Intelligent Tutors and Multi-Agent Systems

António Silva, 2009

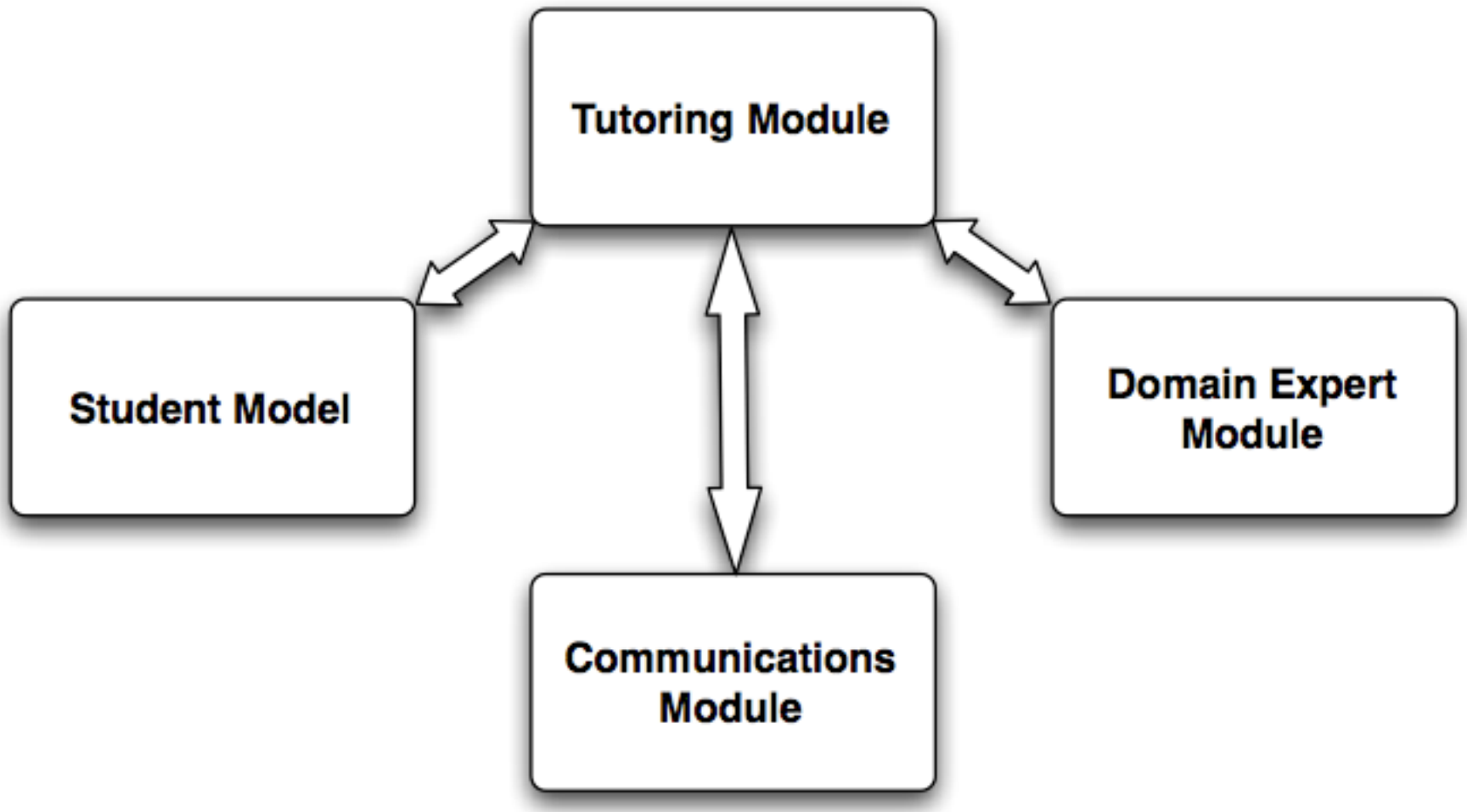
Intelligent Tutors

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.

ITS Architecture



Knowledge

- Domain knowledge

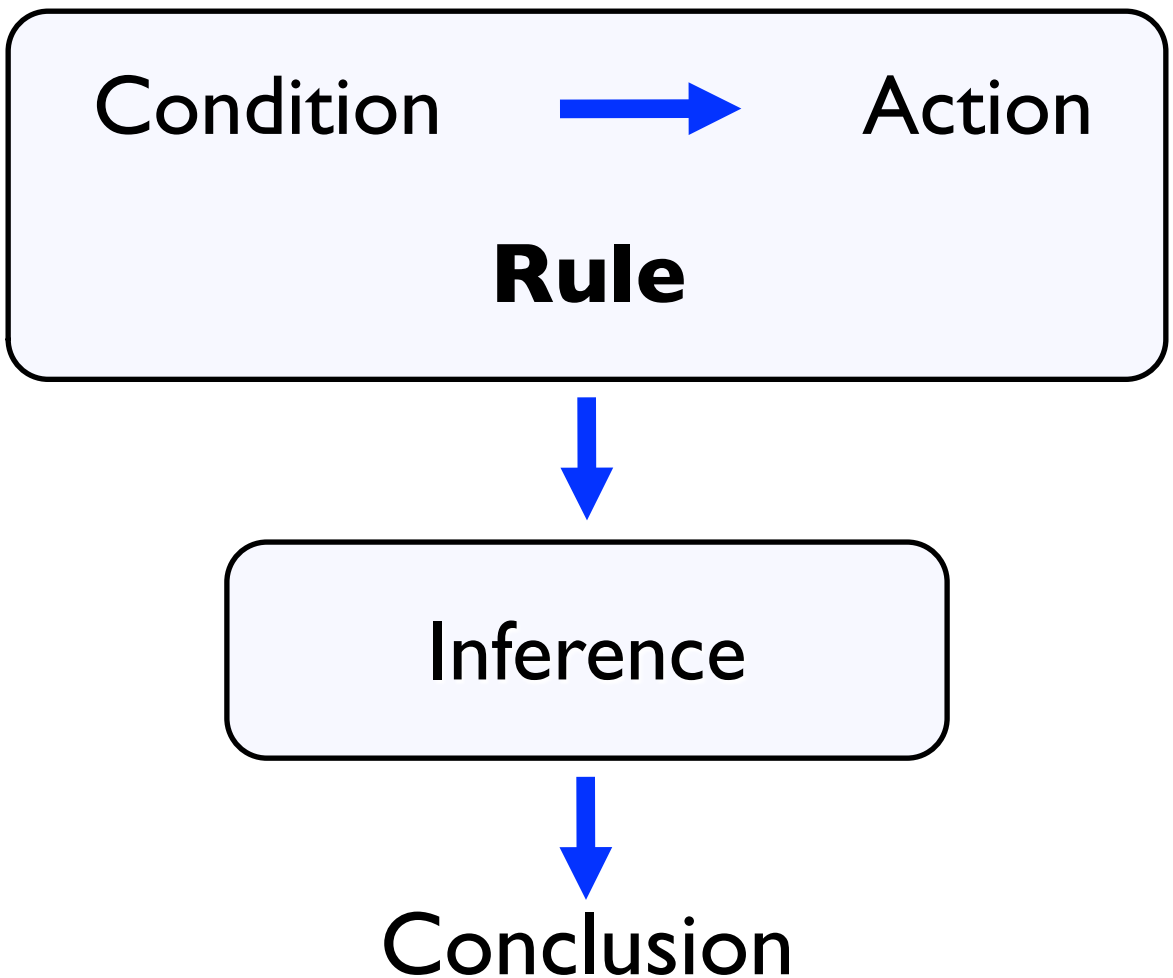
  What to teach?
- Didactic knowledge

  How to teach?
- Knowledge about the students

  Whom am I teaching?

Domain Knowledge

Production Rules



Student Model

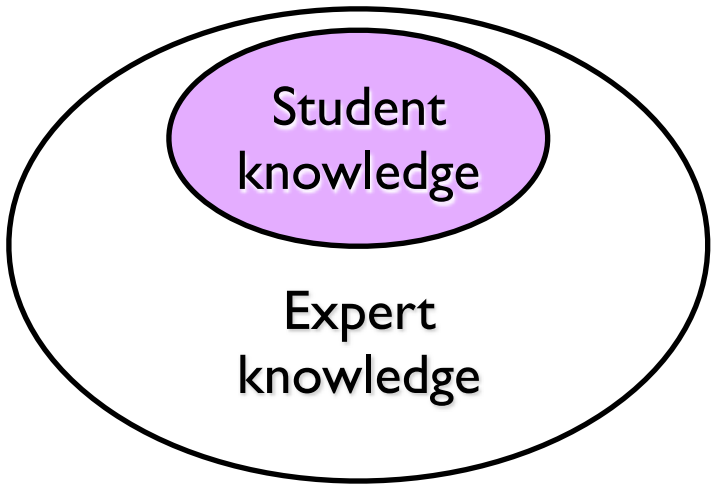
Why is it so important?

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

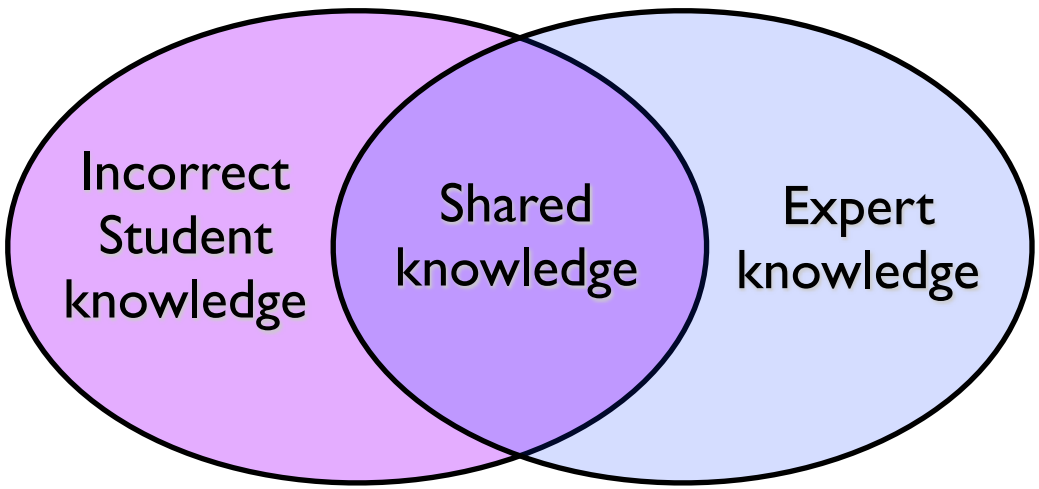
- Overlay
- Model Tracing
- Constraint-based Modeling

Student Model

Overlay Models



Standard Model

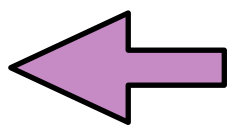


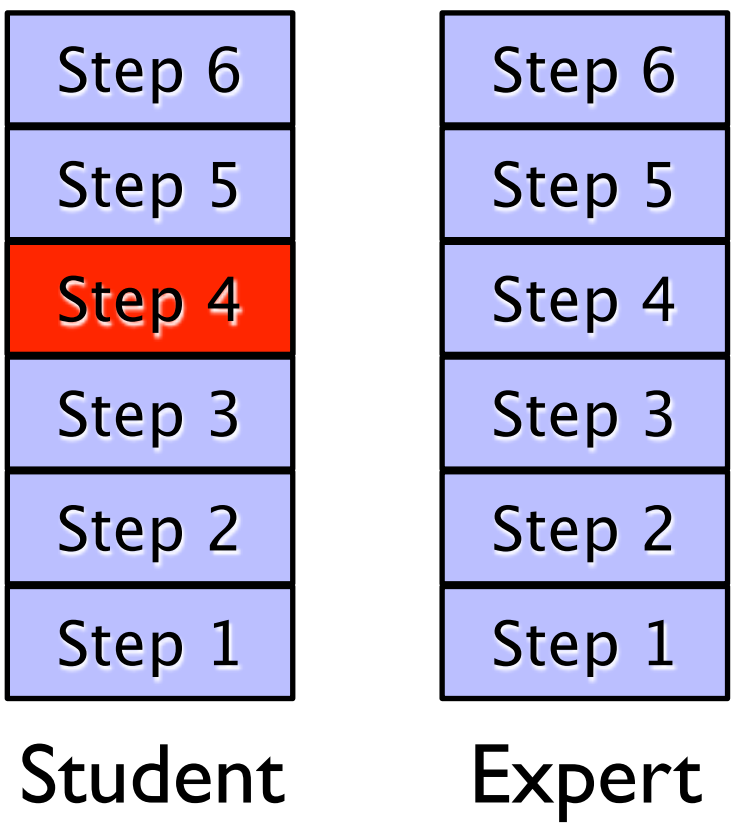
Disturbance Model

Student Model

Model Tracing

Remediation!



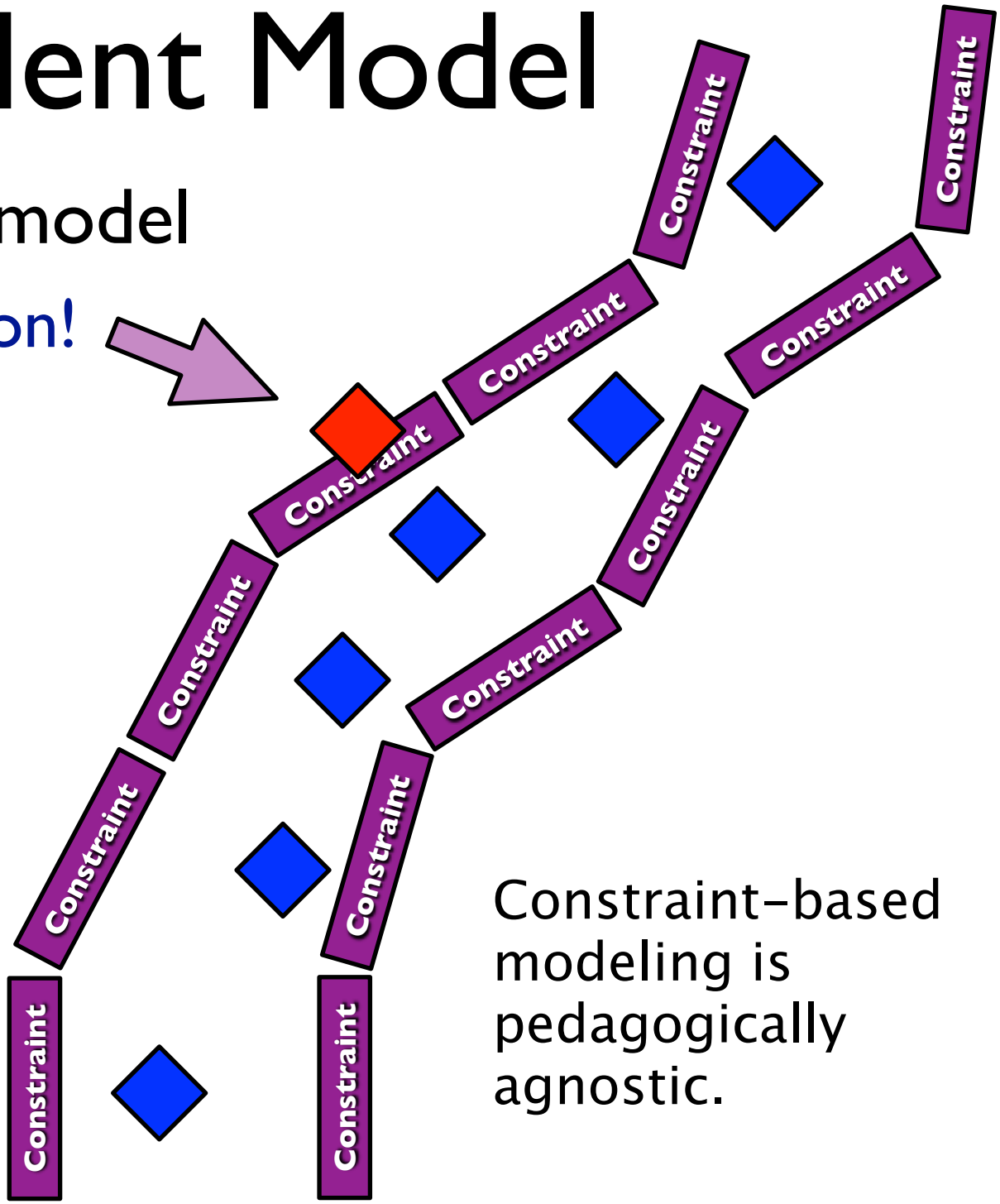


Student Model

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.

Team training

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

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

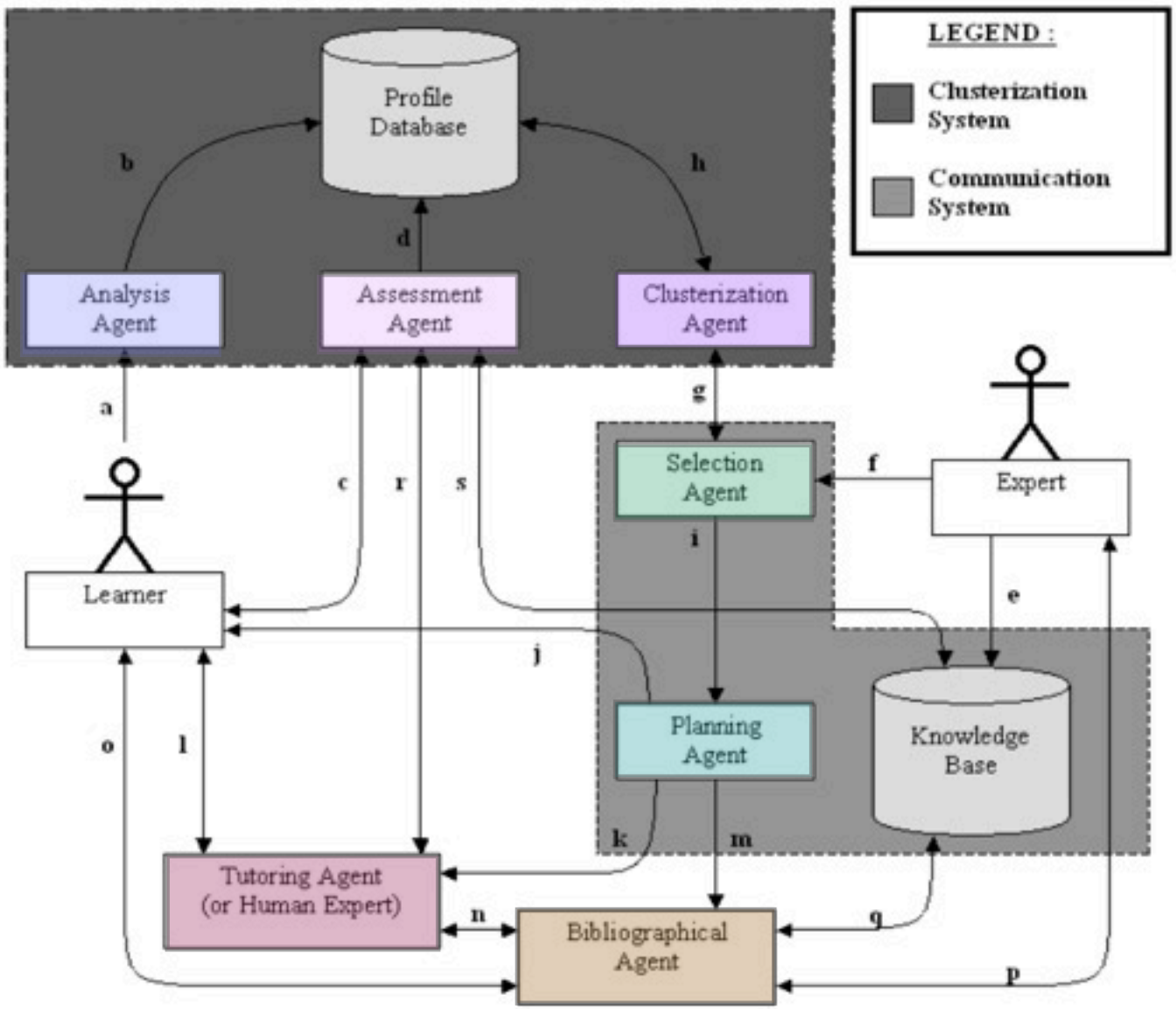
Segmentation agent

Selection agent

Planning agent

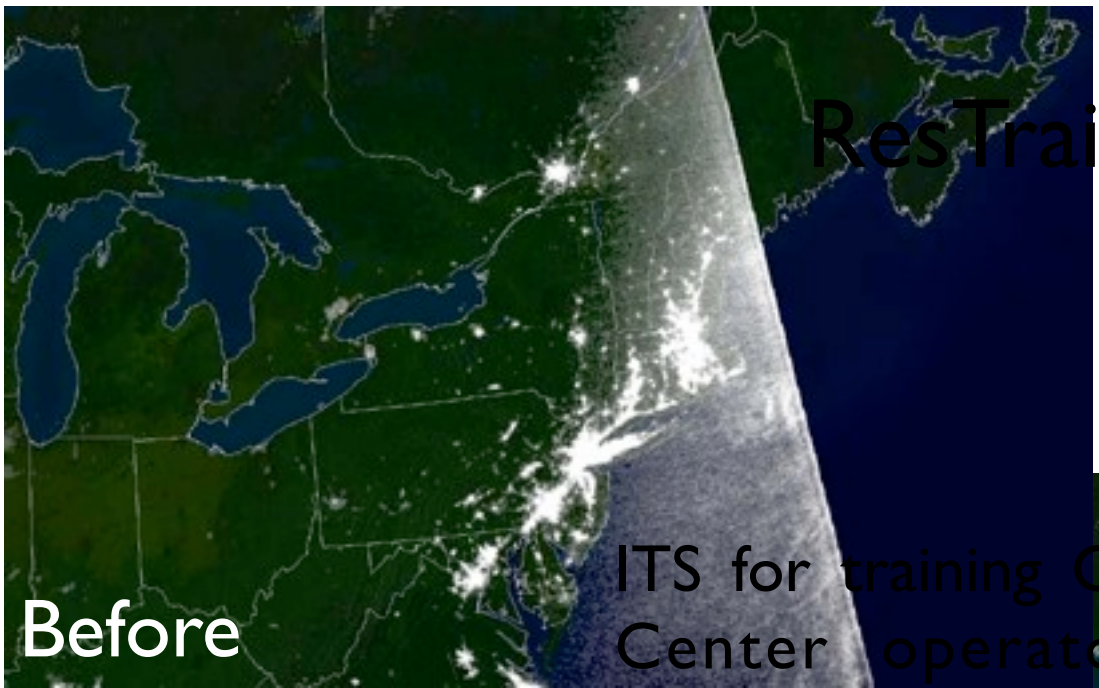
Teaching agent

Library agent



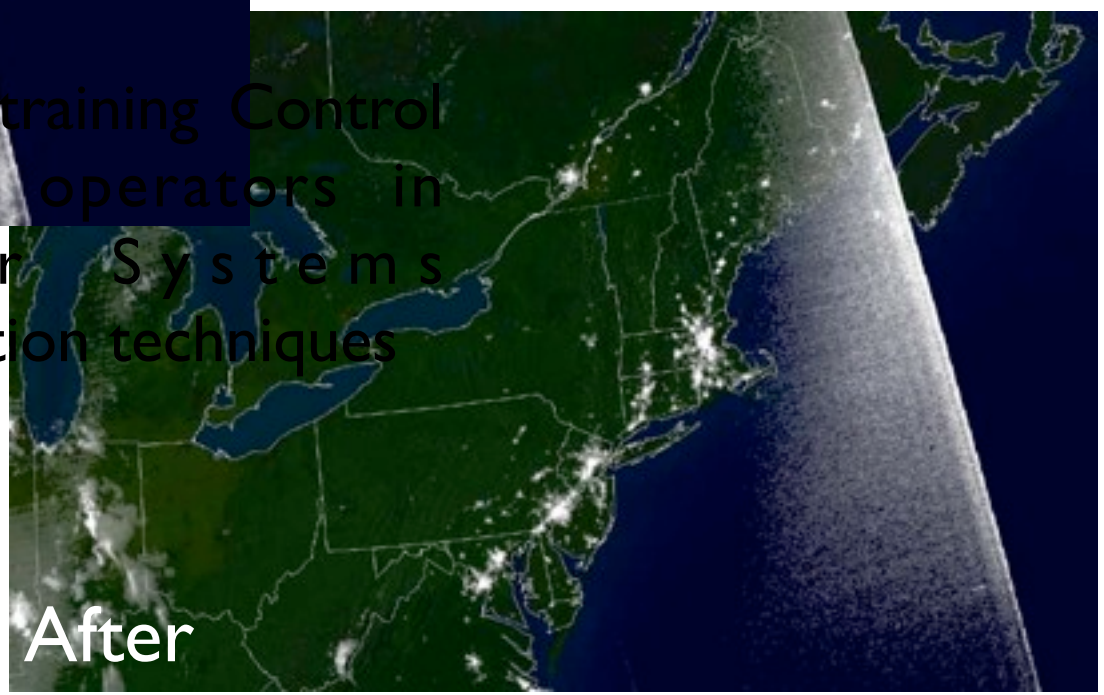
Alice / WhiteRabbit

MAS in ITS



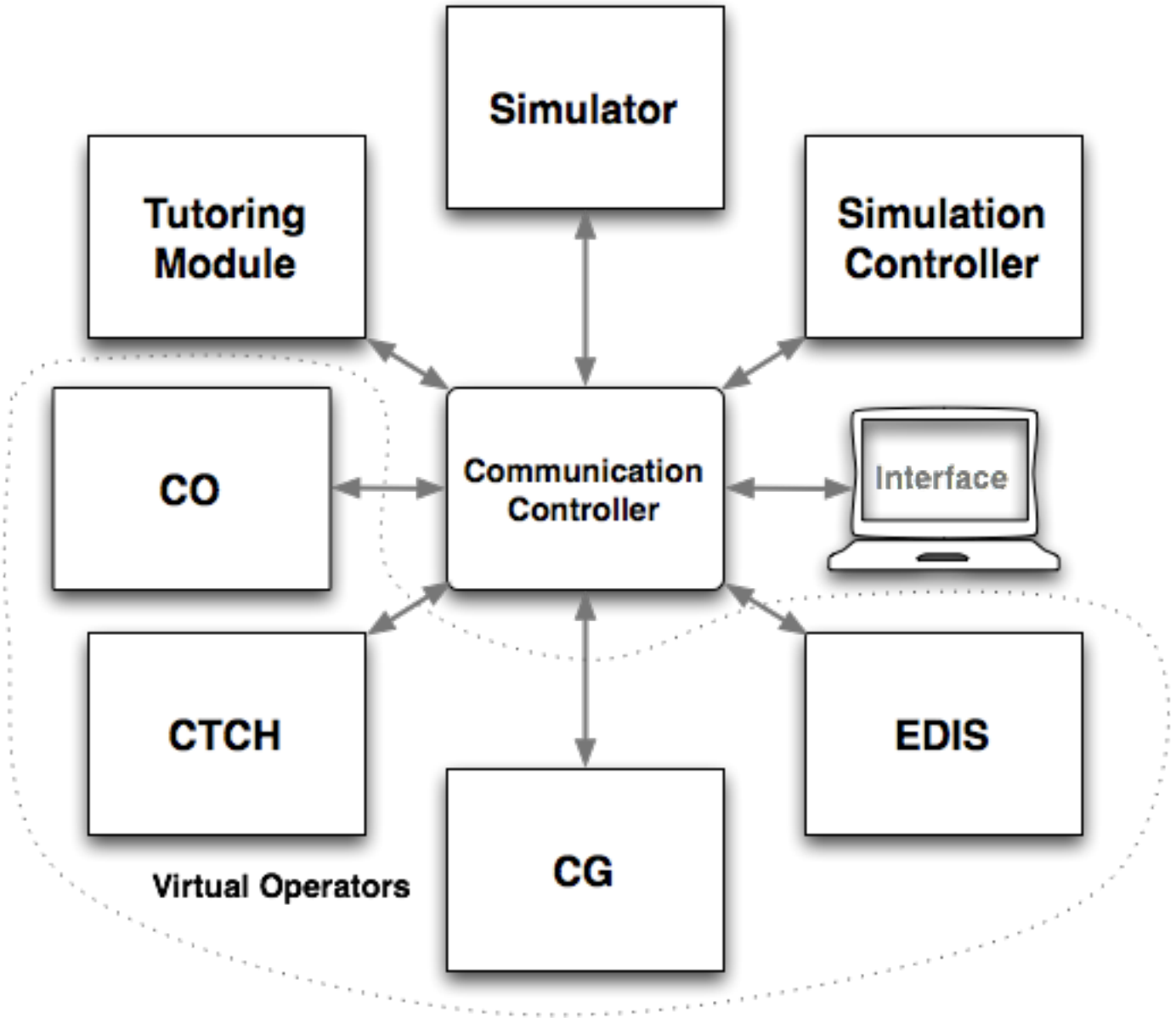
ResTrain

ITS for training Control Center operators in Power Systems Restoration techniques



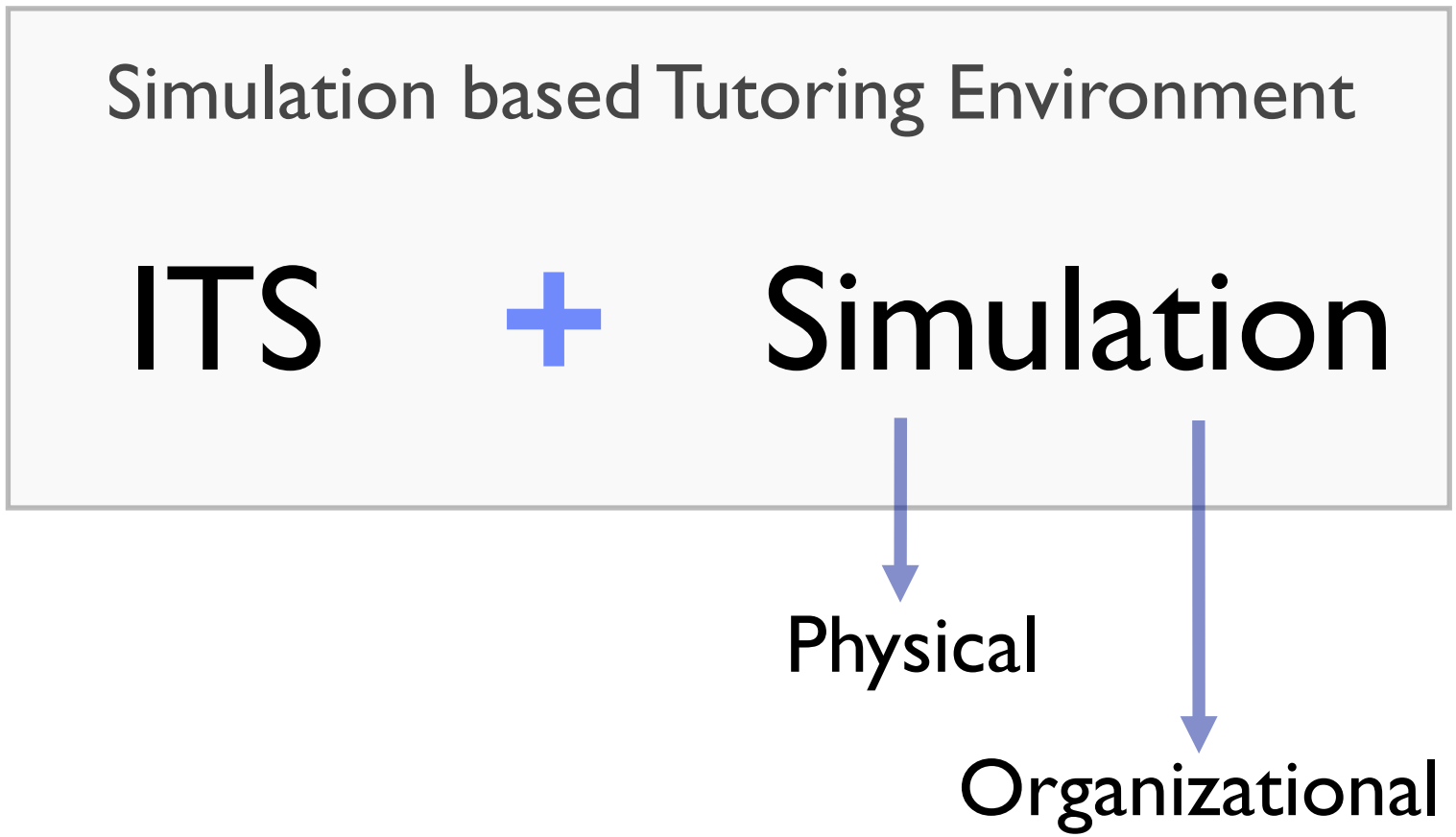
MAS in ITS

Architecture

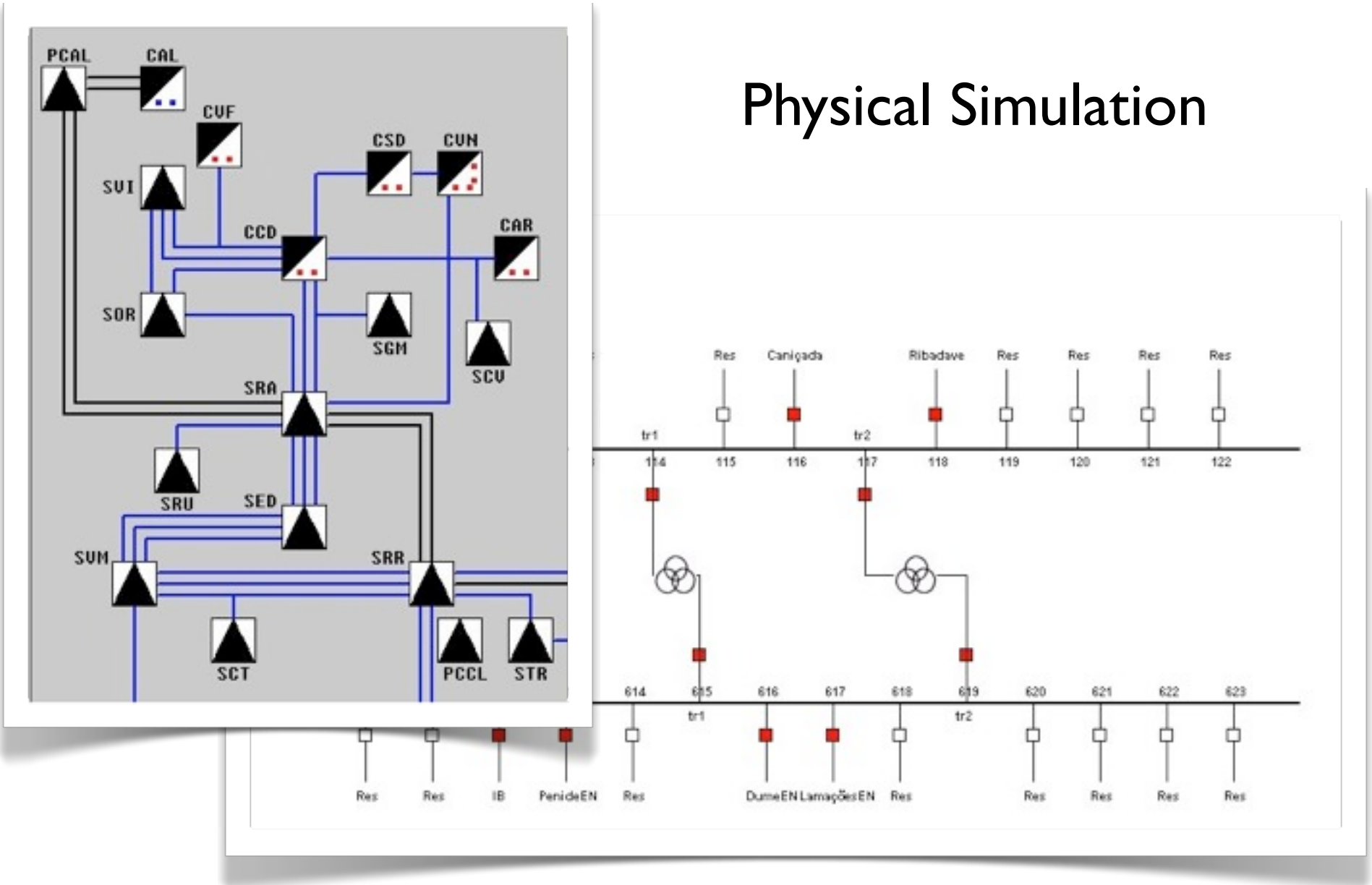


ResTrain

MAS in ITS


Simulation based Tutoring Environment
ITS
+
Simulation
Physical
Organizational

MAS in ITS

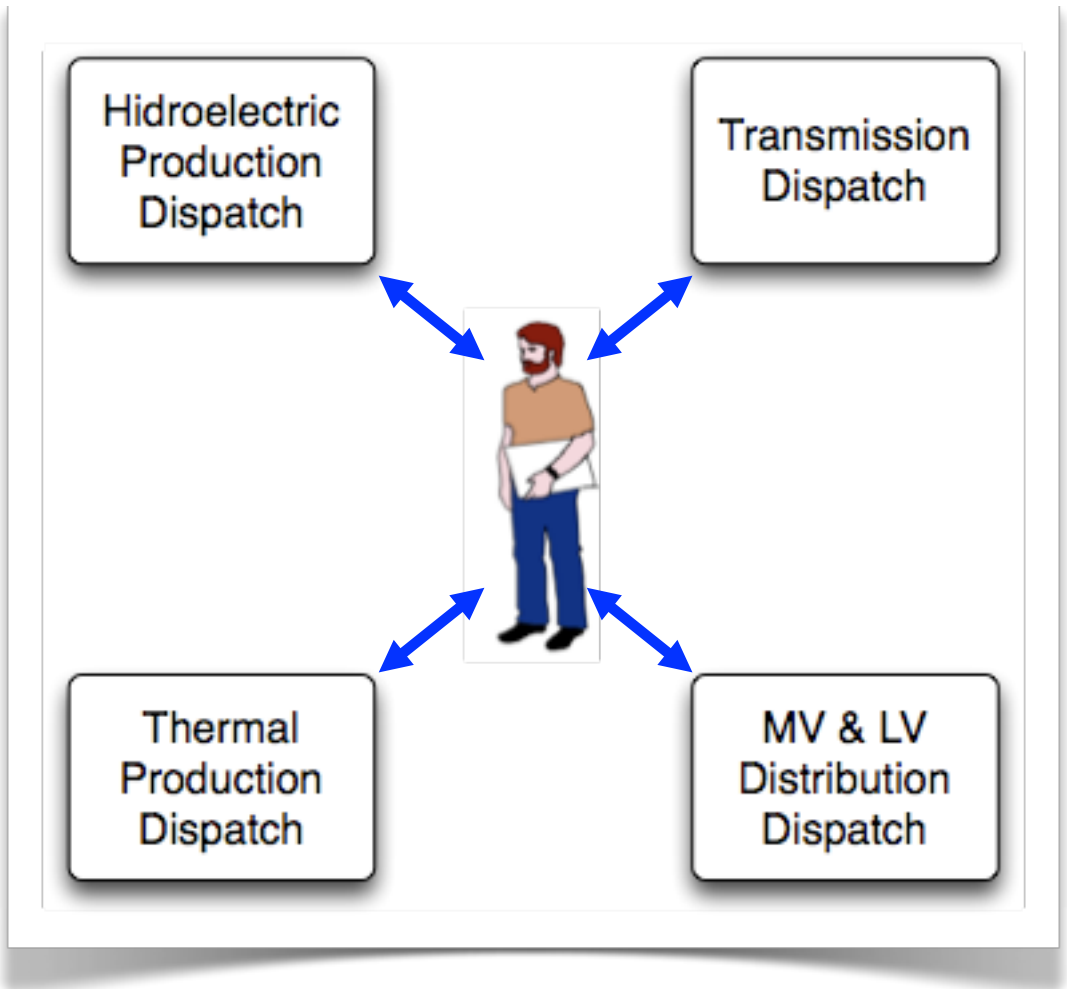


Physical Simulation

ResTrain

MAS in ITS

Organizational Simulation



ResTrain

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