Programming Humanoid Robot in Python

Introduction

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Outline

1. Humanoid Robot
2. RoboCup: Robot World Cup
3. NAO - Technical overview
4. Python and Scientific Libraries
5. Robot Simulation: SimSpark
6. Exercise
Humanoid Robot

ASIMO development process
Humanoid Robot

DARPA Robotics Challenge

Programming Humanoid Robot in Python
Humanoid Robot

DARPA Robots

http://youtu.be/diaZFIUBMBQ
Humanoid Robot

1 can work in the environment for humans as it is,
2 can use tools for humans as it is,
3 has a human-like shape
RoboCup: The dream

By the **middle of the 21st century**, a team of **fully autonomous humanoid** robot soccer players shall win a soccer game, complying with the official rules of FIFA, against the winner of the most recent World Cup.

[http://youtu.be/Sm2WpSz8g0w](http://youtu.be/Sm2WpSz8g0w)
RoboCup Standard Platform League

Final in RoboCup 2014
RoboCup Standard Platform League

Teams and robots in RoboCup 2013
RoboCup: the landmark and standard AI problem

<table>
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<th>Chess</th>
<th>vs.</th>
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<td>Environment State Change</td>
<td>Dynamic Real time</td>
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<td>Central Control</td>
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Team DAInamite

http://youtu.be/oMkUI8f_TMQ

- 3 researchers, master students
- 6 NAOs
- one small and one big field
- passed: RoboCup 13-14, German Open 12-13, Iran Open 14
- coming: German Open 15, RoboCup 15
NAO - Hardware

- Tactile Sensors
- Speakers (X2) and Earleds
- Infrared Emitter/Receiver and Eyeleds
- Head Joint
- Chest Button
- Hip Joint
- Prehensile Hands
- Bumpers (X2)
- Front & Rear Microphones
- Cameras (X2)
- Lateral Microphones (X2)
- Shoulder Joint
- Sonars (X2)
- Elbow Joint
- Battery
- Wrist Joint
- Knee Joint
- Tactile Sensors
- Sensor Pressure
NAO - Software

C++

Python

Linux

NAOqi

Motion Module
Motion Core

FastGetSetDCM
Vision Module
Vision Core

CAgent
ALMemoryProxy
ALLedProxy
ALTTSProxy
DCMProxy

INao
debg tools
pyagent

Self Localization
Ball Tracker
Behavior
Sonar
Team Communication
Game Controller Client

C++

Python

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Python and Scientific Libraries

- **NumPy**: N-dimensional array
- **SciPy**: Scientific computing
- **Matplotlib**: Comprehensive plotting
- **IPython**: Interactive console
- **Scikit-learn**: Machine Learning
Robot Simulation: SimSpark

SPL Fork: https://github.com/xuyuan/SimSpark-SPL
Exercise

https://github.com/DAInamite/programming-humanoid-robot-in-python
More Information

- robocup.org
- tzi.de/spl
- aldebaran.com
- python.org
- scipy.org
- http://simspark.sf.net

Introduction to Humanoid Robotics

Humanoide Roboter: Theorie und Technik des Künstlichen Menschen

Kajita, S., Hirukawa, H., Harada, K., Yokoi, K.