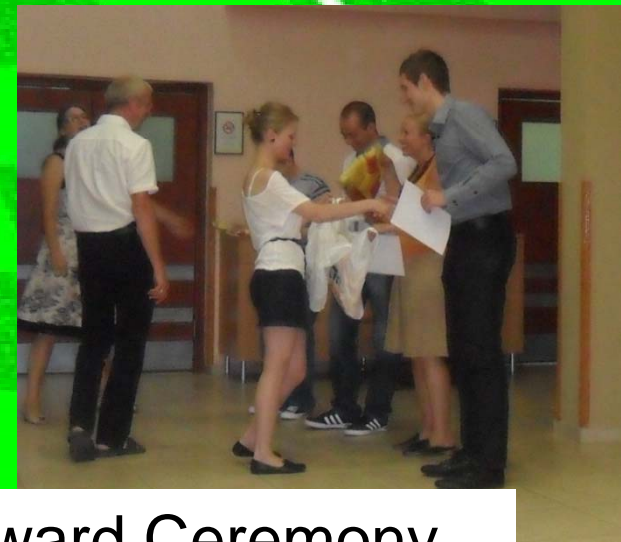
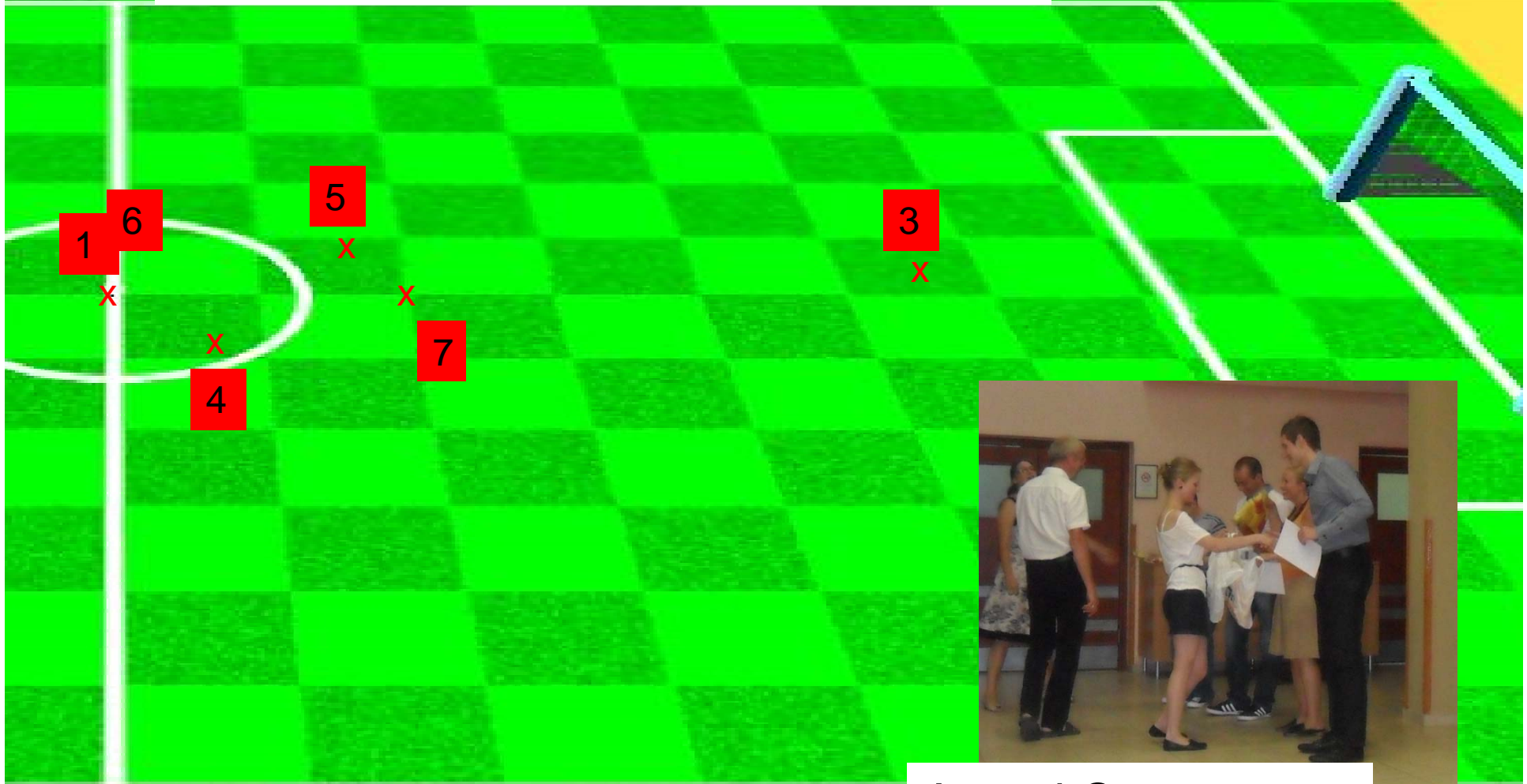




foreKickOff t=0.00

<Right>

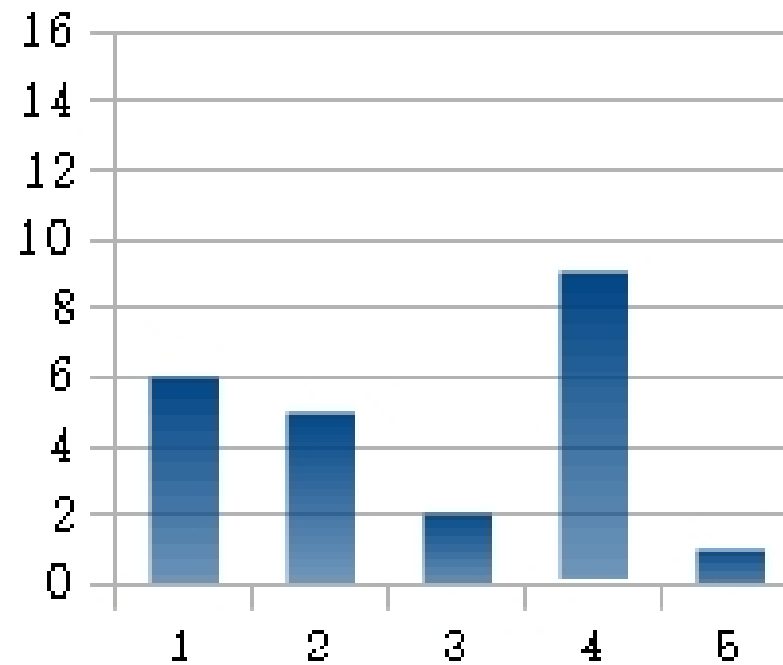
Final result: No team could score,  
But one team came close to the goal.



Award Ceremony

# Evaluation

Did you program in Java before the course?

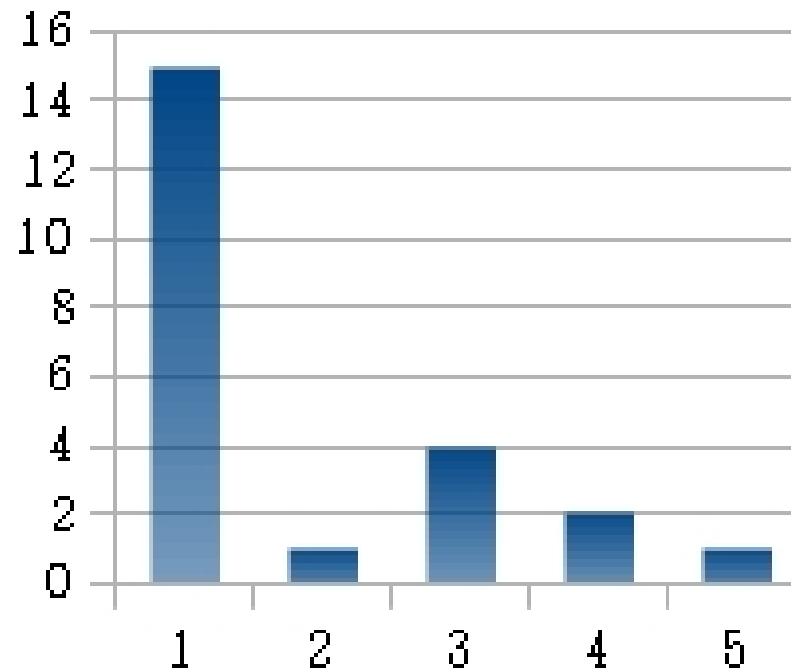


1 - "few or any experience"

5 - "much experience"

# Evaluation

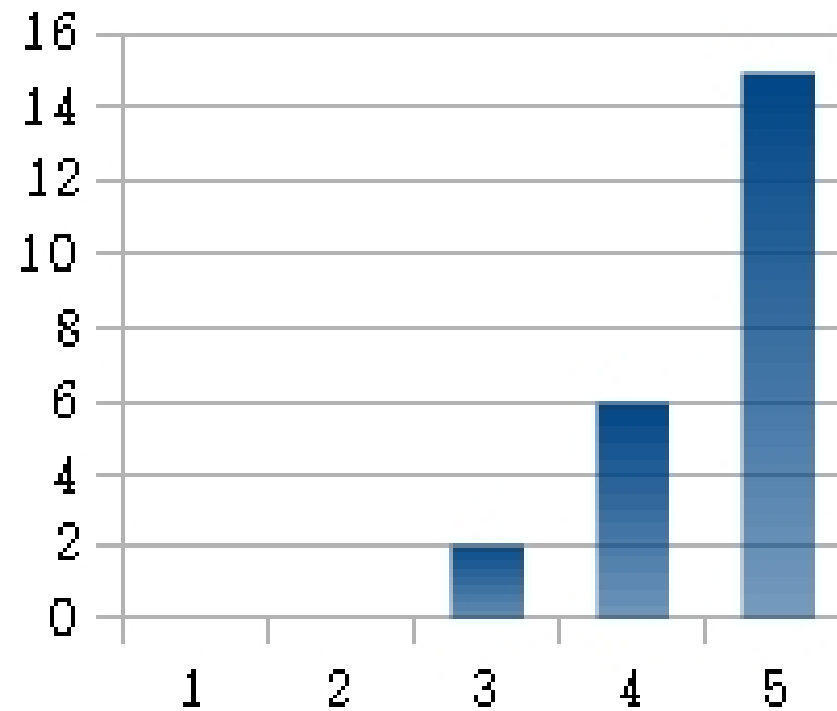
Did you implement robot controls before the course?



1 - "few or any experience"  
5 - "much experience"

# Evaluation

Where the exercises motivating?

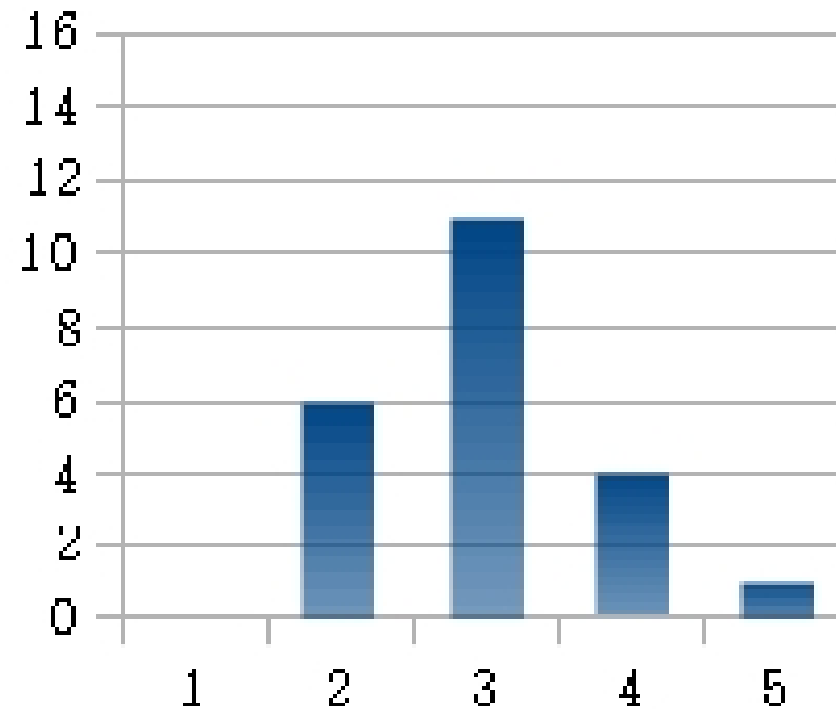


1 - "boring"

5 - "motivating"

# Evaluation

How was the level of the exercises?



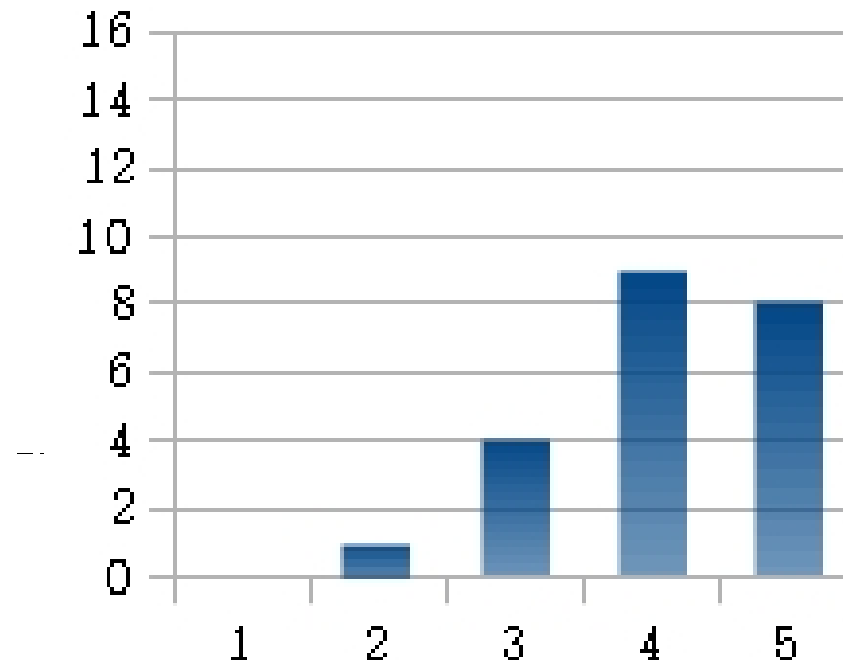
1 - "too easy"

5 - "too difficult"



# Evaluation

Did the "Quick start"-lessons help to understand the framework?

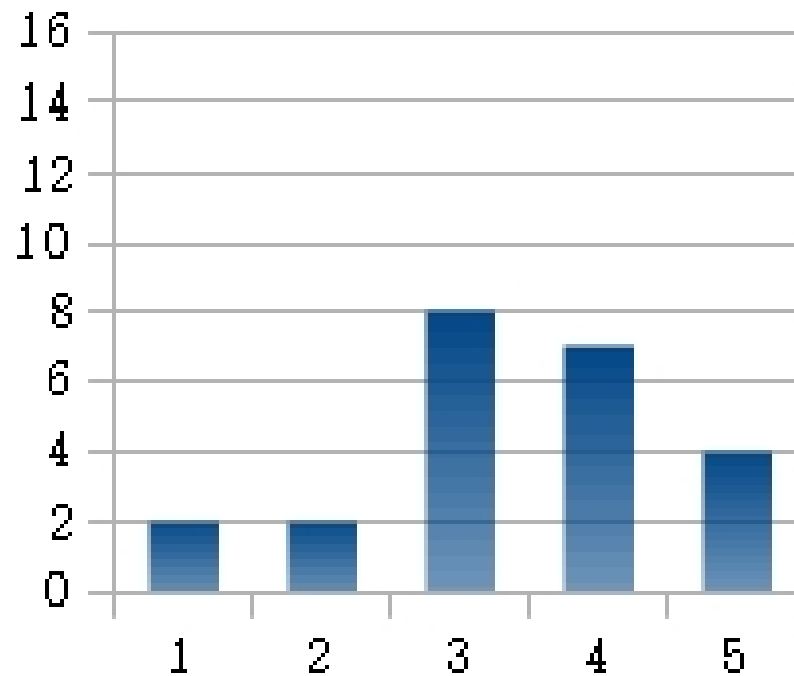


1 - "not at all"

5 - "very helpful"

# Evaluation

How do you consider the structure of the framework?

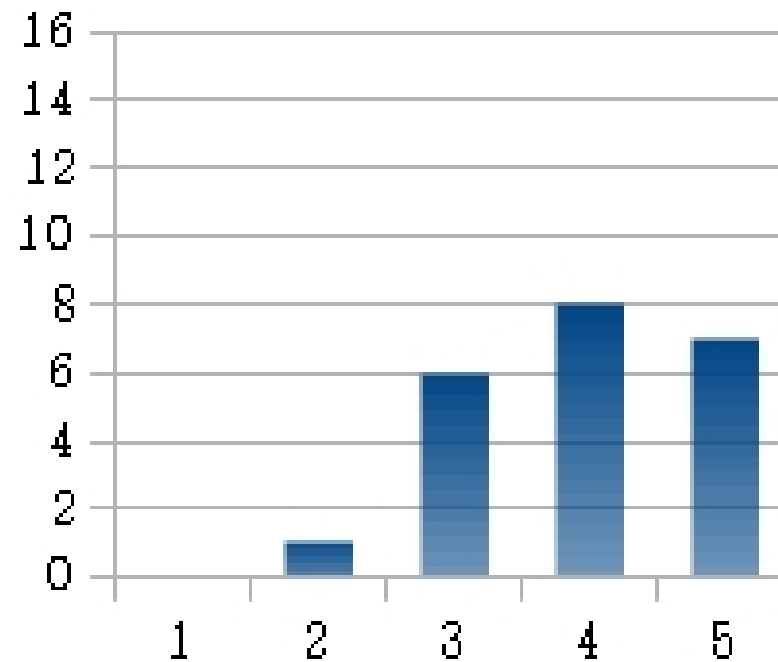


1 - "hard to understand"

5 - "intuitive"

# Evaluation

How is the usage of the classes?

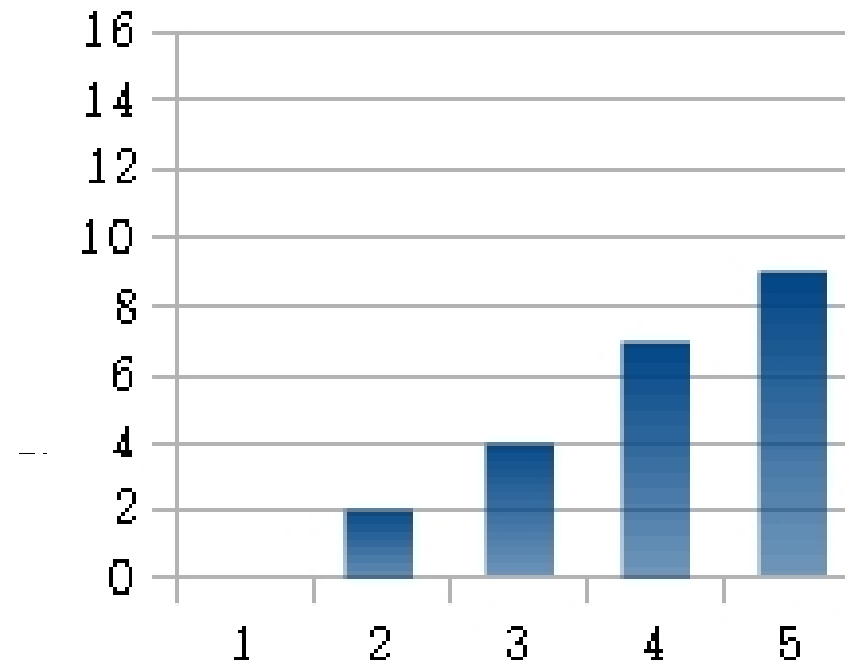


1 - "not comfortable"

5 - "intuitive"

# Evaluation

Did you use the documentation inside the source code?

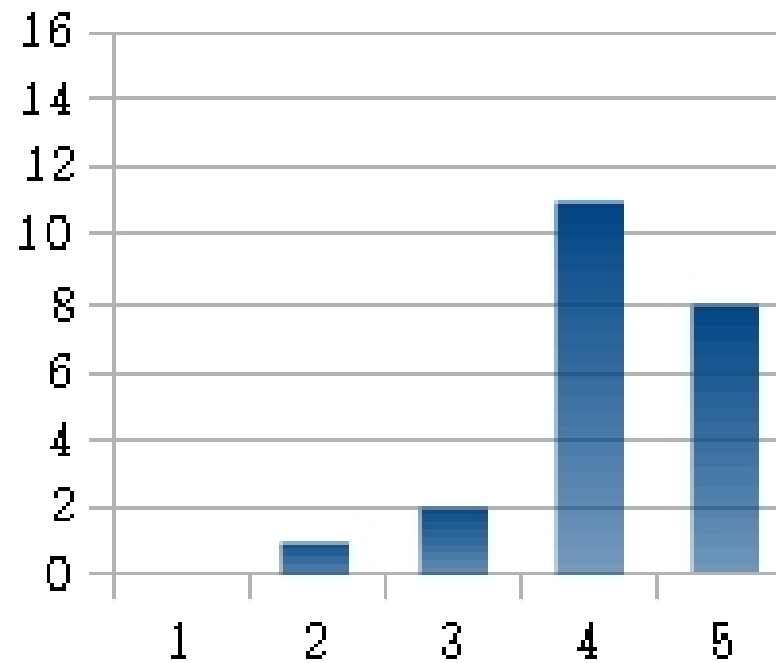


1 - "not at all"

5 - "very often"

# Evaluation

Is the documentation helpful?

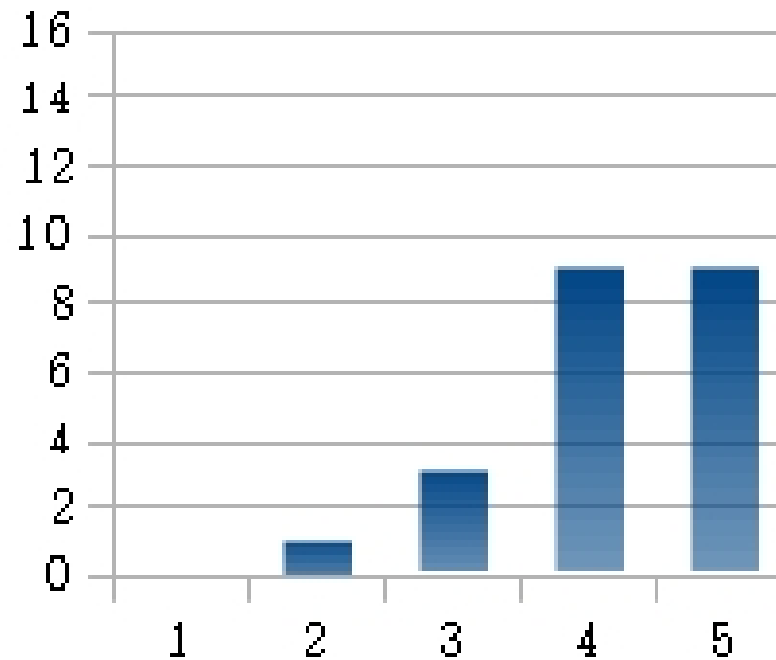


1 - "not at all"

5 - "very helpful"

# Evaluation

Does simulation help to understand real robots?



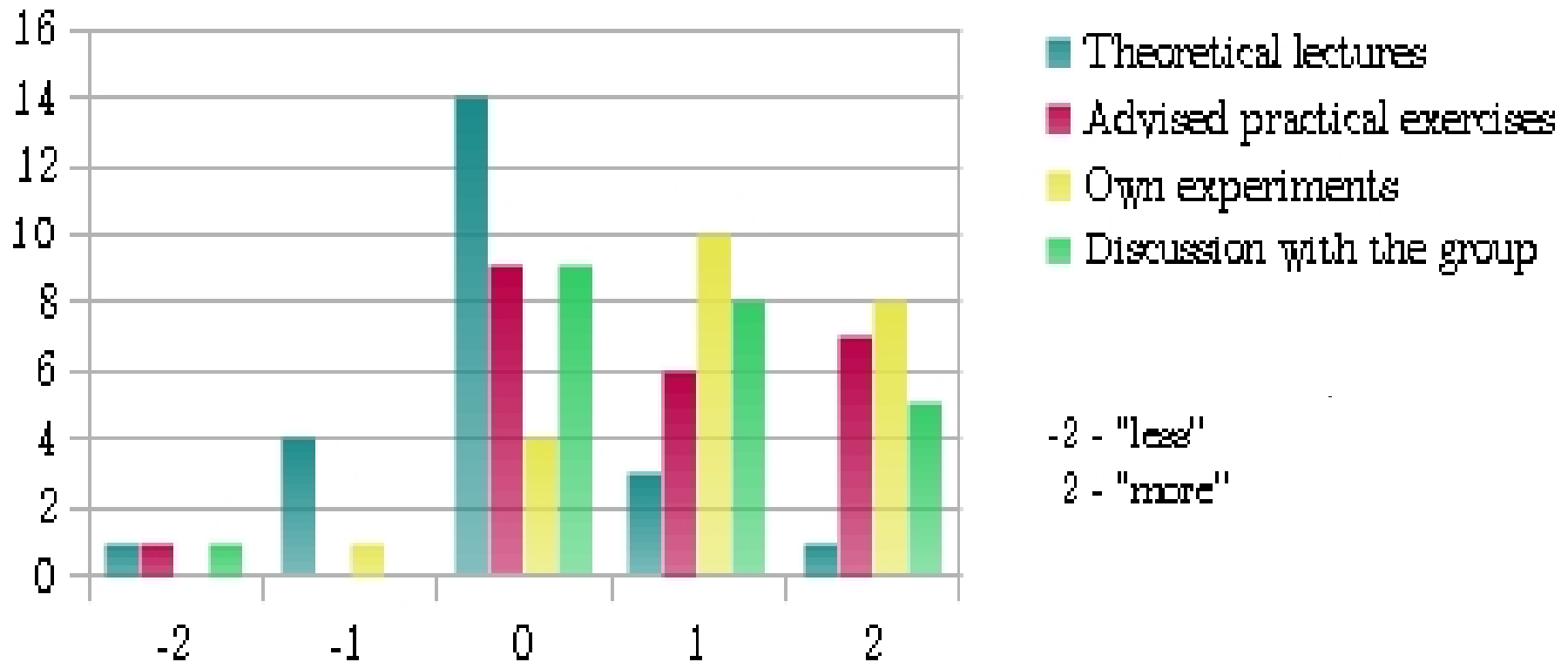
1 - "not at all"

5 - "very helpful"



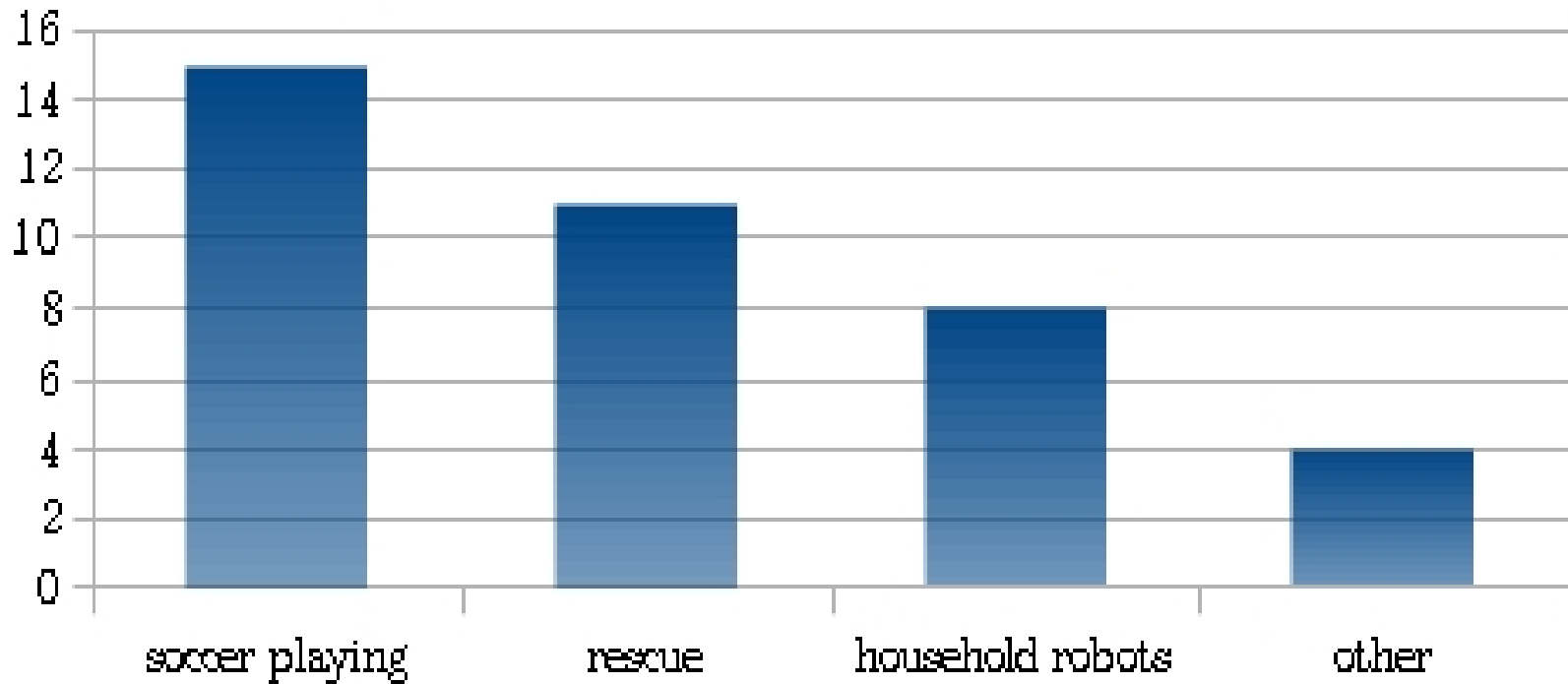
# Evaluation

Should we spent more or less time on the following parts of the course?



# Evaluation

Which scenarios are interesting as a task for learning robots?



# Next Steps with project RoboNewbie

- “Stabilization”: Program, Documentation, Website
- Extensions:
  - More motions, methods, etc.
  - More complex exercises
  - Machine Learning
  - Other scenarios besides soccer
- Test with High Schools
- Course “Cognitive Robotics” at Humboldt University
- One week course in Novi Sad in 2013

## Not the End ...

I would only add one more slide that states about the connections between the people. This really amazes me because we are talking about Balkans. Namely it seems that the students become really friendly to each other. Now they plan new schools, conferences and courses together. I follow them in Facebook and I'm quite amazed by the cooperation, even friendship that the school triggered. As Balkan born I find that very optimistic.



**Thanks to all!**