Towards Conscious-like Behavior in Computer Game Characters

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Introduction (I)

- Objective:
  - Design more appealing synthetic characters.
  - More engaging, more real.
  - Human-like (Conscious-like behaviors).

- Problem:
  - Many cognitive skills involved.
  - How to integrate them effectively?

Introduction (II)

- Character design challenges:
  - Emotions, planning, learning, opponent modeling, attention, set shifting, etc.
  - How can they be integrated effectively?

- Our hypothesis:
  - Use a cognitive architecture based on a model of consciousness.

Motivation and Objectives

- Ultimate goal:
  - Characters able to pass the (adapted) Turing test.

- Why?
  - State of the art video games
    - Complex virtual environments.
    - Elaborated scripts.
    - Require more realistic behaviors.

State of the art

- Current AI characters cannot match human-like behavior.
  - E.g. see last year 2K Botprize contest results.
- Usually, playing with other humans is more realistic and engaging that playing with AI bots.
  - Apply Machine Consciousness to games to improve believability?

Consciousness and Games (I)

- **Embodiment** and **situatedness** are claimed to be critical for the production of consciousness.

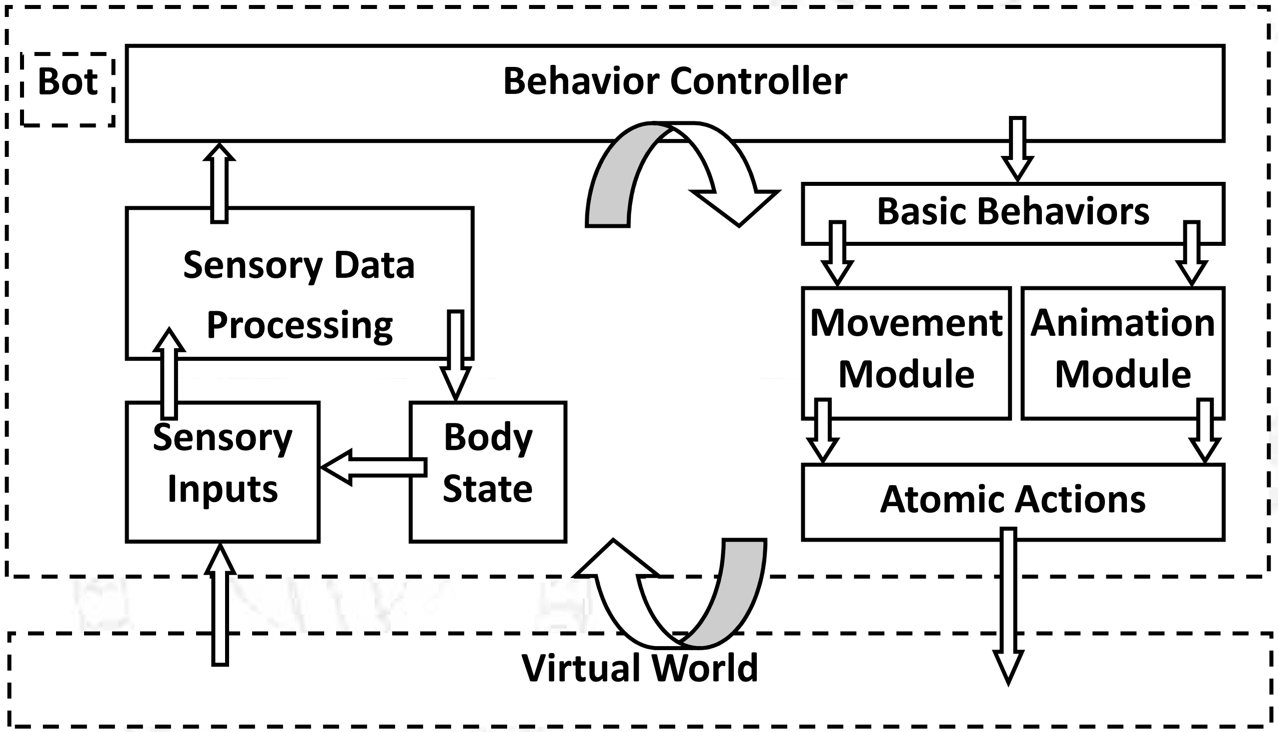
- We argue that consciousness-based software agents can also be embodied and situated.
  - Software sensors and actuators.
  - Causal interaction with the world.
    - Virtual World (virtually situated).
    - Real World (interaction with human players).

Consciousness and Games (II)

- Games versus Physical Robots
  - Robots possess physical body.
  - Robots interact directly with physical world.
  - Robots have to deal with noise and uncertainty.
- These aspect can be seen as benefits or drawbacks
  - Games are ideal for focusing on high-level control.

Experimental Environment

- FPS: Unreal Tournament 2004



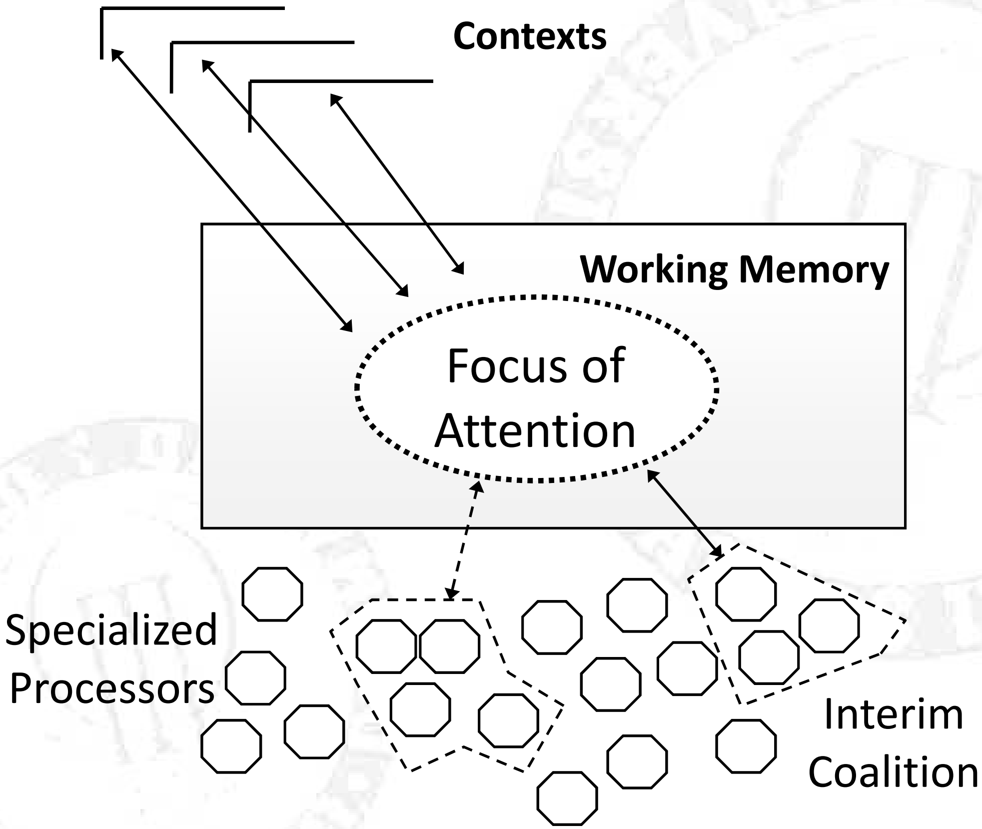
Proposed Architecture (I)

- Context: Machine Consciousness Research.
  - Specifically: Design of machines showing conscious-like behavior.
- Access Consciousness (***A-Consciousness***) Approach:
  - Only a small selection of contents gain access to a unique sequential thread for explicit processing and volition.
- Computational model based on:
  - Global Workspace Theory (Baars, 1988).
  - Multiple Draft Model (Dennett, 1991).

Proposed Architecture (II)

- Computational model of consciousness:
  - Large number of specialized processors.
  - Competing and collaborating to access a global workspace (working memory).
  - Where coherent information patterns are selected.

Proposed Architecture (III)

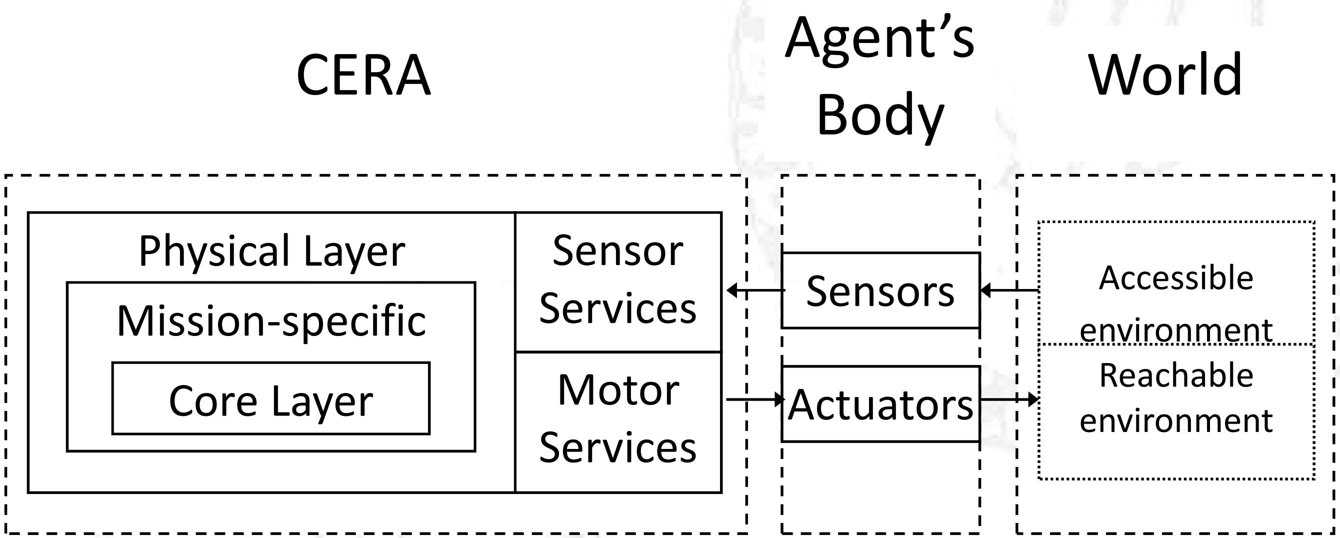


Proposed Architecture (IV)

- CERA-CRANIUM Architecture
  - Implements the computational model of A-Consciousness.
  - CERA is a layered control architecture.
  - CRANIUM is a runtime component for the management of specialized processors.

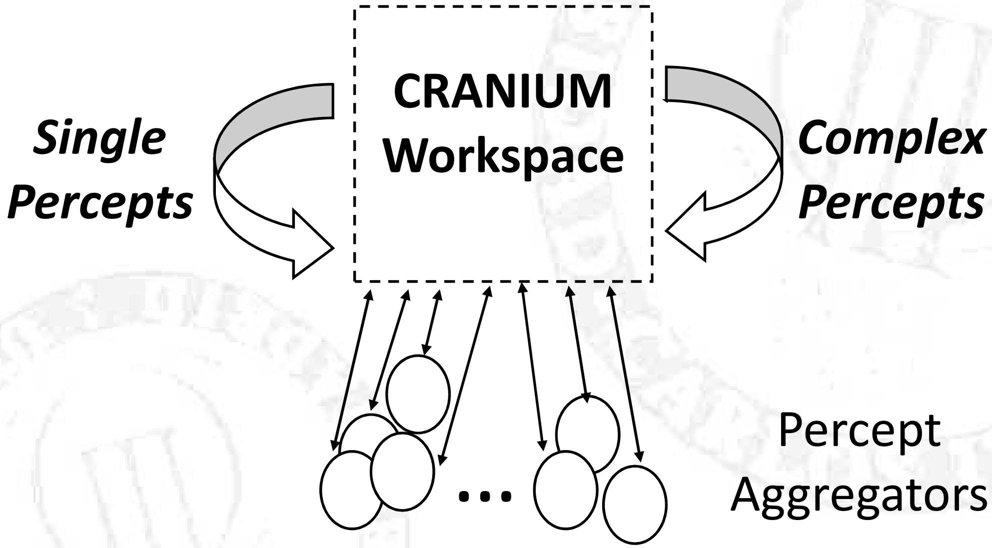
Proposed Architecture (V)

- CERA-CRANIUM Perception Flow



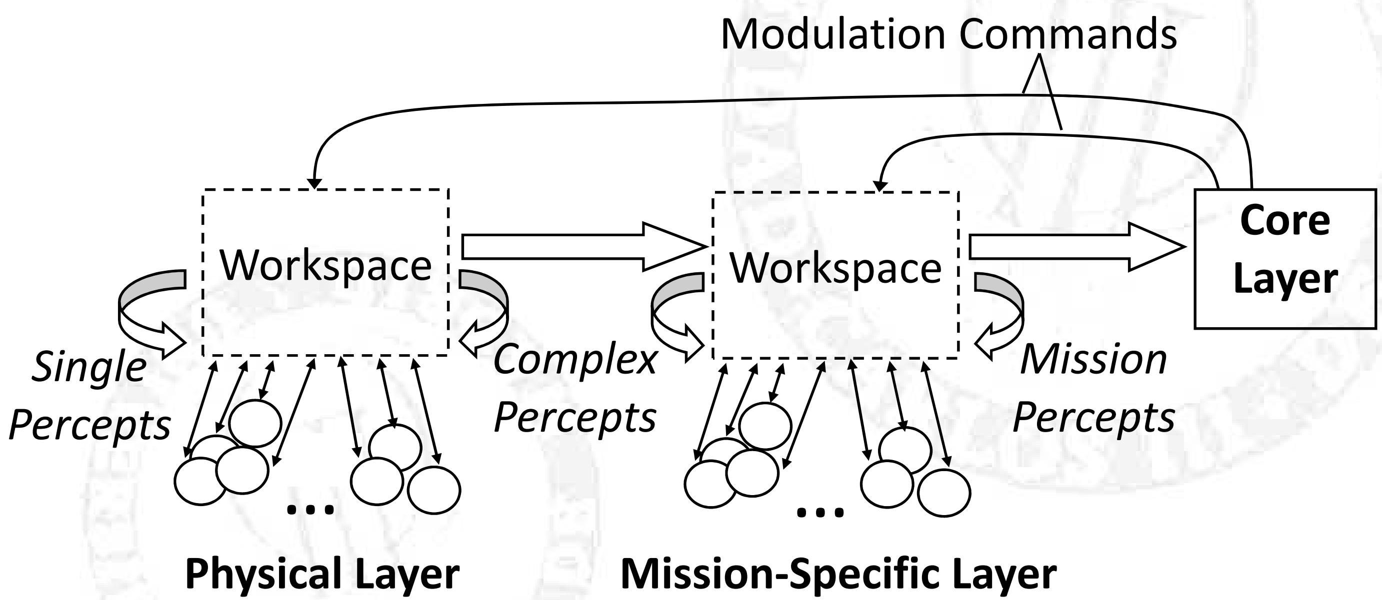
Proposed Architecture (VI)

- CRANIUM Workspace (at CERA Physical layer)



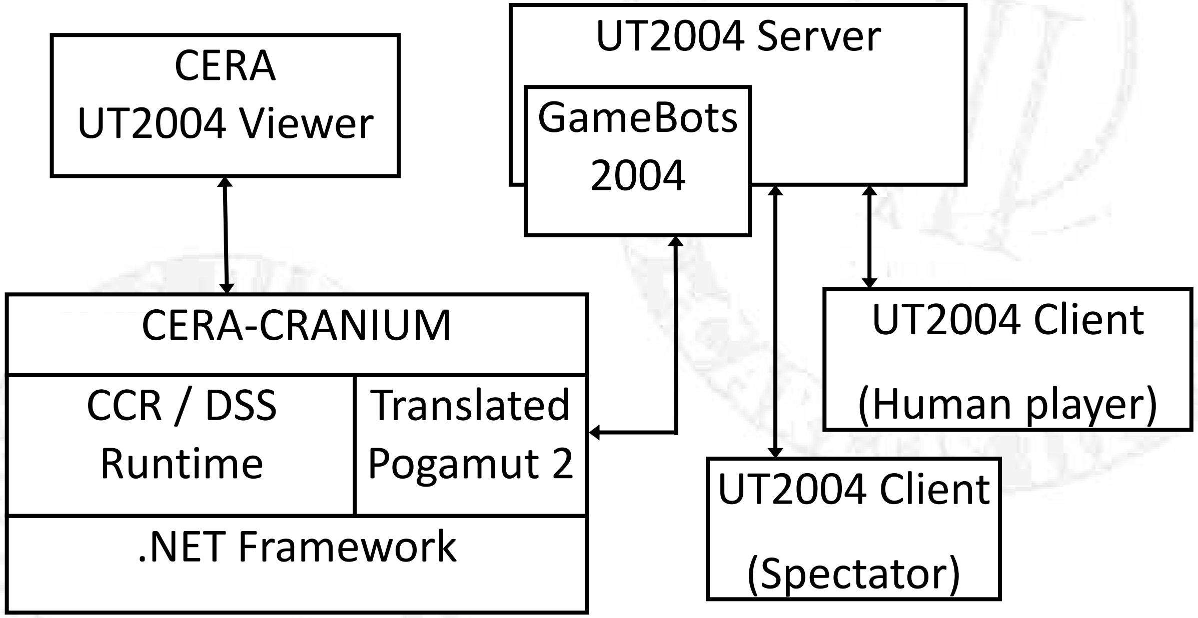
Proposed Architecture (VII)

- CRANIUM Workspace Modulation



Proposed Architecture (VIII)

- CRANIUM Workspace Modulation



Proposed Architecture (IX)

- CERA-CRANIUM instantiation for UT2004
  - CERA sensory-motor services layer.
  - CERA physical layer specialized processors.
  - CERA mission-specific layer specialized processors.
  - CERA core layer goals and model state.

Proposed Architecture (X)

- Example of percepts for UT2004

  - SP(*Being Damaged*) +
    SP(*See Enemy*) +
    CP(*Enemy Approaching*) =
    MP(*Enemy Attacking*)

Evaluation (I)

- Assessing believability is not straighforward.
  - Subjective process.
  - Depends on opponents behavior.
  - Game score is not significant.

PLAYER	AVERAGE SCORE
Rule-Based System Bot	**19.2**
Q-Learning Bot	**5.2**
Q-Learning and Expert Systems Hybrid Bot	**11.3**
CERA-CRANIUM Bot	**18.3**

Conclusions

- The application of consciousness-inspired cognitive architectures is promising.

- We need to incorporate learning algorithms and long term (episodic and semantic) memory to the model.

- Improve ToM (opponent/friend modeling).

Thank you