Designing Human-like Video Game Synthetic Characters through Machine Consciousness

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Introduction

- Context:
  - Machine Consciousness Research.
- Experimentation domain:
  - First Person Shooter (FPS) video games.
- Working hypothesis:
  - To improve Human-like synthetic character design using cognitive theories of consciousness.

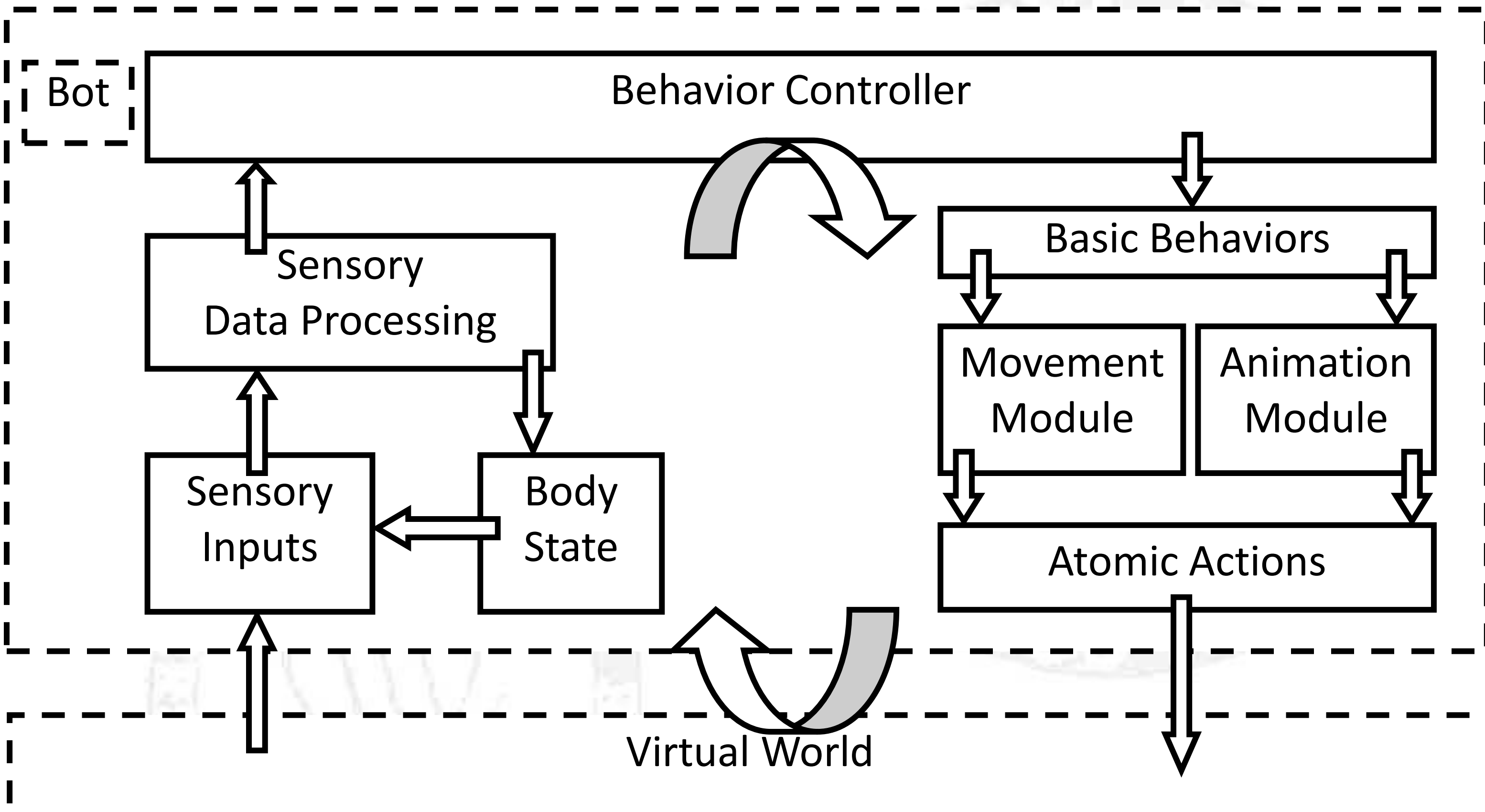
A bit of History

- From robotics to computer games:

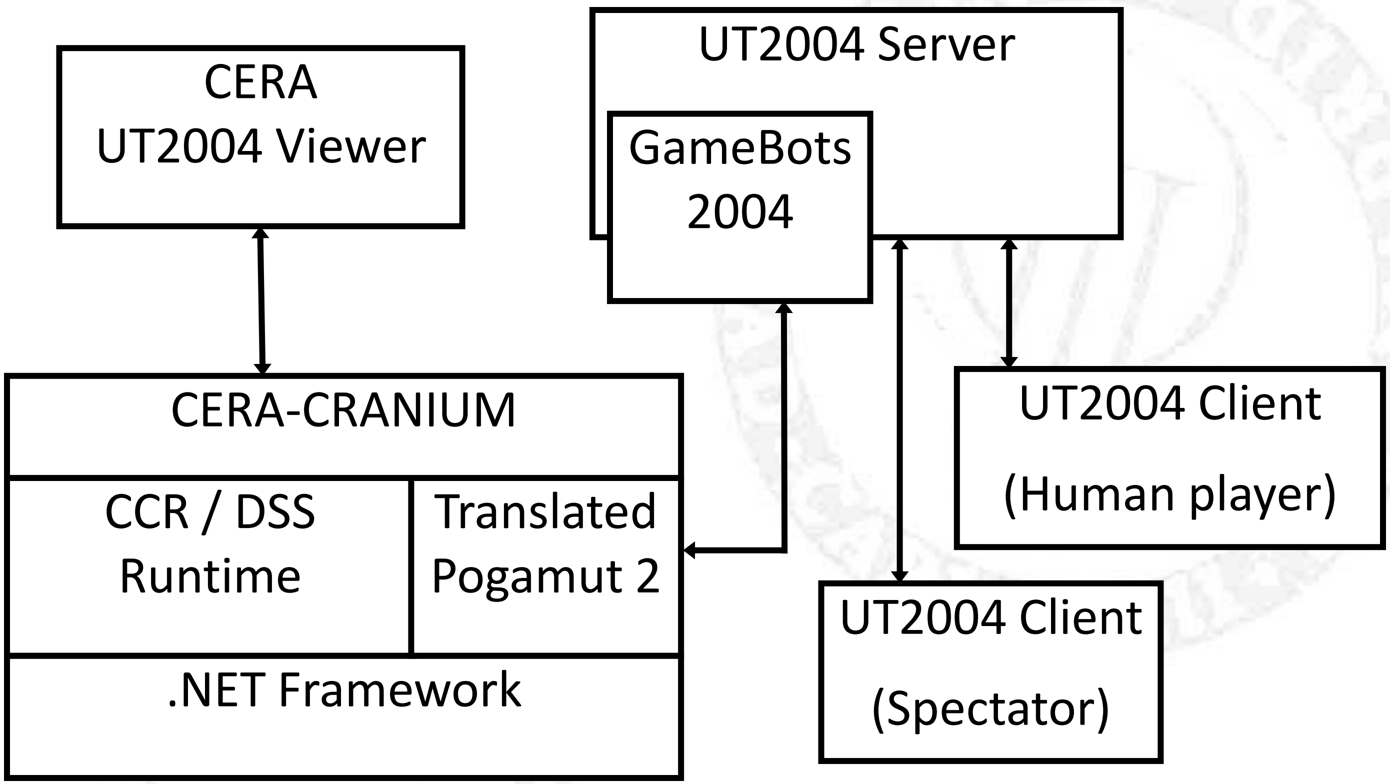
Context (UTIII and UT2004)

Unreal® Tournament 2004 ©2004 Epic Games, Inc.

Environment (I)



Environment (II)



Technologies

- Unreal Engine.
- Unreal Script.
- GameBots.
- Pogamut 2.
- Robotics Developer Studio.
- CERA-CRANIUM.

Main Objectives

- To understand how cognitive skills associated with consciousness can be combined.
- To understand what does human-like means.

Other objectives

- To test Machine Consciousness models.
- To explore the role of qualia in behavior generation.
- To develop practical measures of consciousness based on behavior.
- To develop more engaging synthetic characters.

Video games as research tools

- Benefits:
  - Practical experimentation environment.
  - Computationally affordable and rich.
  - Easy assessment of global agent behavior.
  - Focus on high-level control.
  - Human (virtual) interaction.

Video games as research tools

- Drawbacks:
  - Lack of real physical world interaction.
  - Results cannot be directly applied to robotics or other domains.
  - Noise and uncertainty are generally ignored.
  - Prone to misinterpretations.

Research Approach

- Bots controlled by flexible cognitive architecture to explore the integration of cognitive skills.
- But, How?
  Using consciousness as inspiration.

Cognitive Skills (0)

- First step: Identifying cognitive skills associated with consciousness.

- Is this a reductionist approach?
- Does this mean that phenomenal aspects are ignored?

Cognitive Skills (I)

- Executive Function
  - High level control for maintaining and implementing a goal.
  - Attention.
  - Set Shifting.
  - Planning.
  - Coordination.

Cognitive Skills (II)

- Emotions
  - Emotions as low level reactions.
  - Feelings as representation of the former.
  - Conscious feelings as second order representations of the relation between the self and feelings.

Cognitive Skills (III)

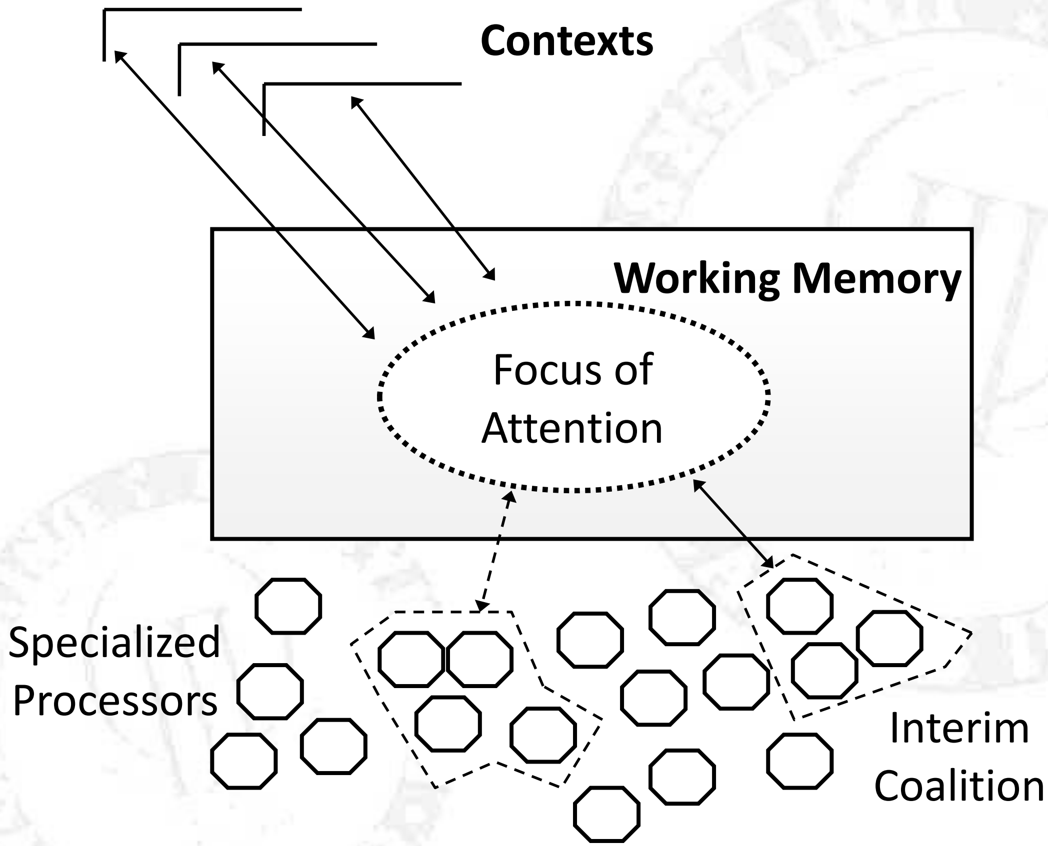
- Theory of Mind (Lewis, 2003)
  - “I know” (proprioceptive sensing).
  - “I know I know” (self-consciousness).
  - “I know you know” (inter-subjectivity).
  - “I know you know I know” (development of Machieavelian strategies).

How to integrate everything?

- Using a cognitive architecture…
  - But, how the different skills can be combined effectively?

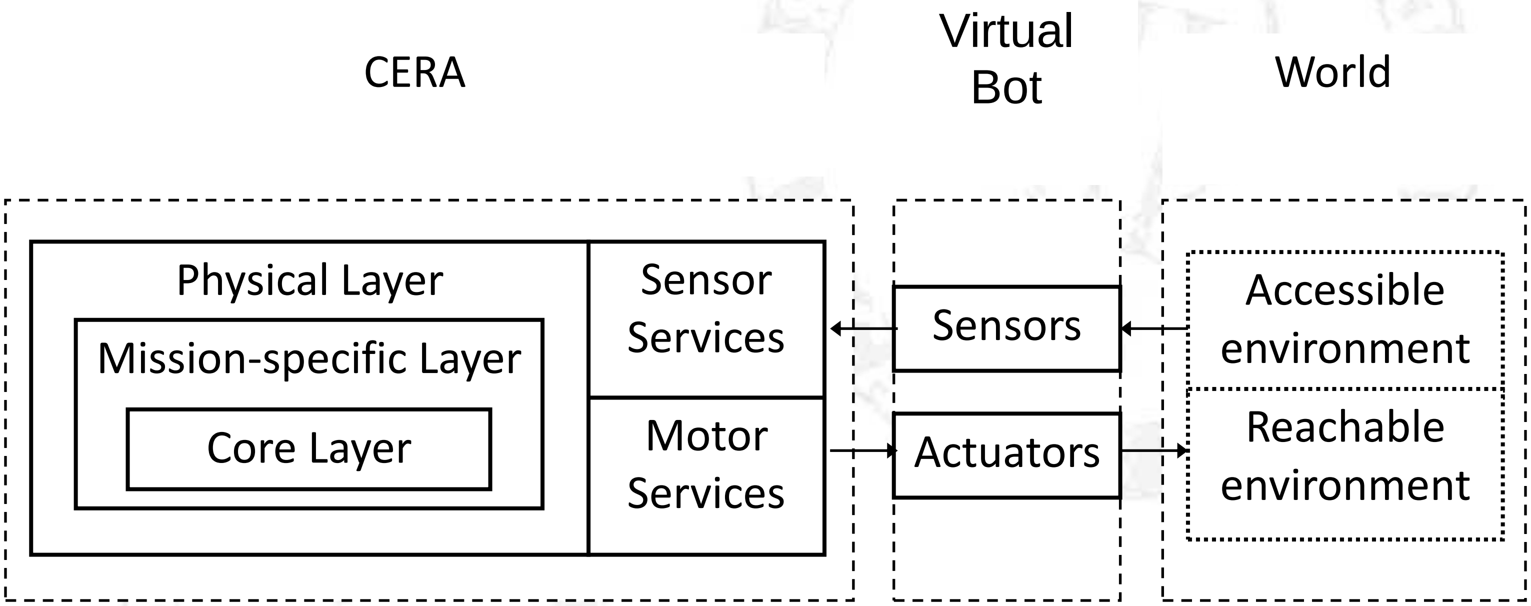
- Let’s use consciousness as the source of design inspiration.

Computational Model

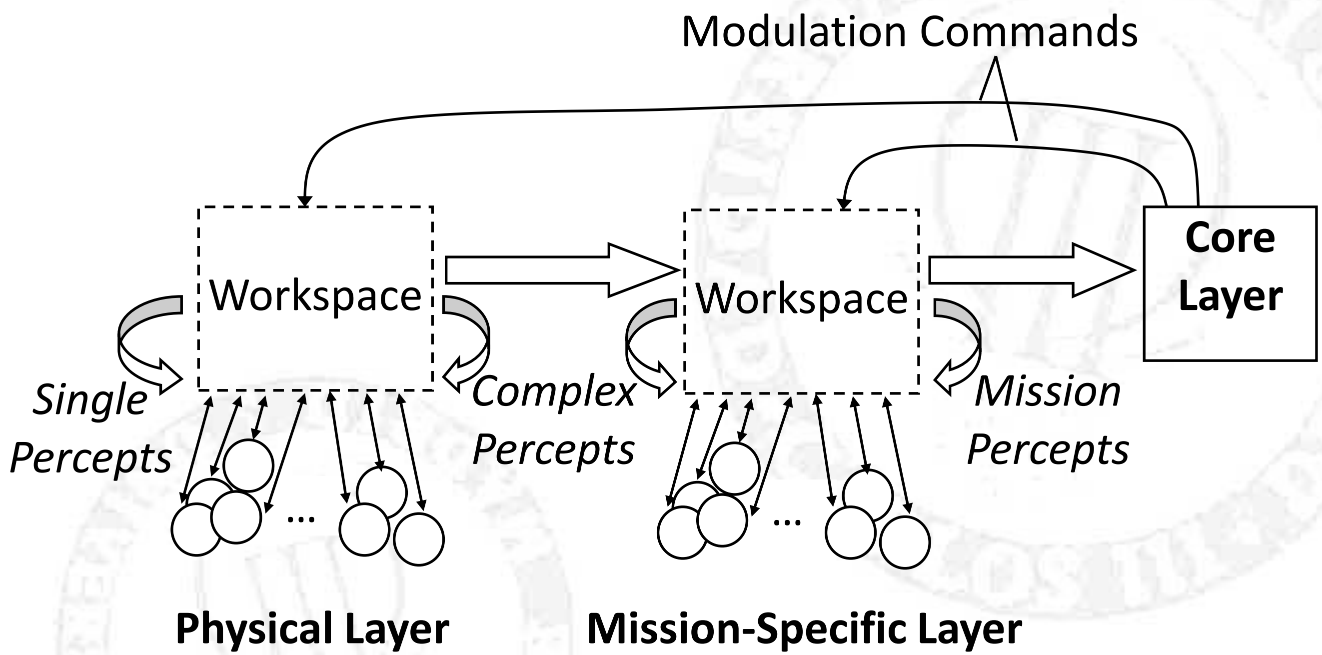


Cognitive Architecture

- CERA-CRANIUM



CERA-CRANIUM (I)



CERA-CRANIUM (II)

- Core Layer
  - Goals and meta-goals (keep positive emotional state).
  - Long term memory.
  - Learning mechanisms.
  - Model of self.
  - Models of others.
  - …

What should be done first?

- What makes the agent behave human-like?
- *ConsScale* proposes a developmental path.

Small Demo (video)

http://www.youtube.com/watch?v=tJVpm4KfRJk

Open Problems

- Accurately testing for consciousness.
- Lack of accurate verbal report.
- Practical definition of human-like behavior.
- Judging protocol.
- Other problem domains.

Conclusions (I)

- When the judge is just a passive spectator bots are more likely to appear as humans.
- When the judge participates in the game, interaction is better assessed, and bots look less smart.
- Some human players don't pass the Turing test.

Conclusions (II)

- “Human-like” versus “Conscious-like”.
  - To improve believability (*it is always a "ToM game"*).
- Very good performing bots are unlikely to be considered human.
- Poorly performing bots are unlikely to be considered human.

Conclusions (III)

- Current state of the art
  - Multiplayer online games are more appealing because opponents are human-like.
  - Current Synthetic characters are not human-like (see 2k BotPrize 2008 contest).

Conclusions (IV)

- Considering fixed repertories of behaviors or isolated cognitive skills doesn’t seem to be a good approach.

- We argue that using the “conscious-like” approach is helpful in the quest for human-like characters.

Future Work

- "Turing Test for Bots"
  2K BotPrize Competition 2009.
  - IEEE Symposium on Computational Intelligence.
  - September. Milan. Italy.

- Challenge: "narrative bot".

Related talks

- CERA-CRANIUM: A Test Bed for Machine Consciousness Research.
  - ***International Workshop on Machine Consciousness.***
- Establishing a Roadmap and Metrics for Conscious Machines Development.
  - ***8th IEEE International Conference on Cognitive Informatics.***

Thank you