Intelligent Tutors and Multi-Agent Systems

António Silva, 2009
Intelligent Tutors

An Intelligent Tutoring System (ITS) is a training software that mimics a human teacher by adapting its instructional methods to each student.

ITS are used as
- a complementary tool / self-study
- substituting a human tutor in domains where they are scarce.
Knowledge

- Domain knowledge
  What to teach?
- Didactic knowledge
  How to teach?
- Knowledge about the students
  Whom am I teaching?
Domain Knowledge

Production Rules

Rule

Condition \rightarrow Action

Inference

Conclusion
Student Model

Why is it so important?

It is the key to adaptation, the basis to personalized tutoring.

• Overlay
• Model Tracing
• Constraint-based Modeling
Student Model

Overlay Models

- Student knowledge
- Expert knowledge

Standard Model

- Incorrect Student knowledge
- Shared knowledge
- Expert knowledge

Disturbance Model

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Student Model

Model Tracing

Remediation!

Student

Step 1
Step 2
Step 3
Step 4
Step 5
Step 6

Expert

Step 1
Step 2
Step 3
Step 4
Step 5
Step 6

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Student Model

Constraint based model

Remediation!

Constraints fix the boundaries of the correct knowledge.

Constraints processing needs only pattern matching.

Constraint-based modeling is pedagogically agnostic.
Didactic knowledge

How to teach?

- Curriculum Management
- Sequence of subjects
- Modes of interaction
- Type of Help assistance
Multi-Agent Systems

Why using MAS to build ITS?

1 - Flexibility

2 - Modularity - Tutoring tasks decomposition

3 - Assistants in Social learning systems
Multi-Agent Systems

Tutoring tasks decomposition

Fulfilling roles traditionally performed by ITS components (or humans):

- Different teaching strategies
- Different pedagogical tasks
  - Problem selection
  - Student Modeling
  - Explanations generation
Multi-Agent Systems

Social Learning Systems

Systems that integrate a set of agents, human and virtual, performing different roles in the pedagogical process.

Computer supported Cooperative Learning systems - based upon the assumption that students learn through interaction between themselves and with the world.

Team training

Virtual “Troublemakers” and “Learning Companions”
MAS in ITS

Alice / WhiteRabbit
[Blanchard/Frasson]

• Multi-Agent system to support collaborative learning
• Places students in homogeneous coherent groups
MAS in ITS

Analysis agent

Evaluation agent

Segmentation agent

Selection agent

Planning agent

Teaching agent

Library agent

Alice / WhiteRabbit

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MAS in ITS

Before

ResTrain

ITS for training Control Center operators in Power Systems Restoration techniques

After

ResTrain

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MAS in ITS

Simulation based Tutoring Environment

ITS + Simulation

Physical
Organizational

ResTrain

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MAS in ITS

Organizational Simulation

ResTrain

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MAS in ITS

Student Model

Constraint-Based Modeling

Example of a Constraint:

If
    any circuit breaker controlling 150kV/SRA lines is closed
Then
    the SRA 150kV and 400kV buses must have been previously connected
Else
    the error 2 will be raised.
MAS in ITS

Conclusions

- ITS are useful for supporting self-learning or as a complementary tool to traditional tutoring
- When tutor task decomposition is needed or domain knowledge is distributed, MAS offer a good architectural base to ITS
- The pair ITS/MAS is particularly apt at training role-based techniques in a team environment