



Collaborating with Multiple Distributed Perspectives and Memories

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Basic Premises



- Learning by Doing
 - Experience-based reasoning is an approach for decision-support systems which leverages human memories as examples to solve problems.
- Multilateral Decisions
 - Different cultures may have different assumptions about experience in problem solving.
 - Decision makers can use coherence to establish the justification in otherwise disparate solutions to problems.

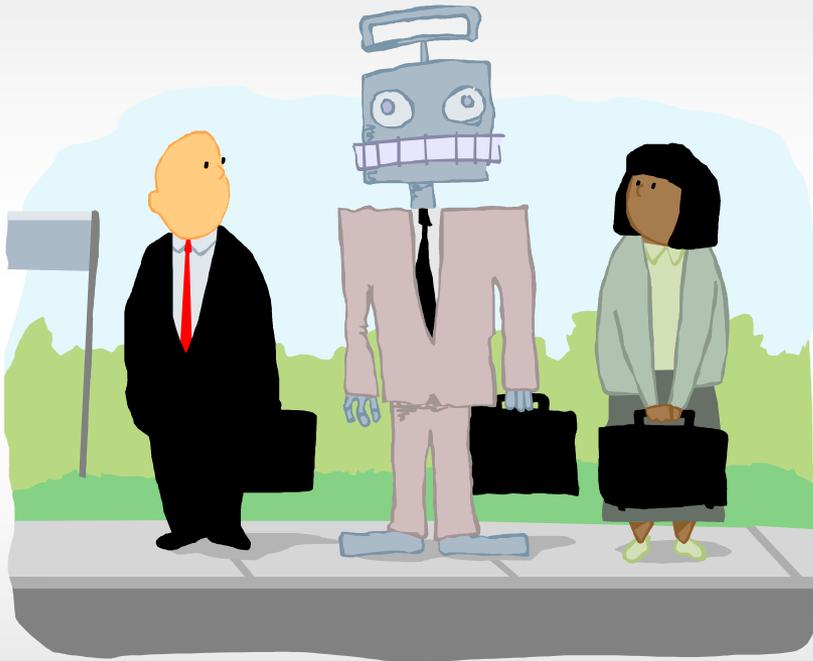


Major Challenges

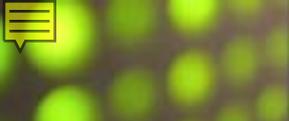


- How do you search and apply recorded experiences that are created by a set of diverse users?
- How do you reconcile different personal and cultural perspectives while making group decisions?
- How can a coherent story be generated from a set of different versions of events?

Assumptions

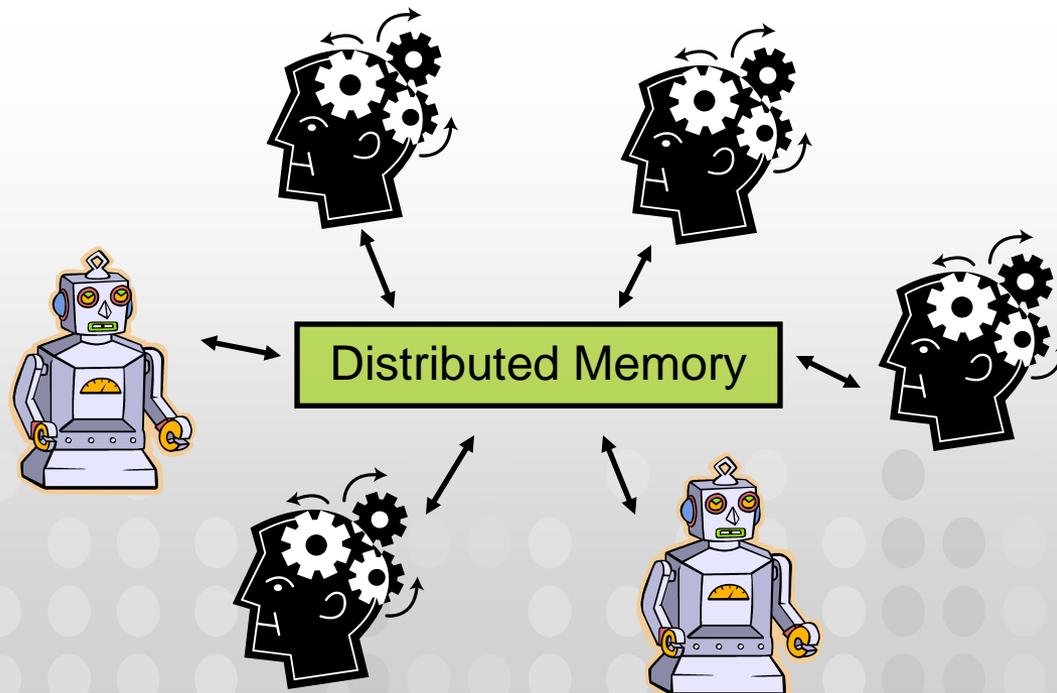


- People learn to communicate about individual and shared experiences.
- Culture-based biases affect retrieval, classification and problem solving.
- Internet technology is allowing distributed computing to become the “norm”.
- In a team there may be both humans and software agents with:
 - Human – human communication
 - Human – agent communication
 - Agent – agent communication



Distributed Episodic Memory

- Leverages users in a distributed setting to access and use historical data.
- These memories tend to be highly individualized and self oriented.
- Includes the recorded experiences of a particular operator or a set of operators in a given problem solving context.





Memory



- Memory is a subjective experience – we each build an episodic memory, but from our perspective of what happened.
- Memories bias what we perceive.
- Because we accumulate experience and learn, we probably have larger models that enable us to know how to refer to the “same story”.
- Reuse of stored memories is highly influenced by the current goal of the actor in the current problem solving situation.



Cultural Models



- Cultural models are:
 - Culture: of or relating to the shared knowledge and values of a society
 - Model: A schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and may be used for further study of its characteristics
- Applying cultural models to artificial reasoning:
 - The experience and memories accumulated in particular roles and activities will influence how the actor interprets information.
 - Each actor's unique experiences are searched based on aspects of their cultural model
 - As cultural models and experience-based reasoning techniques are refined, our approach will grow.



Cultural Model Implementation

- Simple cultural models
 - Each contained different roles which parameterize the behavior of adherent agents.
 - The roles change how each agent recalls, adapts, and stores experiences in its personal history.
 - Each role includes three sets of variables:
 - Key situation factors (constrains how the agent searches its personal history for past experiences to utilize)
 - Policy variables (constrains what variables each agent is expected to change in the environment)
 - Expected output set (constrains how each agent assesses success in the environment after executing their policy)



Coherence Maintenance

Problems:

- *People don't always agree*: Often a decision needs to be made before complete certainty and trust can be attained
- *Experiences don't always agree*: The everyday world is complex and ever-changing, so no two experiences are exactly the same

Approach:

- Planning agents contribute and understand unique experiences in a group context. We will address this using *Coherence*.
- Agents provide expertise that corresponds with the truth of a situation. We will address this using *Verisimilitude*.



Consistency and Truth

Robust Coherence:

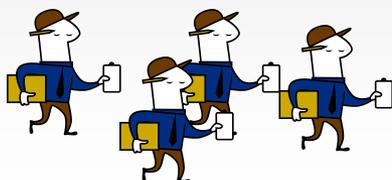
- Use *Coherent and Incoherent relations* to form a 'web' or 'package' of mutually supportive actions and goals.
- Use *Verisimilitude* to adjust coherence relations to reflect impossible preconditions or undesirable effects in the world.
- Use *Constraint Satisfaction* to allow agents to determine the most coherent set of actions and goals.

Relation	Constraint	Explanation
Coherent	Positive	These elements support one another, either both are <i>accepted</i> or both are <i>rejected</i> .
Incoherent	Negative	These elements cannot coexist, if one is <i>accepted</i> then the other is <i>rejected</i>

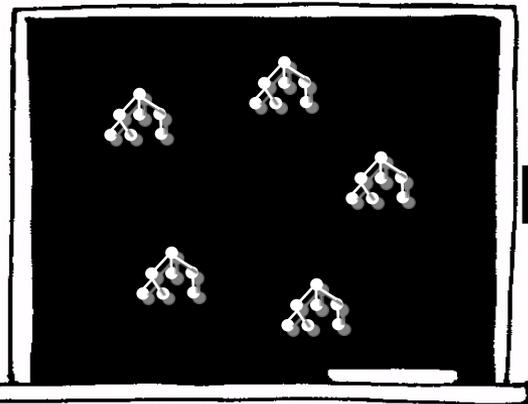
Coherence Maintenance Implementation

(a)

Planning Agents



Past experiences based on similarity

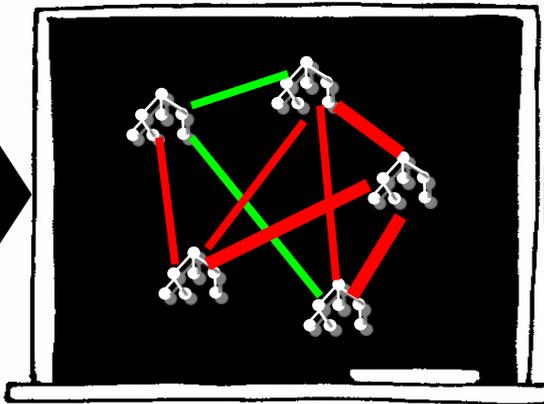


(b)

Discovery Agents



Constraints based on coherence and falsification

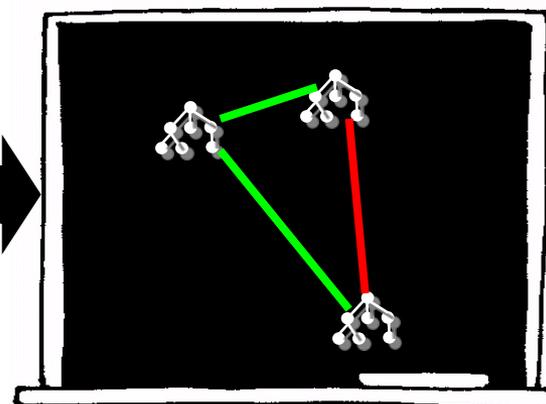


(c)

Watcher Agents



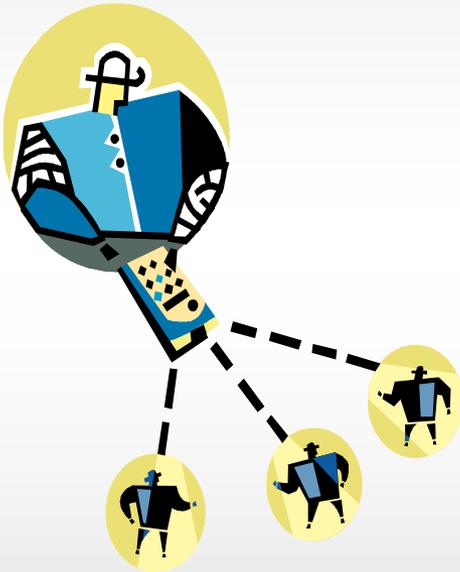
Unique solution to CSP based on policies





Experiment Setup

- Setting:
 - A fictional nation state's economic health is at stake. What is the best course for injecting resources to spur growth?
 - We used NOEM (National Operating Environment Model) to simulate effects on this notional state.
 - Each agent assumes a role within an overall culture. The role describes the important features for recall and planning.
 - A coherence monitoring agent attempts to find the most consistent and truthful approach among the participants.

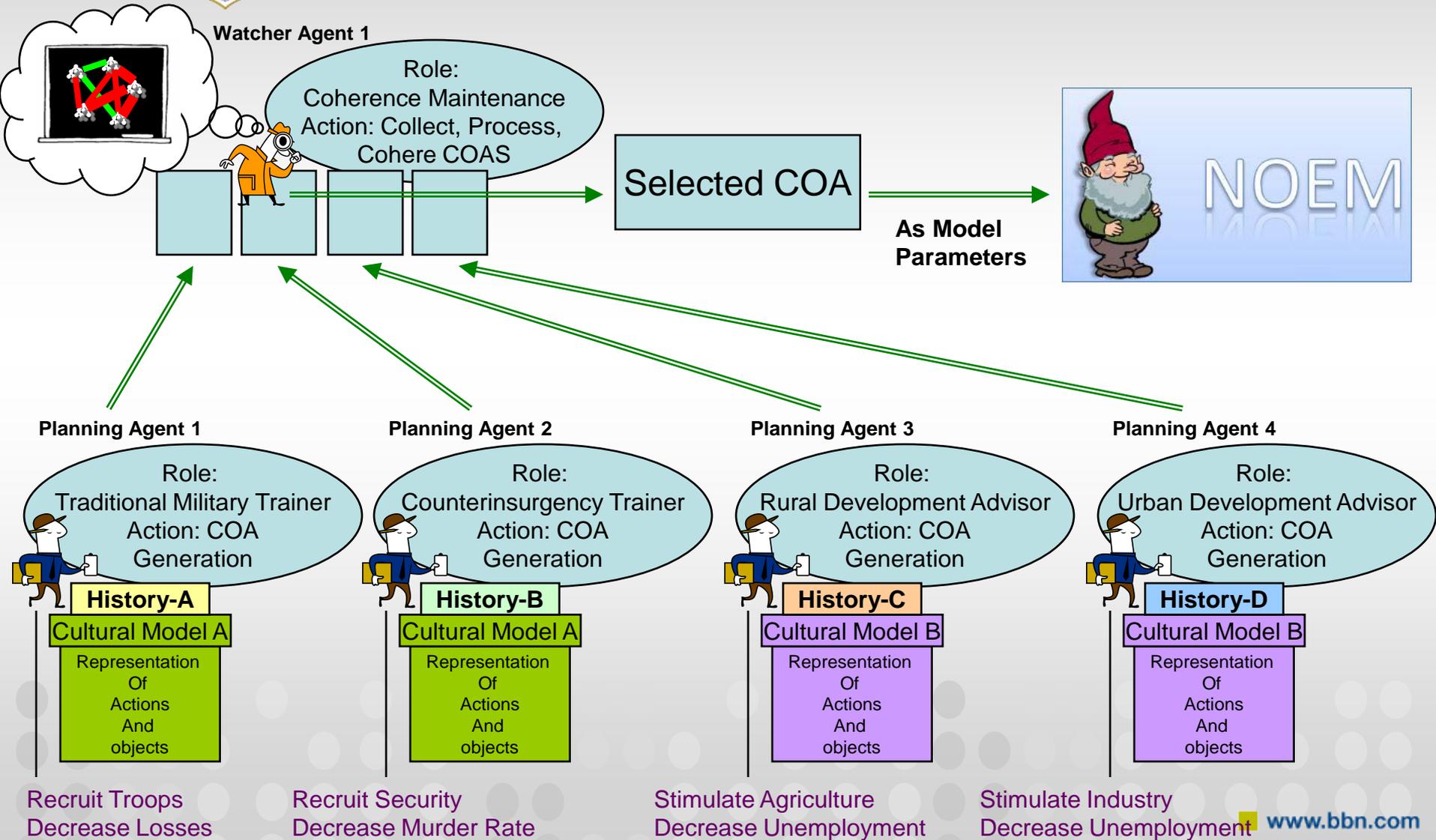




Experiment “Participants”

- Two cultural models were implemented, each with two roles.
 - Military advisor model
 - Role: traditional military trainers
 - Role: counterinsurgency advisors
 - Economic policy advisor model
 - Role: rural development advisors
 - Role: urban development advisors
- One adherent artificial agent was implemented for each role.
 - The personal histories for these agents were populated using NOEM

Experiment Architecture





Experimental Results

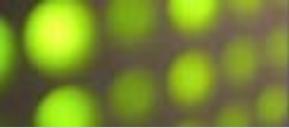
- Our results show the combination of policies was disadvantageous.
- A possible explanation is the failure of the individual experiences to capture more sophisticated causal linkages.
 - Our simplistic cultural model assumes a causal relationship between recall, policy, and outcome factors. The cultural model or personal history should contain a way to assess the veracity of this assumed relationship.
- Simply recording the input and output factors and assuming a causal relationship may have left important inconsistencies unnoticed.



Future Work

- Our future work will allow for multiple agents to learn how to establish coherence based on their individual and cultural perspectives.
- We also want to incorporate other cultural modeling work to increase the realism in our cultural models
 - *Important to discover how culture affects problem-solving... this provides the linkages to artificial reasoning.*





Backups





Agents, roles, actions and memories

