



Task 7.2

Towards the Grounding of Abstract Categories in Cognitive Robots

Francesca Stramandinoli (ESR 13)

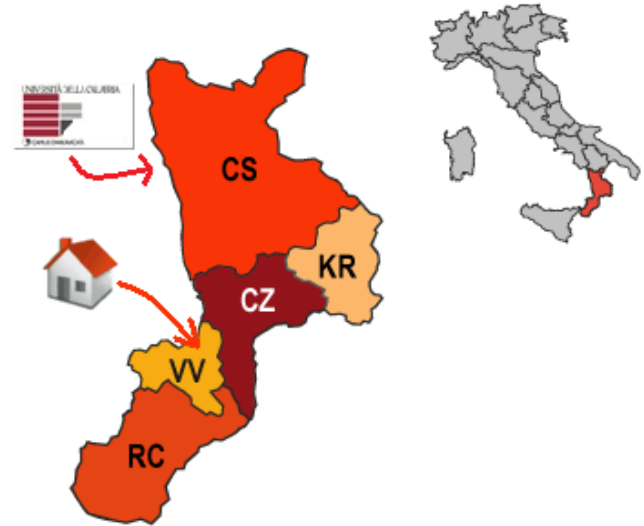
University of Plymouth
THINK&TALK Node

RobotDoC

Robotics for Development of Cognition

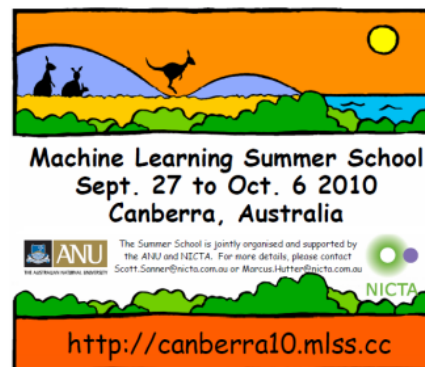
About Myself

- **My Home Town:**
 - Vibo Valentia, Italy
- **My Education:**
 - BEng in Computer Science Engineering
 - MEng in Automation Engineering
- **My Previous Research Interest:**
 - Design of CNN-based Algorithms for Image Processing
- **My Current Research Topic:**
 - Design of Robotic Models for the Grounding of Abstract Words in Humanoids



Summer Schools Attended

- VVV10 iCub Summer School, Sestri Levante (IT), July 2010
- Machine Learning Summer School (**Scholarship Award**), Canberra (AU), Sept 2010
- VVV11 iCub Summer School, Sestri Levante (IT), July 2011



- General Chair of the "RobotDoC-PhD Conference"

List of Publications

- Stramandinoli F., Cangelosi A., Marocco D., *"Towards the Grounding of Abstract Words: A Neural Network Model for Cognitive Robots"*, Proceedings of IJCNN-2011 International Joint Conference on Neural Networks, San Jose, August 2011
- Stramandinoli F., Rucinski M., Znajdek J., K.J. Rohlfing, Cangelosi A., *"From Sensorimotor Knowledge to Abstract Symbolic Representations"*, abstract in the Proceedings of "FET11 - The European Future Technologies Conference and Exhibition", Budapest, Hungary, 4th - 6th May 2011
- Stramandinoli F., Rucinski M., Znajdek J., K.J. Rohlfing, Cangelosi A., *"From Sensorimotor Knowledge to Abstract Symbolic Representations"*, poster presented at the "FET11 - The European Future Technologies Conference and Exhibition", Budapest, Hungary, 4th - 6th May 2011 (**Second Prize, Best Poster**)
- Stramandinoli F., *"Investigating the Grounding of Abstract Categories in Humanoid Robots through Multidisciplinary Collaborations"*, poster presented at the "Marie Curie Workshop", satellite event of the ESOF Conference, Turin, July 2010

Task 7.2

The Grounding of Abstract Categories

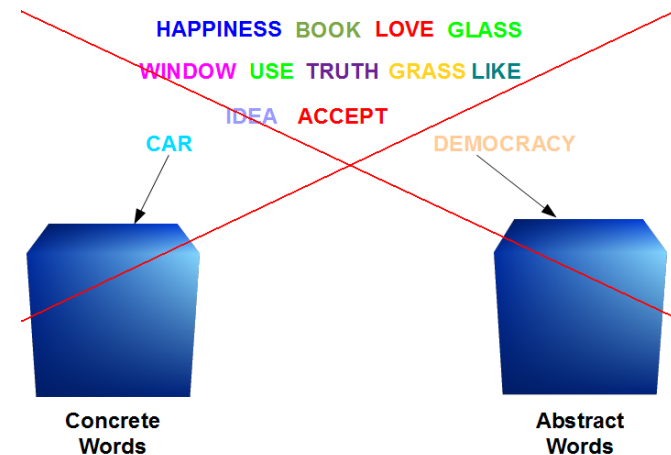
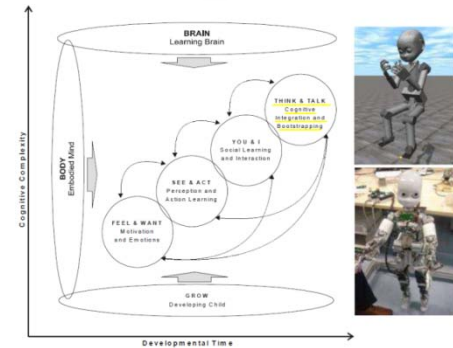
- **THINK&TALK Node:** Cognitive Integration and Bootstrapping (WP7)

- **My Supervisory Team:**

- Prof. Angelo Cangelosi, Dr. Davide Marocco
- Prof. Tom Ziemke, Dr. Francesco Nori

- **Open Questions:**

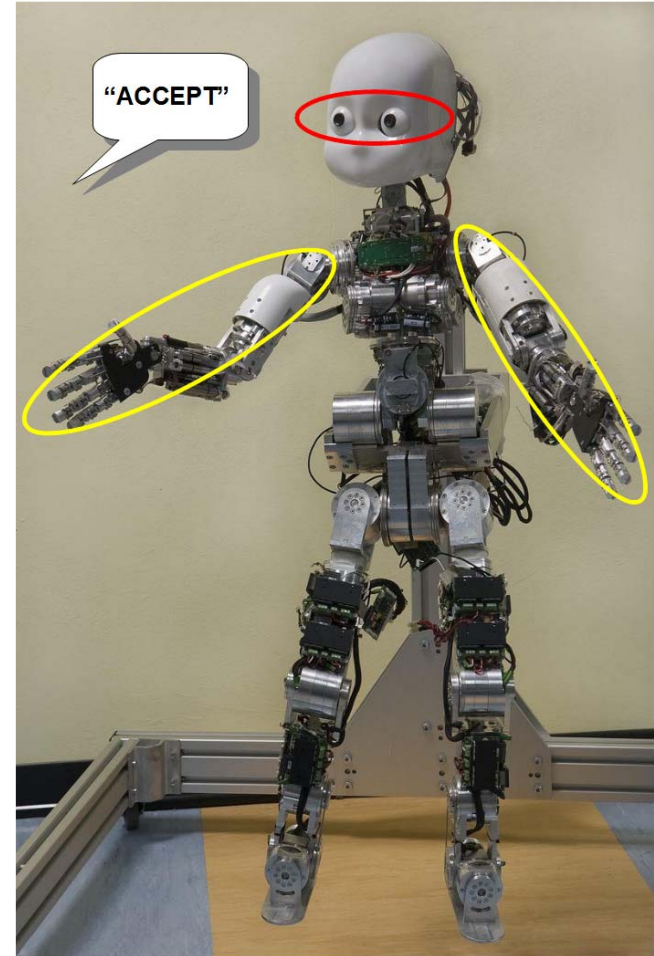
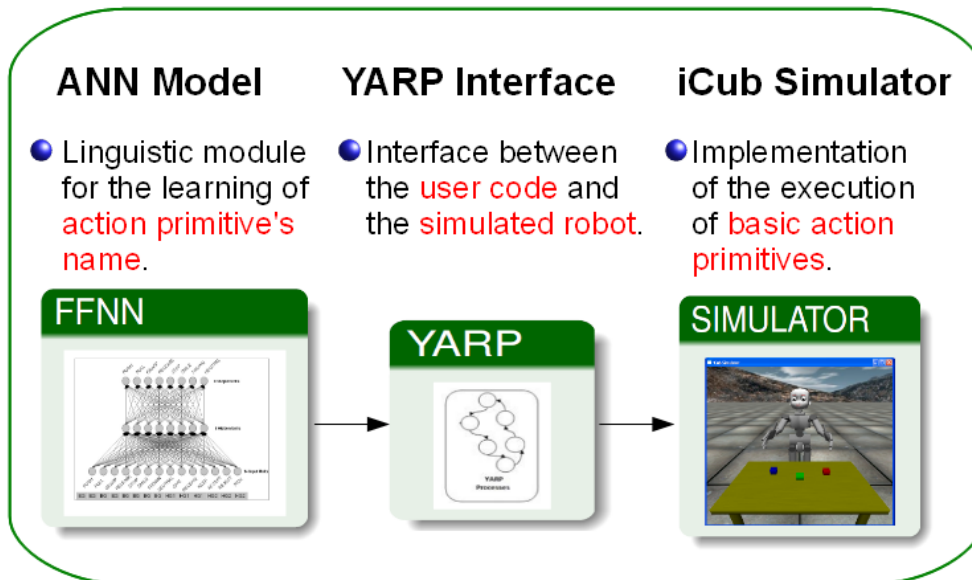
- How can robots use sensorimotor categories to indirectly ground abstract concepts?
- How can the symbol grounding mechanism be extended to generate and ground abstract categories?



Task 7.2

The Grounding of Abstract Categories

- Design of a **robotic model** for the grounding abstract words in sensorimotor experience
- Study of the relations between **LANGUAGE, VISION, ACTION**



Expectations of Working in RobotDoC:

- Visit of the Cognition and Interaction Lab in Skövde:



UNIVERSITY
OF SKÖVDE

RESEARCH
WITH
PLYMOUTH
UNIVERSITY

- Period spent: 19-29 June 2011
- Presentation of my research studies and the first results achieved for fostering further collaborations
- My Career Development:
 - Communication and time management skills
 - Presentation of scientific topics and academic writing
 - Developmental psychology, programming skills, artificial neural networks models)
 - Join established research community

Thank you for your attention





Second Part PhD Transfer Workshop

Francesca Stramandinoli (ESR 13)

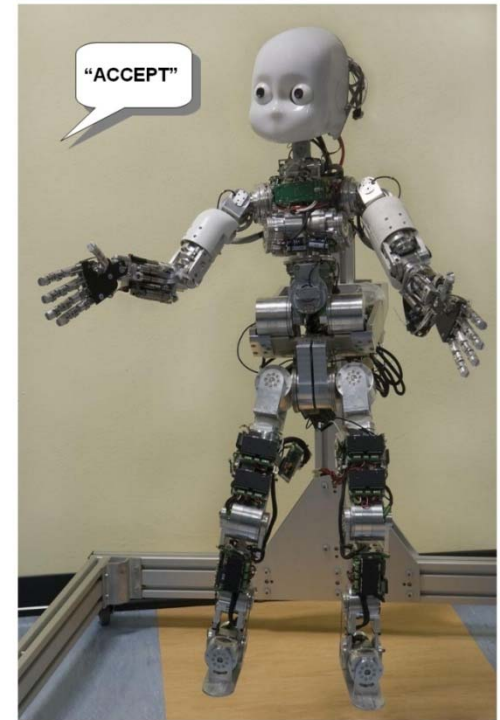
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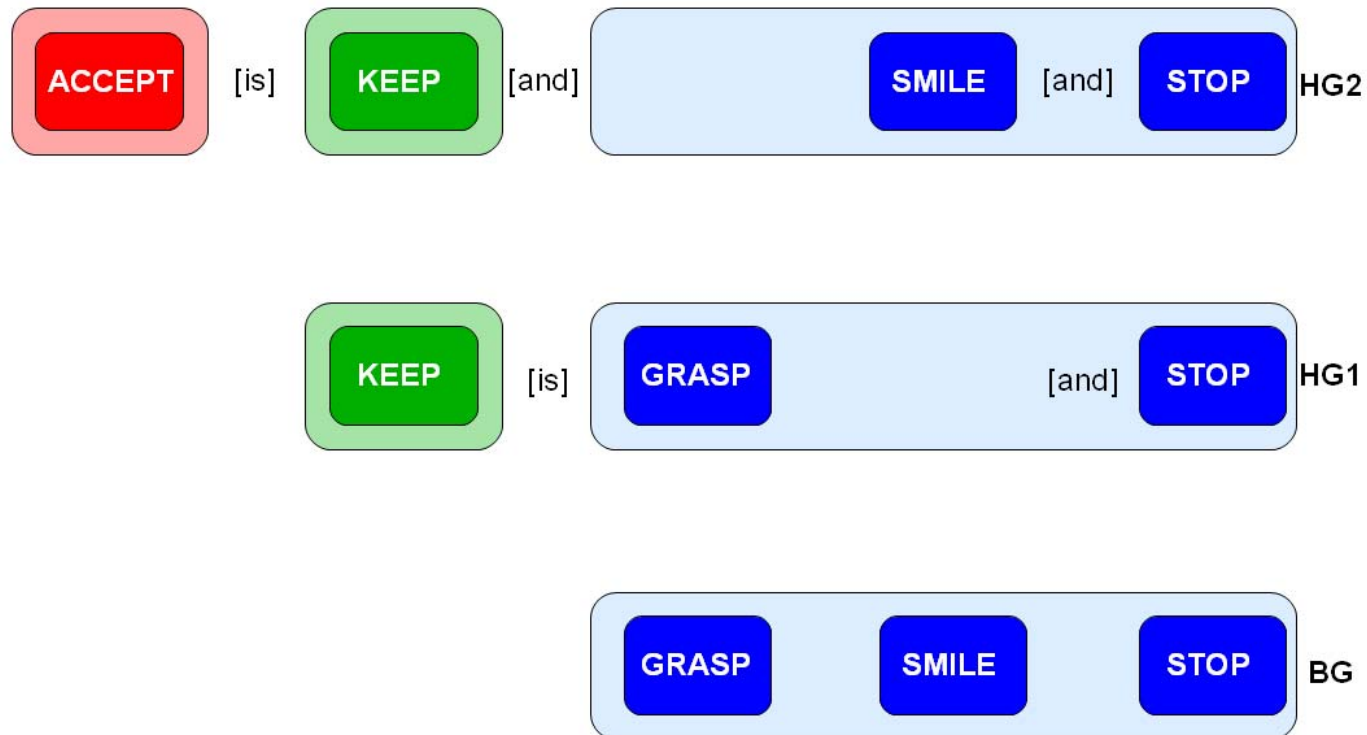
Robotics for Development of Cognition

Experiments Details

- GOAL: To train the iCub
 - To perform a set of **action primitives** (e.g. "PUSH", "PULL", "GRASP", "RELEASE")
 - Subsequently, by correlating **higher-order action words** (e.g. "KEEP", "GIVE", "RECEIVE") **with basic action primitives**, the robot acquires more **abstract concepts** (e.g. "PICK", "REJECT", "ACCEPT")



Learning the Meaning of "ACCEPT"



BG Stage: "GRASP", "SMILE", "STOP", etc..

HG1 Stage : "KEEP" [is] "GRASP" [and] "STOP"

HG2 Stage : "ACCEPT" [is] "KEEP" [and] "SMILE" [and] "STOP"

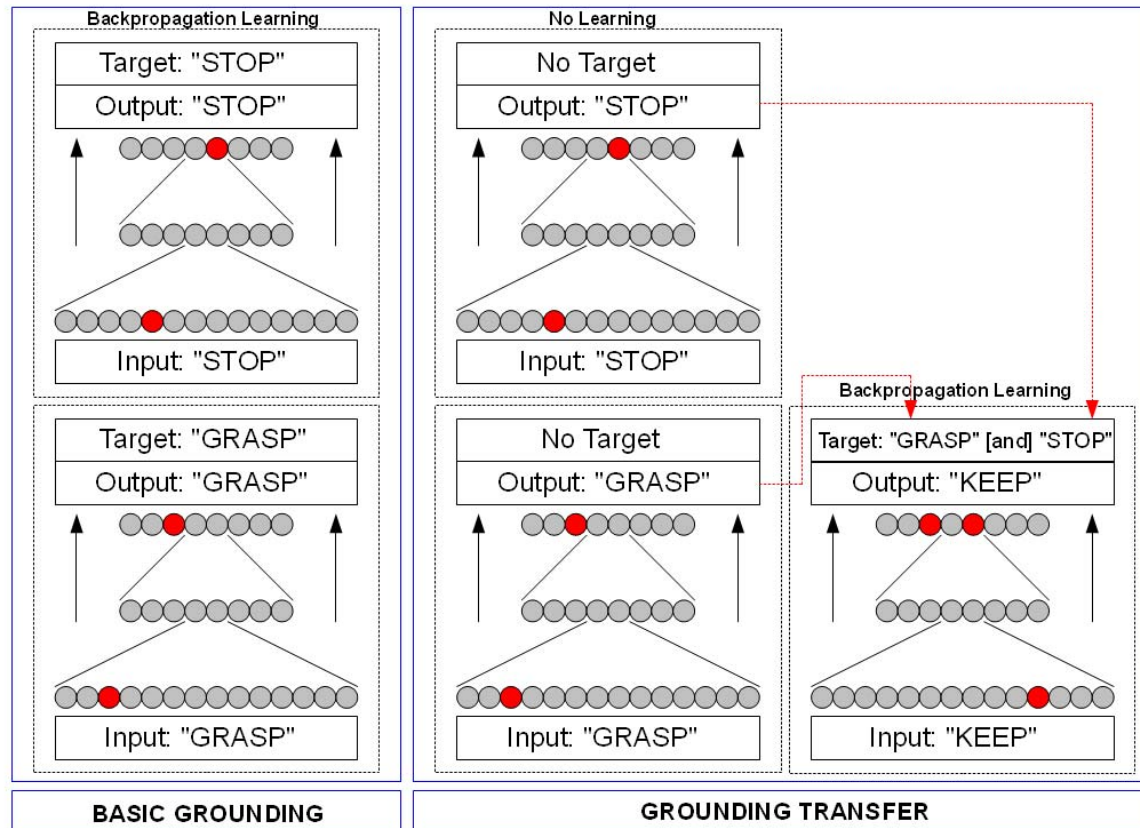
Neural Network Model

- **Basic Grounding Stage**

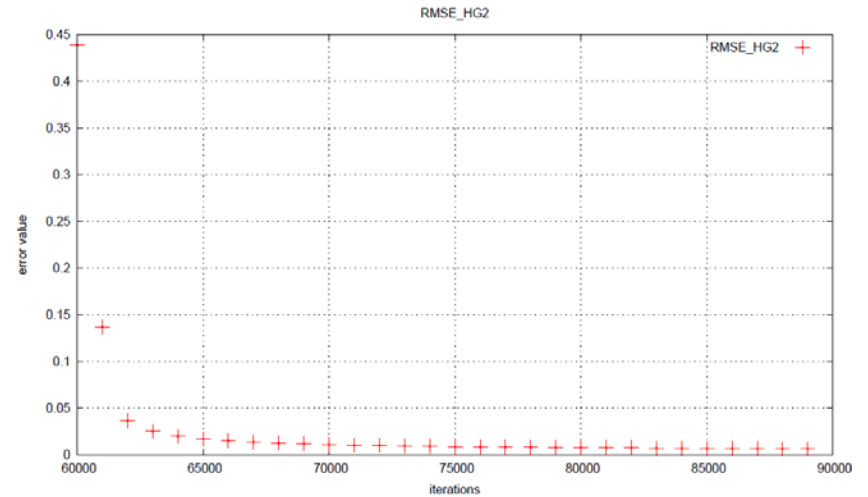
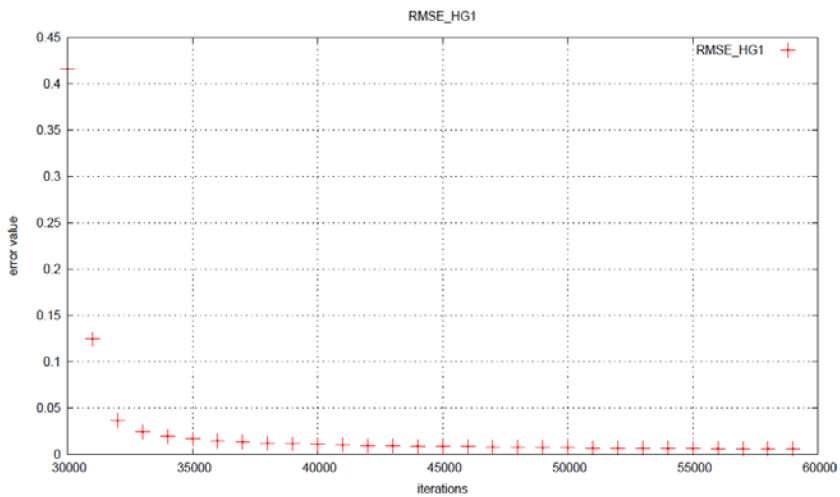
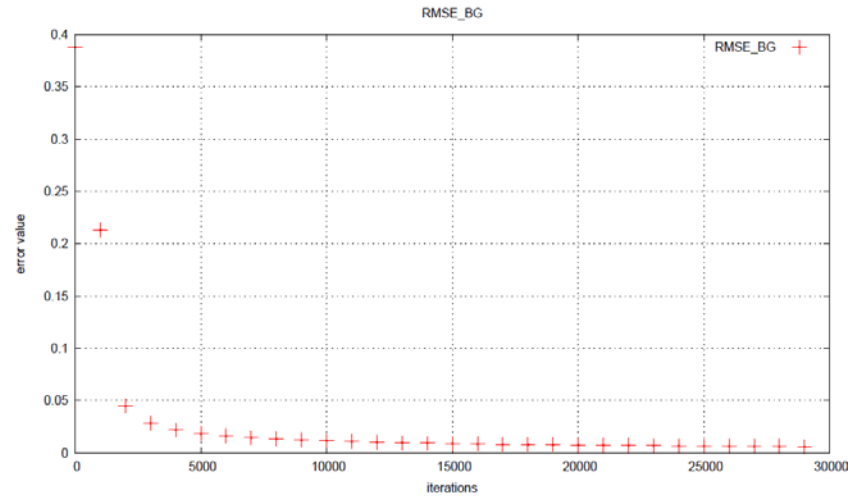
"GRASP", "STOP", etc..

- **Grounding Transfer Stage**

"KEEP" [is] "GRASP" [and] "STOP"

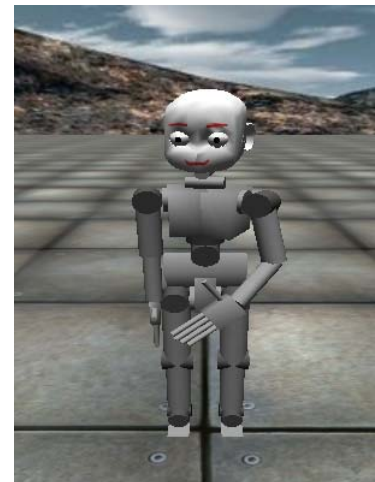
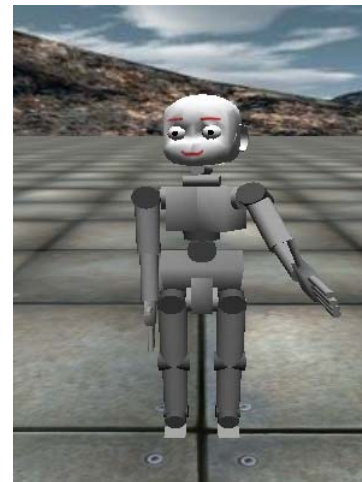
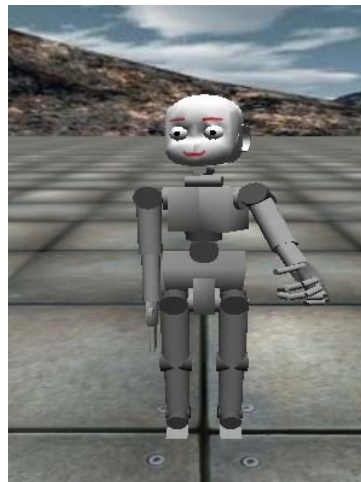
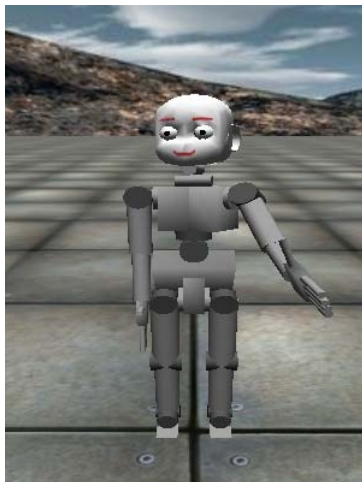
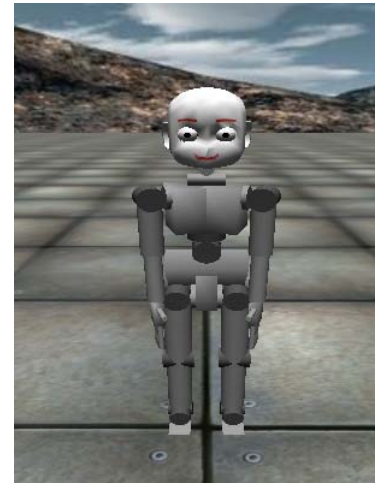


Simulation Results



Implementation of Action Primitives

- The basic action primitives are implemented by using the **Action Primitives Library** of the iCub software repository

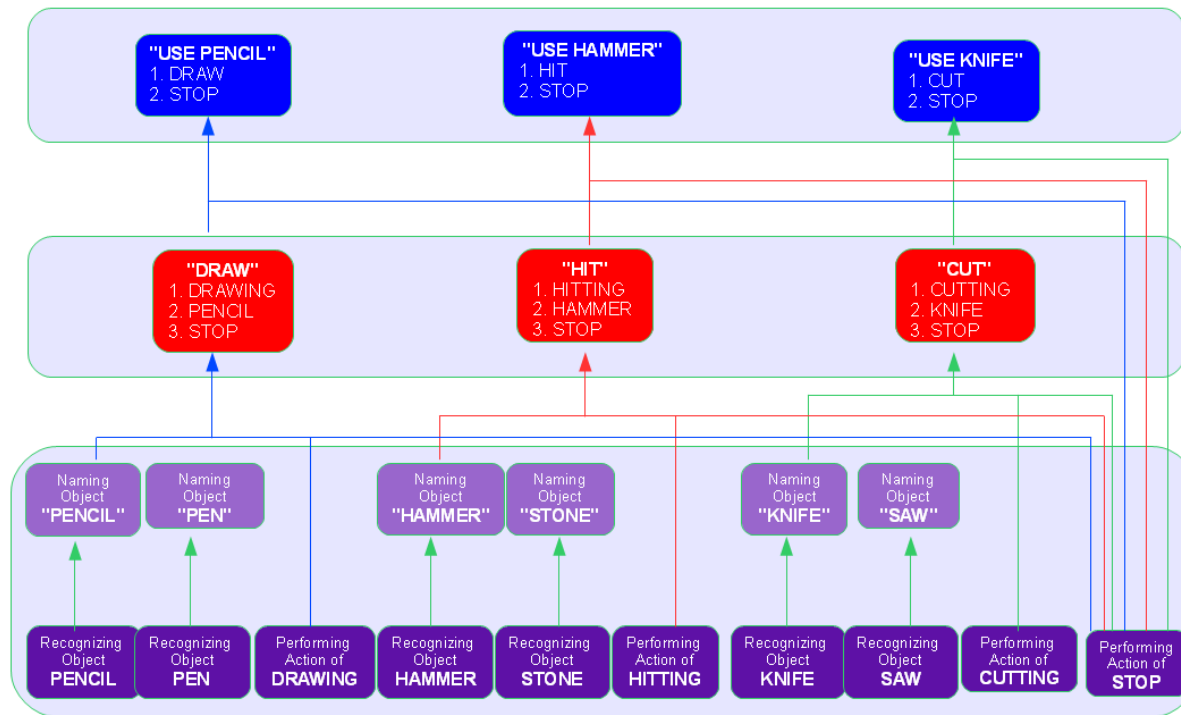


Conclusions and Future Work

- **Results** of simulated experiments show that the simulated iCub is able to gradually acquire **abstract representations** via combinations of **directly grounded words**
- **Extension** of the presented model to include in the Neural Network controller the execution of **action primitives**
- **Extension** of the current work to concepts with a major level of **abstractness** (e.g "USE", "MAKE")

Future Work

- Learning the Meaning of "USE"



Thank you for you attention