A Master of Science Topics 2021-2022, AI-MAS Laboratory

Multi-Agent Systems and Digital Assistants

Title: A Distributed and Flexible Testbed for Agent Learning

Coordinator: *Conf. dr. ing Andrei Olaru (cs@andreiolaru.ro)*

Description:
Almost ever since ML has become a scientific interest, researchers have also become interested in the case where multiple entities learn and act in the same environment. The field of multi-agent learning (MAL) has, however, evolved more slowly, as MAL is a more difficult problem than single-agent learning, adding an additional layer of complexity by multiplying the number of agents. Moreover, the computational resources needed to perform multi-agent learning increase much faster than the number of agents itself. The purpose of the project is to **develop new multi-agent learning techniques** through the creation **of a holistic framework for the design, deployment, and execution of MAL simulations**. The framework will support representative cases and applications in the field and will enable the comparison of MAL applications. The framework will provide the necessary building blocks for enabling rapid development of new multi-agent learning methods and distributed execution of experiments in high-performance computing environments.

For more information, check the presentation on this link.

Title: FLASH-MAS as top MAS deployment solution

Coordinator: *Conf. dr. ing Andrei Olaru (cs@andreiolaru.ro)*

Description:
FLASH-MAS (A Flexible and Lightweight Agent Shell) is a development and execution environment for multi-agent systems, with an architecture that allows a modular and flexible implementation of system components. FLASH-MAS can use a variety of technologies for the interaction between entities and for the mobility of entities among the devices in the system (WebSocket, ROS, MPI), uses well-known formats and standards (JSON, YAML, FIPA-ACL), and can function on a variety of platforms (e.g. Android).

Our goal is for FLASH-MAS to be able to successfully replace other more used platforms such as JADE, Repast, or JaCaMo.

This year's objectives in FLASH-MAS are:

- The inclusion, as first-class entities, of machine learning models, either pre-trained or in the progress of training, such that they can be used by agents or transferred among them; the adequate updating of FLASH-MAS so that it can be used as a Multi-Agent Learning framework.
- Interoperation between multiple communications mechanisms, such that the same multi-agent system is able to use, simultaneously, multiple communication

mechanisms in different areas of the system, reaching a high degree of openness and heterogeneity.
- The implementation of decentralized communication and discovery mechanisms which support the openness and robustness of the multi-agent system.
- Testing the platform using complex scenarios involving a large number of agents, devices, and exchanged messages; this includes development of the testing methodology, the implementation of scenarios, and the analysis of results; scenarios should include devices with reduced computational power, such as Raspberry Pi devices.

Prerequisites: Since FLASH-MAS is written in Java, good command of Java and OOP is a must. Familiarity with other technologies used by FLASH-MAS is a plus.

For more information, check the presentation on this link.

Title: AI based assistant for smart fridges

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Description:

Topic designed in partnership with Infosys Consulting Romania

Along with the expansion of IoT solutions many *smart things* have made their way into people's houses. One such item is the *smart fridge,* a connected appliance which is equipped with various sensors: video, temperature, status, door open-close, etc. Even though information becomes easily available given the connectivity and the variety of sensors, the need to interpret the data requires intelligent algorithms.
In this project we will explore two tasks related to a smart fridge:

- Detect products inside and keep track of their quantity and usage by employing computer vision techniques.
- Analyze activity sequences regarding the contents of the fridge and its utilization using machine learning methods.

The partner company (Infosys) is providing an instance of a smart fridge, equipped with the type of sensors mentioned previously (in particular, an RGB camera). Prospective students have the opportunity/requirement to integrate their work on a real device.