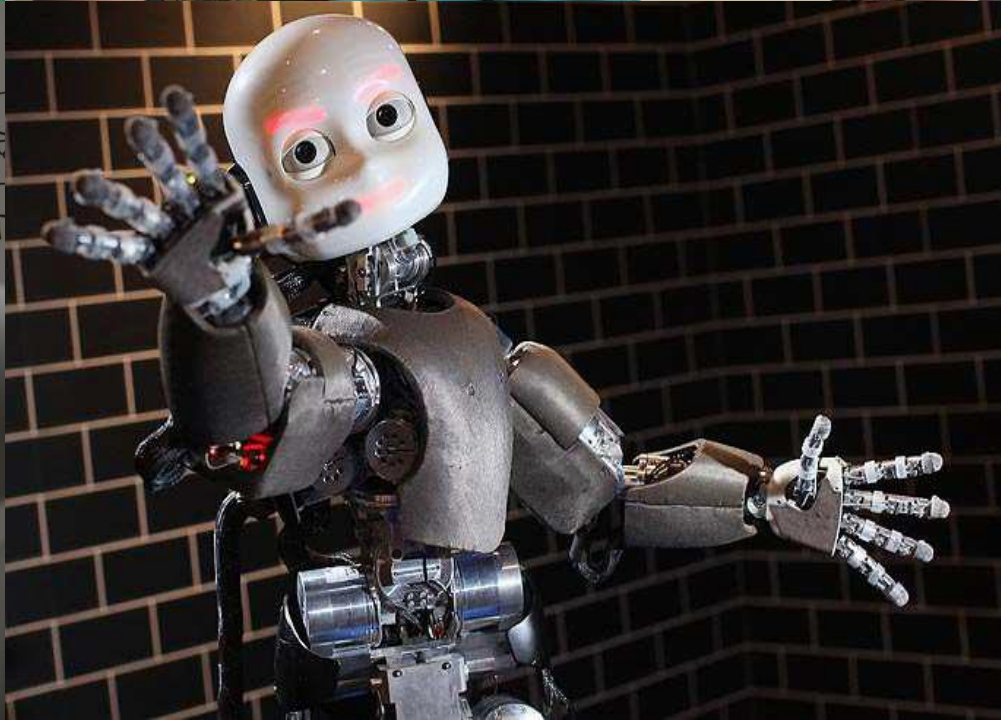
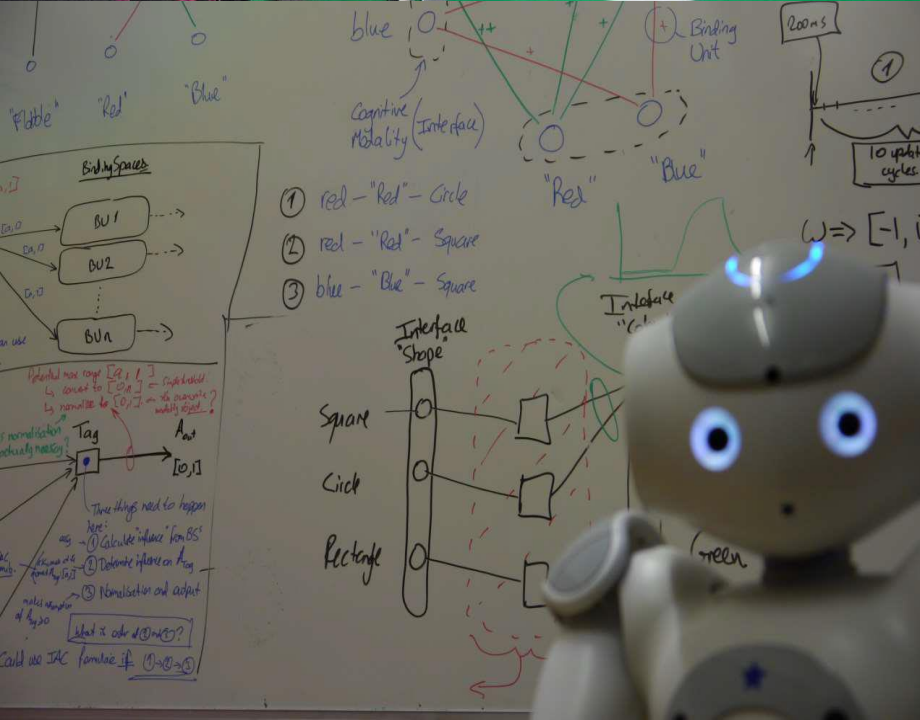


Cognitive Robots

Biointelligence Laboratory
School of Computer Science and Engineering
Seoul National University



What is Cognitive Robotics?

- Endowing robots with mammalian and human-like cognitive capabilities to enable the achievement of complex goals in complex environments.
- Focused on using animal cognition as a starting point for the development of robotic computational algorithms
- As opposed to more traditional Artificial Intelligence techniques, which may or may not draw upon mammalian and human cognition as an inspiration for algorithm development.

What is Cognitive Robotics?

- Endowing robotic or software agents with higher level cognitive functions that involve reasoning, for example, about goals, perception, actions, the mental states of other agents, collaborative task execution, etc.

-University of Toronto Cognitive Robotics group

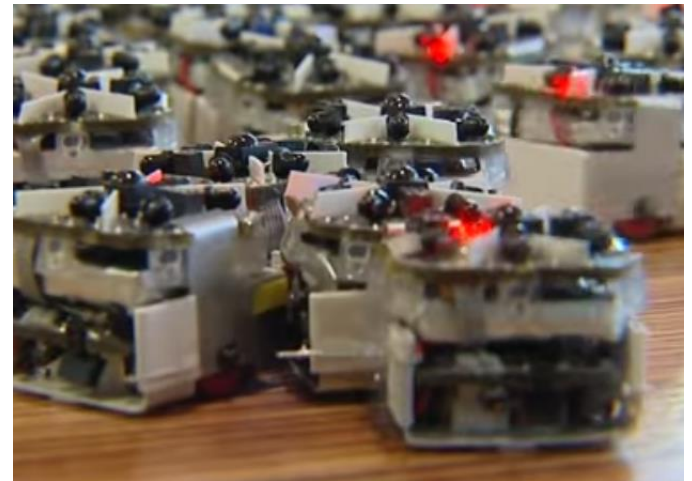
What is Cognitive Robotics?

- Cognitive robotics is a new approach to robot programming based on high level primitives for perception and action. These primitives draw inspiration from ideas in cognitive science

-CMU's Cognitive Robotics course

Cool Videos

- [Animal-Inspired Robots](#)
- [Big Dog](#)
- [Humanoid Robot \(Nao\)](#)
- [Robots with a minde of their own](#)
- [Evolutionary Robotics](#)



Cognitive Robotics: Robotics + Cognitive Science

- Cognitive Robotics as building robots with cognitive capabilities:
 - High-Level Perception and Action
 - Attention
 - Memory
 - Learning
 - Concept Formation
 - Reasoning and Problem Solving
 - Communication and Use of Language
 - Theory of Mind
 - Social Interaction

Cognitive Science to Robotics

- Cognitive Robotics as applying knowledge from cognitive science to robotics.
 - Cognitive psychology has described cognitive capabilities of humans
 - Cognitive science tries to build computational models that could be implemented in a robot
- But why should robots work the way humans work?
 - Maybe robots can do things better than humans!
- On the other hand, maybe there are good reasons for why humans work the way they do, and we can learn from that for robotics
 - Cognitive Science tries to understand why human cognitive capabilities are as they are

From Robotics to Cognitive Science

- Cognitive Robotics can be used to drive the science of cognition
 - Cognitive robotics as a platform to test theories about human cognition.
 - Cognitive Science as the science of all forms and kinds of cognition and cognitive agents, whether these be human, animal, alien, robot, or otherwise. Thus:
 - Robotic systems are cognitive systems, and are interesting to study in and of themselves

From Robotics to Cognitive Science

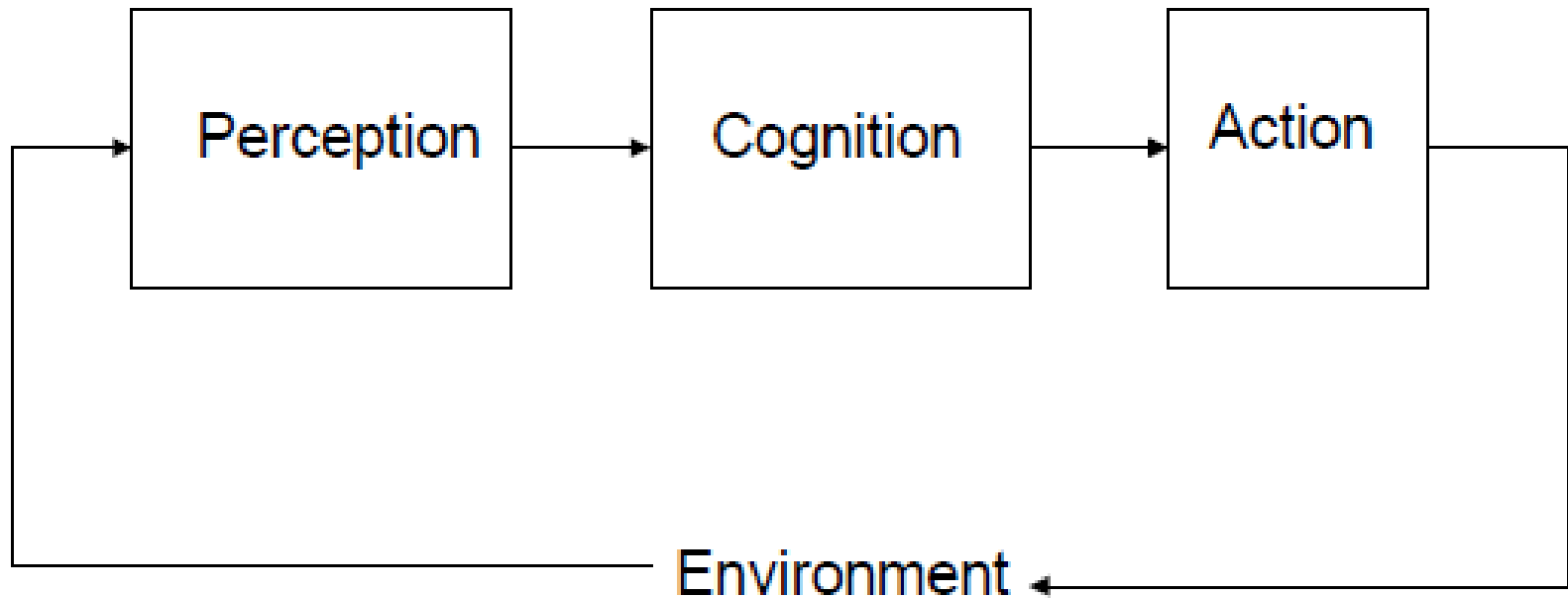
- Cognitive Robotics as Experimental Cognitive Science
 - Cognitive Robotics as the use of robotics to explore cognitive systems or architectures, to develop new concepts and frameworks of cognition, and to formulate and test cognitive hypothesis.

How Cognitive Science can Contribute

- Example : Vision
- Typical robotics/machine vision approach:
 - Bottom-Up processing of static snapshots
 - From raw data to color segmentation to edge detection to object recognition to 3D map
 - Hence:
 - More snapshots often means more work
 - Perception is ‘mere’ input to subsequent processing (‘cognition’)
- Cognitive Science Findings:
 - Plenty of Top-Down effects
 - Perception is Constructive
 - Perception is Selective
 - Indeed:
 - More input helps perception
 - Perception is integrated with other cognitive processes

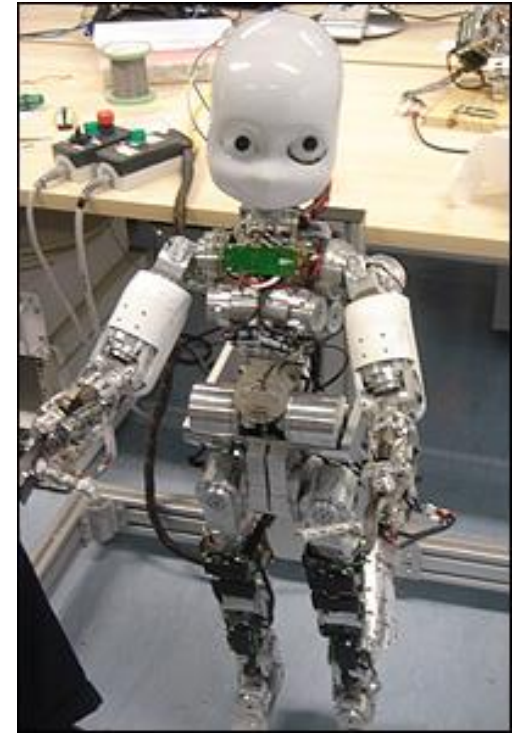
Traditional Cognitive Architecture AI

- Sense, Plan, Act



International Projects (1)

- iTalk project
 - Integration and Transfer of Action and Language Knowledge in Robots
 - Using iCub
 - Learn to handle, manipulate objects
 - Learn to handle tools autonomously
 - Learn to cooperate and communicate with humans, robots
 - Learn to adapt to changing internal, environmental and social conditions
 - [Demo: Gesture memory game](#)



Universität Bielefeld



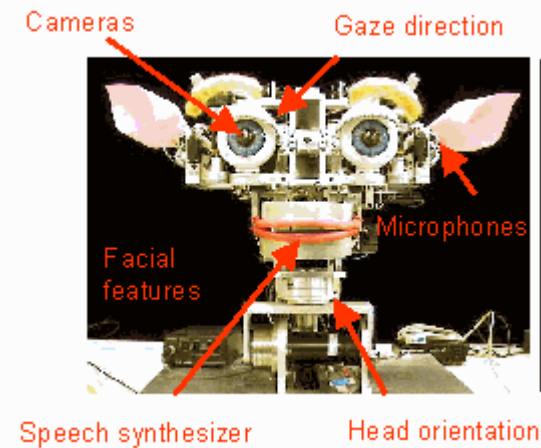
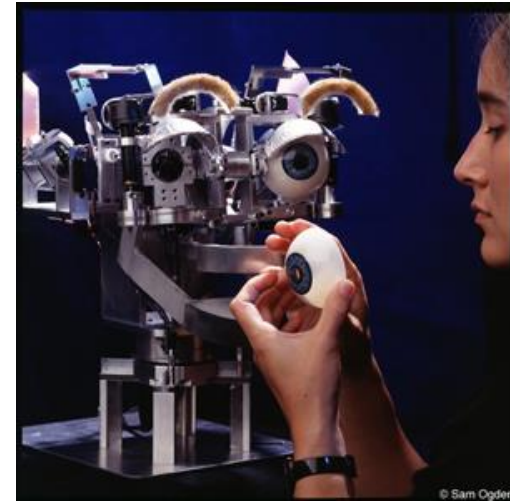
International Projects (2)

- **CoTeSys**
 - Cognition for Technical Systems (Cluster)
 - 6 closely cooperating research areas
 - Cognitive technical systems are equipped with artificial sensors and actuators, integrated and embedded into physical systems, and act in a physical world.
 - **Perform cognitive control and have cognitive capabilities**
 - [Demo: Preparing Bavarian Breakfast](#)
 - [Demo: Physical Human-Robot Interaction](#)



International Projects (3)

- Kismet project
 - In MIT AI Group
 - Learning Social Behaviors during Human-Robot Play
 - Develops an expressive anthropomorphic robot
 - Inspired by infant social development, psychology, ethology, and evolution
 - Perceives a variety of natural social cues from visual and auditory channels,
 - Delivers social signals to the human through gaze direction, facial expression, body posture, and vocal babbles
- [Demo](#)



[<http://www.ai.mit.edu/projects/humanoid-robotics-group/kismet/kismet.html>]

International Projects (4)

- Leonardo projects

- In MIT Media Lab
- To make a social robot
- To mimic human expression
- To interact with limited objects



- Blends **with psychological theory** so that Leonardo **learns, interacts, collaborates more naturally** with humans.

- [Demo: The most expressive robot](#)
- [Demo: Teaching robots as a collaborative dialog](#)
- [TED Talk: The rise of personal robots](#)

[<http://robotic.media.mit.edu/projects/robots/leonardo/body/body.html>]