

Computer Supported Learning in Complex Problem Solving

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May 18, 2011

Complex Problem

- What makes things complex?
 - Number of components involved
 - Nature of relationships among components(Spector, 2006)
- An example

Clinical diagnosis



Spector, J. M. (2006). A methodology for assessing learning in complex and ill-structured task domains. *Innovations in Education and Teaching International*, 43(2), 109-120.

Complex Problem Solving

- How to deal with complex problems?
 - Decomposition (tasks, sub-tasks)
 - Coordination

(Simon, 1981)

- Multi-Agent System / Technology

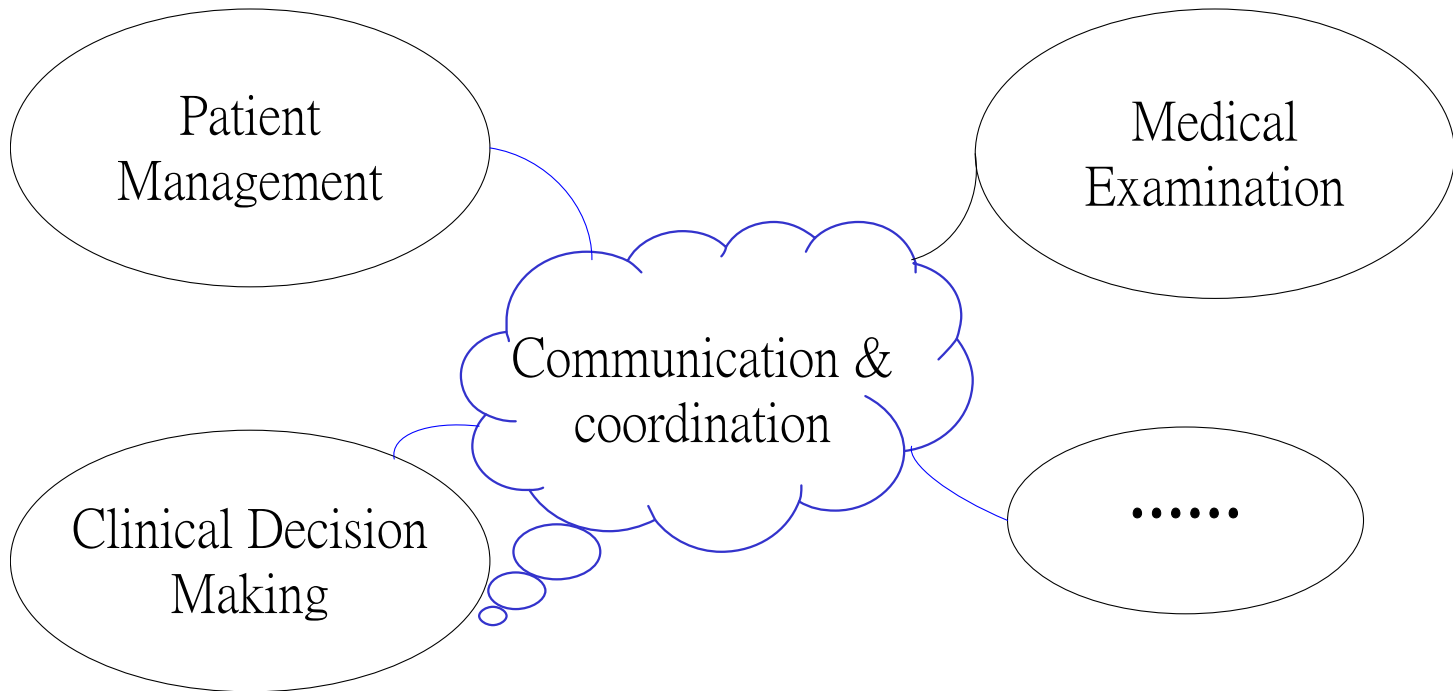
- Agent

- Perform tasks or problem solving
 - Autonomous and cooperative

(Wooldridge & Jennings, 1995)



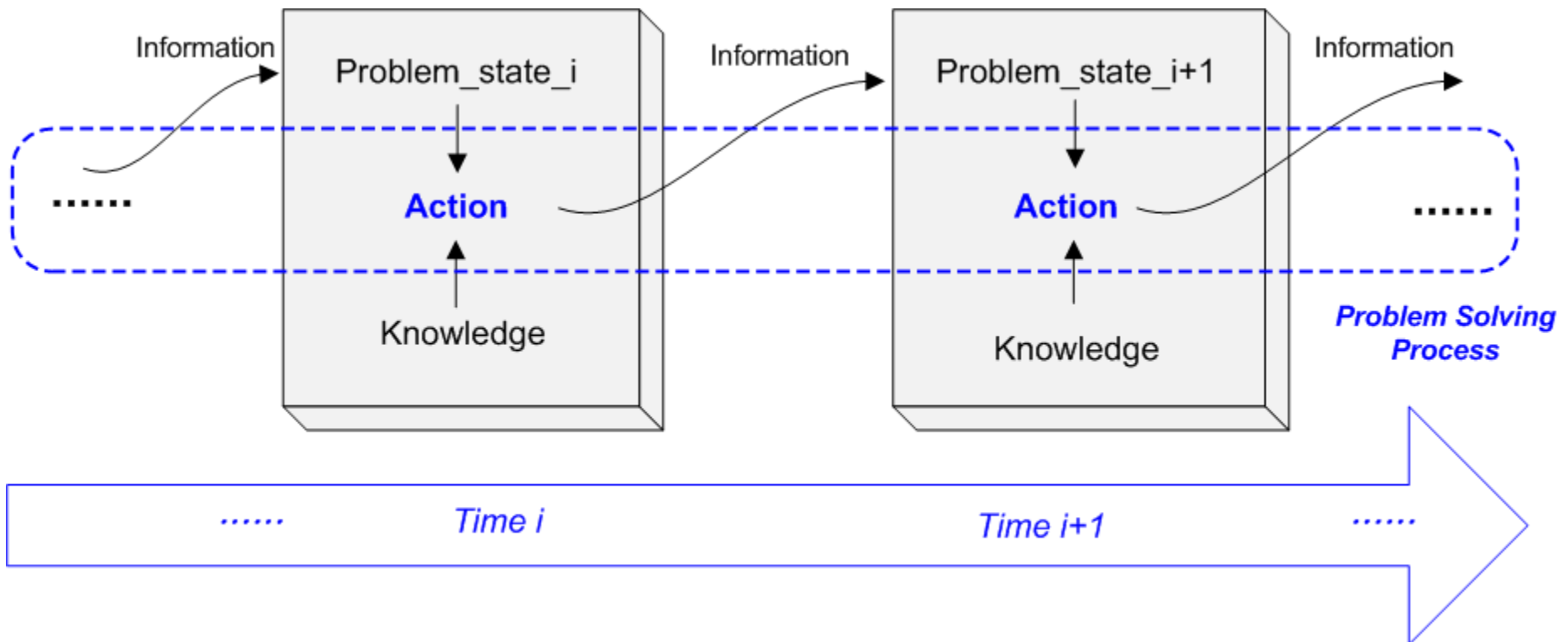
E.g. Clinical Diagnosis



Problem Solving Process

- Well-structured
 - Complete understanding of the problem
 - Well-defined process (start - end)
- Ill-structured
 - Incomplete understanding of the problem
 - Ill-defined process

III-Structured Problem Solving



Wang, M., & Wang, H. (2006). From Process Logic to Business Logic -- A Cognitive Approach to Business Process Management, *Information & Management*, 43(2), 179-193

Focus of Ill-Structured Problem Solving

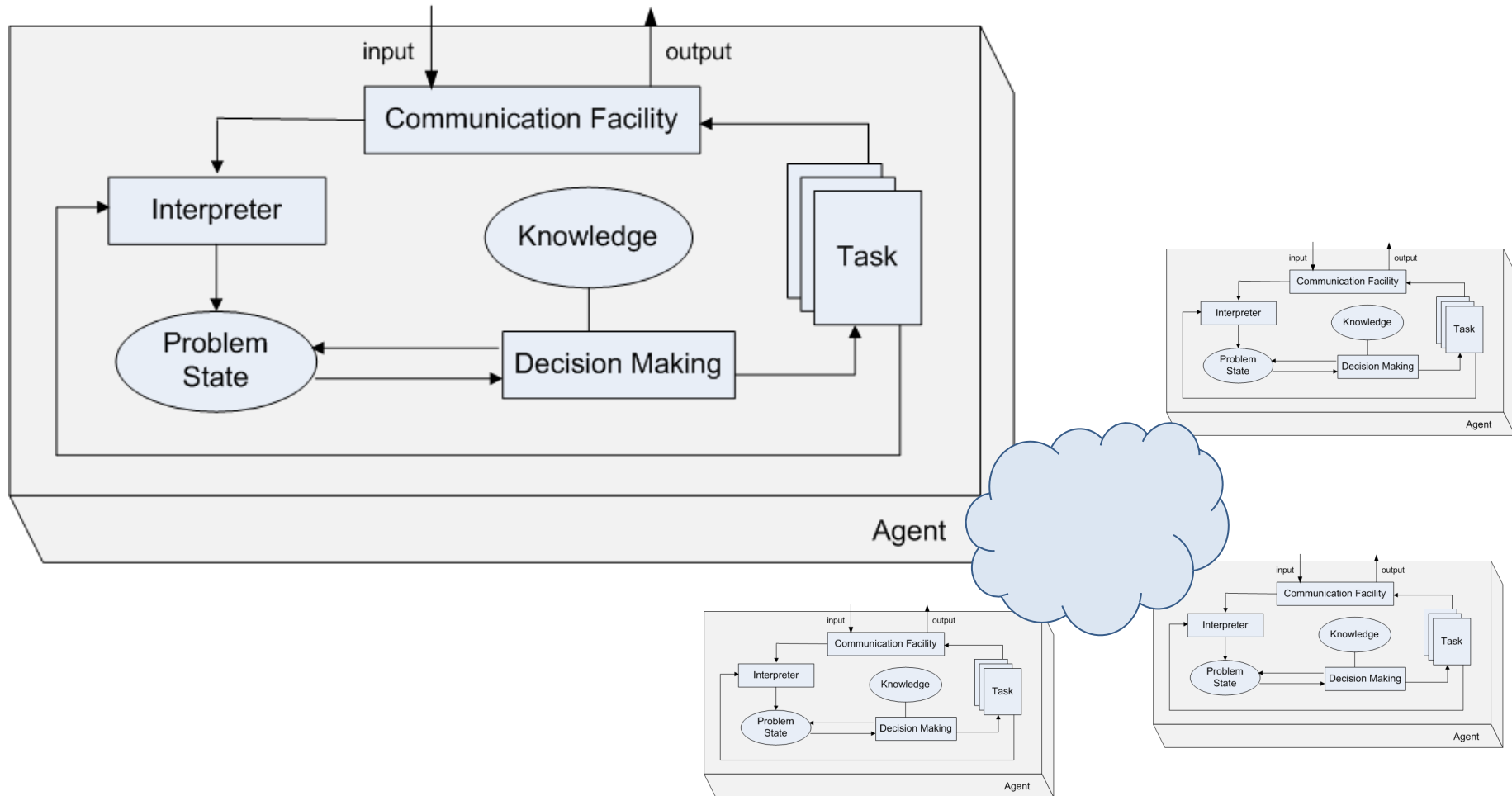
- Problem Solving Process
 - Procedure, steps, actions, ...



- Understanding of the Problem
- Knowledge for Decision Making
 - rules, hypotheses, references, ...

Technology for Ill-Structured Problem Solving

- Multi-Agent System Architecture



Wang, M., & Sun, Z. (2009). *Handbook of Research on Complex Dynamic Process Management: Techniques for Adaptability in Turbulent Environments*, IGI Global, Hershey, PA

Problem Solving Learning (PSL)

- Learning through complex problem solving
(we focus on adult learning & higher education)
- Purpose
 - ✓ Enhance Performance => Enhance Learning

Give a man a fish and he will eat for a day.

Teach a man to fish and he will eat for a lifetime.

Problem Solving Learning (PSL)

- Focus
 - Performance => Performance + Learning
- Support
 - Performance
 - If learners do not perceive they can solve complex problems, motivation will be diminished.
 - Learning
 - Experience alone does not lead to learning automatically.

Technology Support for PSL

- Support to learners
 - Online discussions on problems, solutions, and reflections
 - Online feedback from instructors or experts
 - Computer-generated support
 - General and predefined questions prompted from the system to scaffold the PSL process (Ge, 2005)
e.g., what do you see as the primary problem?
- ✓ More specific support is needed, especially for complex problems

How to support ill-structured PSL?

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- The diagram illustrates the relationship between Performance and Learning in supporting ill-structured Problem Solving (PSL). A red bracket on the left, labeled 'Performance', groups the first three bullet points: 'Methods for complex problem solving' (which includes sub-points on decomposition, coordination, and problem-solving process), 'Domain expertise', and 'Coaching or scaffolding'. A red bracket on the right, labeled 'Learning', groups the last three bullet points: 'Learning assessment and reflection' and 'Individual and social learning'. The bullet point 'Coaching or scaffolding' is positioned between the two brackets, indicating its role as a bridge between performance and learning.
- Methods for complex problem solving
 - Decomposition & coordination
 - Problem solving process => Problem understanding, and Knowledge for decision making
 - Domain expertise
 - Coaching or scaffolding
 - Learning assessment and reflection
 - Individual and social learning

Design of Computer-Supported Complex Problem Solving Learning

- Decomposition of complex problems
- Present problem solving situation
 - Understanding of the problem
 - Problem solving process
 - Knowledge for decision making
- Scaffolding or guidance from
 - the **system**, experts, and instructors
- Tasks, discussions, assessment, reflections
- Individual and collaborative learning