A-DSS FOR FRAUDULENCE PREDICTION

Multi-Agents Systems - MAI

Universitat Rovira i Virgili - Universitat Politècnica de Catalunya

Authors

- *Sergi Cirera Rocosa*
- *Iago Águila Cifuentes*
- *Laia Borrell Araunabeña*
- *Mario Lozano Cortés*

INDEX

1. INTRODUCTION AND OBJECTIVES

It is not uncommon for audits to fail in the challenging task of determining whether a given company is fraudulent or not. Thus, machine learning problems have gained a lot of interest in this field, since its classifiers can be very helpful when building a prediction model able to distinguish between legal and fraudulent fields [1].

In this context, the **main objective** of this project is to develop a decision support system by means of multiple agents able to predict fraudulence in business companies. To achieve this goal, a set of classifier agents will be fed with data related to the risk factors of a given number of enterprises. To be more precise, the dataset used will be AUDIT [2], which consists of 767 instances of enterprises and 25 attributes for each instance (Figure 1). Moreover, each of the classifiers will be working with J48, which is a decision tree algorithm based on entropy gain [3].

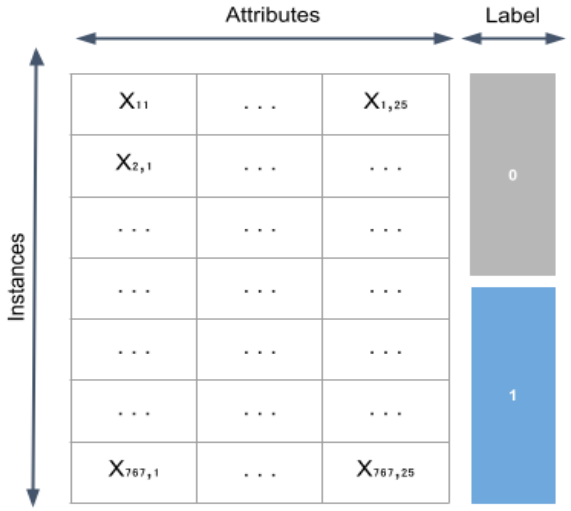

Figure 1: dataset used to train the classification algorithm

The main idea is that the user of the system should be able to enter the application and introduce a new enterprise instance with a set of attributes related to its historic and present actions associated with a given risk, and then the system should return the user an accurate prediction of the enterprise fraudulence.

2. PROPOSED ARCHITECTURE

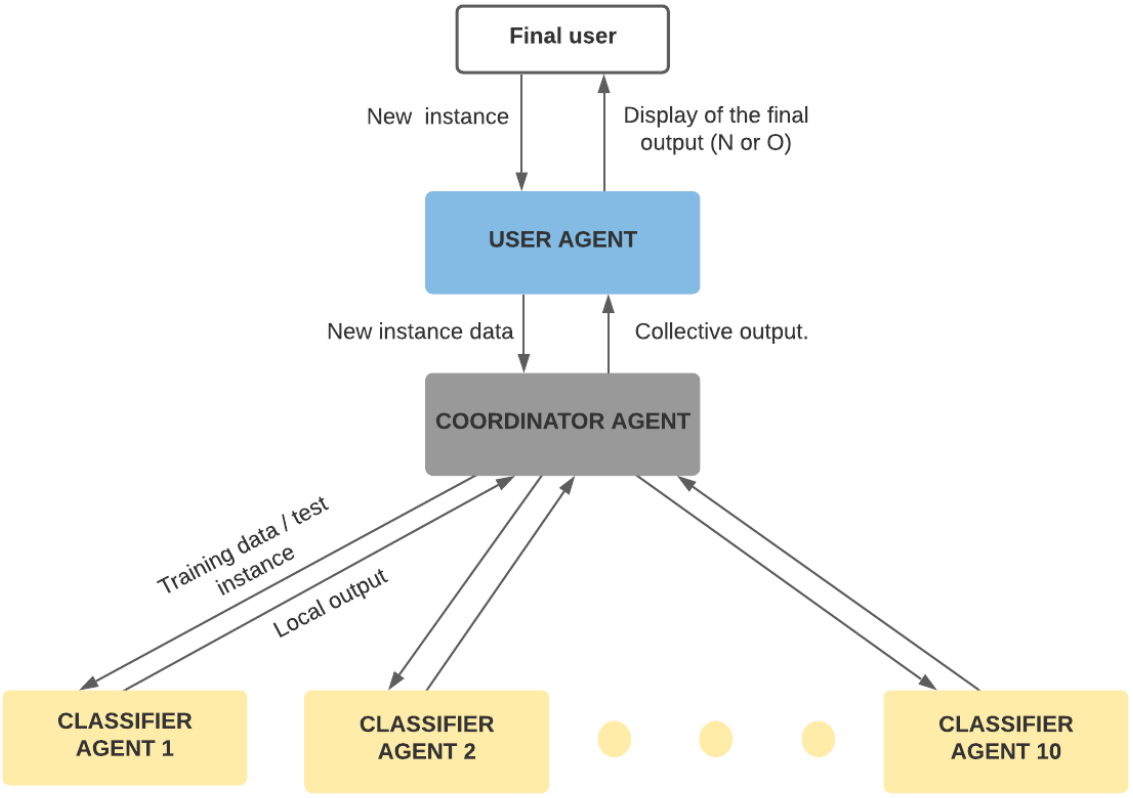

Figure 2: Architecture of the Multi-Agent system

As seen in figure 2, the selected architecture for the proposed problems is based on three different types of agents organized hierarchically, hence, the architecture is designed and implemented as a multi-agent system. Notice that it consists of a hybrid architecture, since not all the agents are from the same type (deliberative or reactive). The agents involved are:

- **User agent**: Its role is to provide an interface for the user to interact with the system. For that reason, it will provide a way of selecting or introducing as input the attributes related to a firm being fraudulent. It has a reactive architecture as it must react quickly to interactions between the user and the interface provided.

- **Coordinator agent**: It has several roles, among which we find serving as a gateway between the user agent and the classification agents. The coordinator agent's roles include:
    - Being in charge of the data splitting to each of the classifiers. It must send 300 instances with 6 attributes to each of the classifier agents for training and save 25% of this train data for validation.
    - Serve as a decision system, gathering the different classification outputs from the ten classifiers and emitting a single answer to the data introduced.

  It is an agent with a deliberative architecture as it contains prior representations of the environment that allow it to react by creating long-term plans.

- **Classifier agents**: They are responsible for classifying as fraudulent or legal a new observation or enterprise after being trained with a reduced set of instances. Their number shall in no case be less than 10 and they shall use 300 instances and 6 attributes in their training, which must be received completely for the classifier agent to be able to make a prediction. Its architecture is deliberative as it contains simple goals and makes use of previously known concrete attributes.

- **Other agents**: Besides the user, coordinator and classifier agents, there will be two more agents in the Main Container, which are automatically created by the JADE library [4]:

    - AMS (Agent Management System). The AMS is responsible for the creation/termination of the agents, and for providing a naming service (i.e. ensuring that each agent has a unique name).

    - DF (Directory Facilitator). The DF has information on all agents. Agents that require services can then use the DF to search for third agents that can provide said services.

3. AGENTS PROPERTIES

In this section, the different properties of each agent in the proposed architecture are defined.

	AGENTS		
PROPERTIES	*USER*	*COORDINATOR*	*CLASSIFIER*
Flexibility	*No*	*No*	***Yes***
Reactivity	***Yes***	*No*	*No*
Proactiveness	*No*	*No*	*No*
Social ability	***Yes***	***Yes***	***Yes***
Rationality	***Yes***	***Yes***	***Yes***
Reasoning	*No*	*No*	*No*
Learning	*No*	*No*	***Yes***
Autonomy	***Yes***	***Yes***	***Yes***
Temporal continuity	*No*	*No*	*No*
Mobility	*No*	*No*	*No*

Table 1: Agents properties.

Table 1 summarizes the properties of the three kinds of agents that compose the designed multi-agent system. The properties are clarified by the following justifications:

FLEXIBILITY

A flexible agent is one that is able to adapt to the environment. Thus, since the classifier agents will adapt the decision tree's parameters while training and the validation set, they can be said to be flexible. On the other hand, neither the coordinator or the user agents are flexible. Like it's been said before, the user agent provides an interface for the user to interact with the system, therefore it's not adaptive and flexible. Also, the coordinator agent already contains prior representations of the environment and it is considered that has a deliberative architecture, so it's not adaptive and flexible.

REACTIVITY

It is understood that an agent is reactive when it maintains an ongoing interaction with its environment. Therefore, it can be easily understood that the user agent is reactive, since it interacts with the user by receiving its orders. None of the other two types of agents are, consequently, reactive, since they do not interact with the environment.

PROACTIVENESS

A proactive agent is one with a goal-oriented behaviour, acting without an explicit user request. None of the agents is proactive, since they limit their actions to respond to the user's queries and they don't change their behaviour unless an event occurs.

SOCIAL ABILITY

All of the agents have social ability because they cooperate with other agents in order to achieve their goals. They interact between them via an agent-communication language in order to work together.

RATIONALITY

All agents are rational since they will not have irrational behaviour nor show irrational results. They won't apply deductive procedures on their own without a purpose.

REASONING

None of the agents has the reasoning property. They do not have a knowledge base with beliefs of the world, and they are not able to infer new knowledge from premises.

LEARNING

An agent is considered to have the learning property if it is able to improve its performance in an automatic way. Since the classification agents will perform a machine learning classification task, it is pretty clear that they will have this property. On the other hand, nor the user or the coordinator will have this property.

AUTONOMY

All of them are autonomous because they will be making actions without continuously asking permission from the user.

TEMPORAL CONTINUITY

None of the agents will be running continuously all the time and they won't move either. So temporal continuity and mobility won't be considered as properties of any of the agents.

4. BIBLIOGRAPHY

1. Shivanna, A., Ray, S., Alshouiliy, K., & Agrawal, D. P. (2020, October). Detection of Fraudulence in Credit Card Transactions using Machine Learning on Azure ML. In *2020 11th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)* (pp. 0268-0273). IEEE.

2. Hooda, N., Bawa, S., & Rana, P. S. (2018). Fraudulent firm classification: a case study of an external audit. *Applied Artificial Intelligence*, *32*(1), 48-64.

3. Quinlan, J. (1993). C4. 5: Program for machine learning morgan kaufmann. *San Mateo, CA, USA*.

4. Caire, G. (2003). JADE tutorial: JADE programming for beginners. *http://jade. tilab. com/doc/JADEProgrammingTutorial-for-beginners. pdf*.