Practical Issues in e-Learning Multi-Agent Systems

Alberto González Palomo

Security:
- Complex and fragile
- Required for real-world use
- JADE platform limitations:
  - mobile agents break security

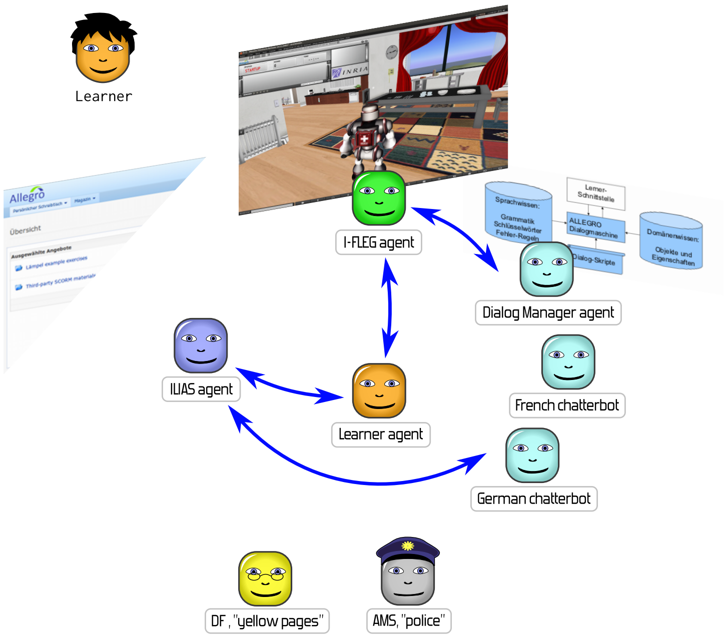
Complexity:
- Agent platform too general, eLearning use requires much work

Integration:
- Different languages: Java, PHP, JavaScript

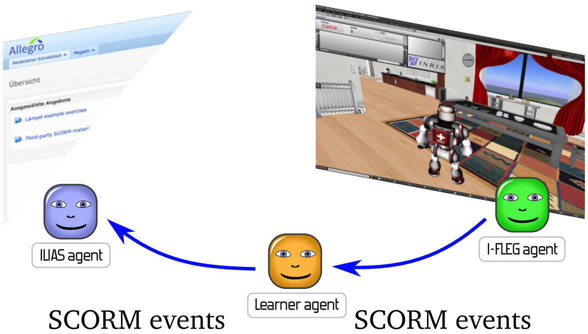
Context: Allegro Interreg IV-A project
- Language learning: German, French
- http://allegro-project.eu

Task: integration platform
- Start: May 2012, 3-year project ends 2012
- Pre-specified MAS platform: JADE
- Pre-existing components:
  - ILIAS Learning Management System
  - I-FLEG 3D game environment for French
  - Dialogue Manager from Uni-Saarland

e-Learning Multi-Agent System: eLMAS



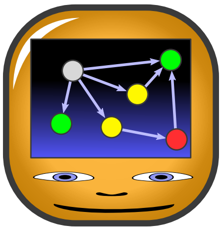
Each learner agent represents a learner:
- Knows the learner's user accounts on each system, and can access them
- Translates between different systems



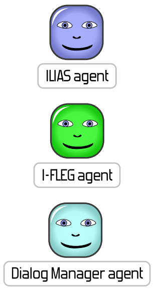
SCORM events	SCORM events
- ILIAS user name	- I-FLEG user name
- exercise score	- exercise score

- Protects the learner's privacy: gives each system only the information it needs
- Tracks the learner's knowledge
- Brain:
  - Beliefs, Desires, Intentions: BDI
    Beliefs: SCORM events, user data, etc.
    Desires: goals, get the learner to train all chosen concepts
    Intentions: chosen plans, that is which exercise to do next

Security:
- Built-in and transparent
- All messages between agents are signed (certifies it was sent by the alleged sender) and encrypted (unreadable by others)
- Learner agents run in sandbox, move by transferring their brain to a new body



Interoperability:
- "liaison" agents represent existing systems in the agent society, are easy to integrate



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Multi-Agent Systems (MAS) seem, in theory, an excellent way to integrate the various component systems used in an e-Learning platform.

Why are they not used more broadly?

I suspect the main reason is that using a multi-agent architecture requires solving many issues from the beginning that can be ignored at the prototype stage in other approaches, like fine-grained security and fault tolerance.

To solve that I am developing the e-Learning Multi-Agent System (eLMAS) that will be used as integration platform in the European project Allegro[1].

In eLMAS there are two kinds of agents: "liaison" agents that connect existing e-Learning systems to the MAS, and learner agents that represent the user, storing the learner model and planning the learning activities.

1 Component Integration

The liaison agents for the components are written in Java using JADE[2], and they can do anything a regular Java program can. Security is provided through user password authentication, code signing, and agent message signing and encryption. However these measures do not suffice if we allow agent mobility.

2 Secure Mobile Learner Agents

Learner agents need to be mobile to interact more efficiently with the different components running at each institution. To make sure they can not cause trouble in the systems they visit, they are implemented in an interpreted domain-oriented language, made simply not to have the low-level functionality needed for breaking out of the security scheme.

I chose a language called AgentSpeak invented specifically for Multi-Agent Systems[3] that implements a Beliefs-Desires-Intentions (BDI) architecture, where agents are defined by a set of initial beliefs and a set of plans. Beliefs are changed by the environment or by actions in the executed plans, and which plan to execute for a given goal is decided by a logic formula resolution engine.

The agent beliefs about the learner's knowledge are the learner model, and the planner engine provides the adaptivity.

[1] Interreg IV-A project Allegro: http://allegro-project.eu

[2] Java Agent DEvelopment Framework: http://jade.tilab.com/

[3] The AgentSpeak implementation is Jason: http://jason.sourceforge.net

A. Ravenscroft et al. (Eds.): EC-TEL 2012, LNCS 7563, p. 547, 2012.