Creating Cognitively-Inspired Context Models to Facilitate Human-Systems Interaction

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Context and Cooperative Interaction

- People use understanding of shared context as tacit basis for interaction, cooperation, teamwork (ICT)
- Domain-specific knowledge presumes and leverages this shared context understanding
- Computational systems don't have human-like context understanding, and have difficulty interacting with people
- Cognitively-inspired (computational) context representation and context-based reasoning can enable improved computational systems' ICT behavior

Context from a Human Perspective

- A product of sensation, perception, and cognition
- People understand and think about context at multiple levels simultaneously
 - moving across/between levels as needed
- Context includes
 - physical/natural environment
 - intentional environment (rational agents, including self, and their behavior)
 - momentary picture, plus links into the past and future

Requirements of Synthetic Context

- Continuous
- Constructive
- Self-organizing
- Operates simultaneously at
 - at multiple (hierarchical) levels of abstraction
 - multiple time-scale across levels



Integrating perspectives on context representation

#/updates per unit of time

Narratively-Integrated Multi-level (NIM) Synthetic Context Representation

Representationbuilding (Procedural)

Build Understanding downward

Build Understanding within Levels

> Bring Information into Context Representation

Perceptual Procedural Knowledge Context Representation (Declarative)

Narrative level -main (presumed) narrative -alternative (plausible) narrative

Story unit level -recognized story units -partially recognized story units

Projection Level -object near-future dynamics -object change indicators -time-base possible futures

Comprehension Level -object types, meanings -object groupings, associations -object capabilities

Perception Level -objects -actions/behaviors -locations -utterances

Environmental data Stream

Representationbuilding (Procedural)

Deconstruct/Repair Understanding (any direction)

Build Understanding upward

Translation to Computational Architecture



Integrated Context Engine (ICE)



Example: The Robotic Interaction Problem

- Robots can (unintentionally) be dangerous
 - "robots do not know that they are in the world that they have within themselves as a model of that world"
 - they are Force compliant but not yet Action Compliant
- Fundamental action compliance *non-interference*
 - not being "underfoot" or in the way of people
 - surprisingly hard to learn, even for humans
- Give the robot an explicit context representation
 - make the robot a part of that context, so that it can reason about its own role/place in that context
 - and achieve action compliance

CARIL – Context-Augmented Robotic Interaction Layer



- Have developed increasingly robust non-interference behavior, via simulation
- Beginning with no communication, now adding context-driven communication to enhance non-interference

Conclusions

- Working toward general synthetic context plug-in for computational systems
- Ongoing work on
 - Robot action-compliance for NASA
 - Context-based proactive Decision Support for Naval C2
 - Control for synthetic players in air combat training
- Beta Release of Commercial ICE late 2016
- Enhance Authoring Tools beta mid 2017