Knowledge Dynamics in a Khepera Robots' Application

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Abstract

The theory change area have defined several operators trying to model the dynamic of knowledge. The goal of this work is to introduce a *preprocessor of perceptions* that could be part of an agent. The purpose of the preprocessor is to select an adequate change operator to store the perceptions that the agent perceives from the environment where their activities are performed. An agent receives perceptions, and classifies them according to how they were obtained by him/her. Once are the perceptions classified, the preprocessor selects one of the change operators to store the new information in the belief base. Then the *preprocessor of perceptions* sends the selected method and the perceptions to a change machine in the agent. When the change machine receives the mentioned inputs, it interacts with the belief base of the agent to store the new information.

Key words: Multi-Agent Systems, Khepera, Preprocessor, Revision, Update.

1 INTRODUCTION

In a multi-agent system with a dynamic environment, agents should store the information that they perceive from the environment where they perform their activities. In order to achieve this, the agents should have a change machine, that will interact with the belief base of the agent, and some storing mechanism to store the new information that perceive from the environment. Furthermore, this mechanism should conserve the consistency of the belief base. Therefore, we will base our work upon the theory change. The main goal of this theory is to model the dynamic of knowledge. That is, how the agents beliefs are defined after they receive the out-source information.

Khepera robots [1] have multiple sources to obtain knowledge from the environment. They have eight infrared sensors and a video camera (for a more detail reading, see Section 4). They use these mechanisms to perceive information from the environment in which they perform their activities. In this work, we will show the proposal through examples including Khepera robots. These examples consider a simple situation of the *"cleaning task problem"* where one robot has to transport to a particular place (store), a particular box.

In theory change have been proposed different change models. The AGM model [2] is one of their main referents. This model belongs to the theory revision, and it distinguishes three change operators: *expansions*, *contractions* and *revisions*. Katsuno and Mendelzon in [11] distinguish other

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type of operators. These are called *updating* and *erasure* (they belong to the theory updating). They model those changes in the world. Furthermore, as we will show below, in the theory revision there are defined several operators with different semantics.

The goal of this work is to introduce a *preprocessor of perceptions* that could be part of an agent. The purpose of this preprocessor is to select an adequate change operator to store the perceptions that the agents perceive from environment where their activities are performed. This preprocessor could be characterized by a framework which is defined as: $< \mathcal{L}, Op, COA >$ where $\mathcal{L}$ is a generic language (the language will not be fully considered in this work), Op is a set of change operators, and COA is a credibility order among agents.

The *preprocessor of perceptions* receives Op, COA and perceptions (sentences belong to the language $\mathcal{L}$), and classifies the perceptions according to how they were obtained by the agent. Once the perceptions are classified, the preprocessor selects one of the change operators from Op, to store the new information in the belief base. If the perception comes from an agent, this selection could depend of a credibility order among agent defined in COA. Then the preprocessor sends the selected method and the perceptions to a change machine in the agent. When the change machine receives the mentioned inputs, interacts with the belief base of the agent to store the new information. In Figure 1 a general scheme of the proposal is depicted.

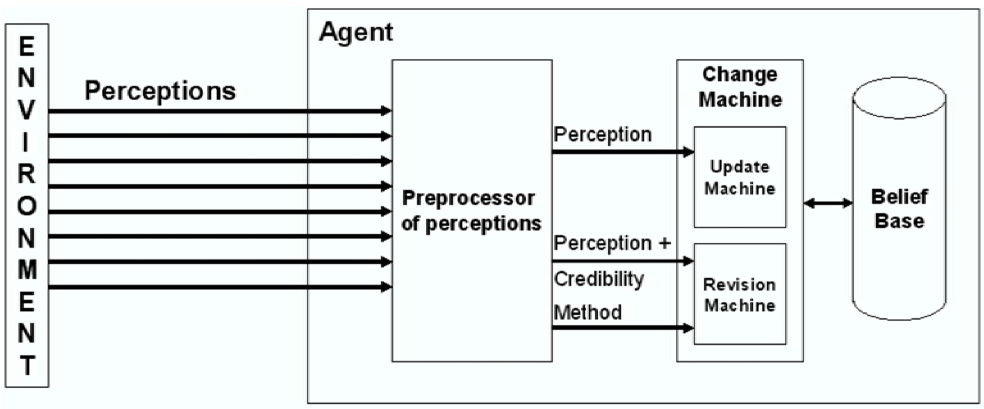

Figure 1: General scheme of the proposal

As shown in Figure 1, the change machine is splitted in two parts, update machine and revision machine. Both machines interact with the belief base to consistently store perceptions, either through an update operator or a revision operator, respectively. The update machine only receives one input, the perception. The revision machine receives two inputs, the perception and its credibility (below we will see that the sentences will have credibility too), and a method. This is because in the theory revision exists several change operators.

The work is organized as follows: to next, we will describe a general example to motive the proposal. In Section 2, a background of theory revision will be given, describing notions about epistemic model, updating and revision. In Section 3, we will introduce the *preprocessor of perceptions* characterized by a multi-change framework. In Section 4, a brief description over Khepera robots will be given, and we will show how the behavior of the preprocessor in the Khepera should be. In Section 5 we will give the conclusions about this work.

Example 1 *Lets suppose we have a multi-agent system with a dynamic environment. The system is composed by Khepera 2 robots [1] and the experimental environment is a square arena. The Khepera robots have infrared sensors and a video camera (for more detail see Section 4). They use* *these mechanisms to perceive information from the environment where their activities are performed. In the arena there are boxes, obstacles and a particular place (store) where they should deposit a determined box. Khepera robots start in an initial position in the arena and they should search a particular box. Once the particular box is found, the robots will transport it towards the store. When the robots start their activities, their knowledge will be submitted to subsequent revision processes. That is, the Khepera incorporate beliefs such as: 'the store is in the position (x,y)', 'there is a box in the position (x,y)' or any related information represented in a determined language. The robot will acquire knowledge to find the particular box and to achieve its goal.*

2 THEORY CHANGE

The main goal of theory change is to intent to model the dynamic of knowledge. That is, how the agents beliefs are defined after they receive the out-source information. In theory change have been proposed different change models. The AGM model [2] is one of their main referents. This model belongs to the theory revision, and it distinguishes three operations of change: *expansions*, *contractions* and *revisions*.

2.1 Epistemic Model

The **epistemic states** represent states of the knowledge of an agent in a moment of time. Generally, we expect that the epistemic state will be equilibrated. That is, we expect that the epistemic state will not have contradictory beliefs. An equilibrated epistemic state does not need to be evaluated because it does not have contradictory beliefs. The epistemic state is evaluated when the agent receives a **epistemic input** of external information that it contradicts the current epistemic state. In this case, we should modify the new epistemic state until lead it to an equilibrated state.

In an idealized interpretation of the epistemic state of an agent, we assume that this is in an equilibrated state. Changes of a belief state are produced by some epistemic input that force the change. It is desirable that the new belief state will be equilibrated too. Our interest is centered in the effect produced by epistemic inputs over the epistemic state. The operation that adds information to the epistemic state and then it modifies the epistemic state to lead it to a equilibrated state is called "*revision*" or "*update*" (this depends of the operator type that should be used).

In this work we consider that the epistemic states of agents are represented with **Belief Bases** and not with closed sets under logic consequents. The Belief Bases are represented through a set of sentences not necessarily closed under logic consequence. This feature makes the change operations computationally tractable over belief states (represented through belief bases). This could make us think that our effort in the development of change operations should be centered in belief bases and not in belief sets. However, we will see that this first impression seem hurried. The models that employ belief bases are based in the intuition of that some of our beliefs do not have a independent sustentation. That is to say, these belief types appear as a consequence of applying inference rules over our beliefs of which they totaly depend [4].

2.2 Revision

The *revision* is one of the most common operations that an agent develops in an dynamic environment where his/her activities are performed. Whether an agent believes in a set K, and the agent perceives an epistemic input α, he/she should revise the beliefs of K. The agent does this in order to determine which of his/her beliefs are in disagreement with α. This is done eliminating some beliefs that contradict α and adding α afterwards. This process generates a new consistent K'. In this context, different situations may arrive:

- The epistemic input has primacy [3] over the epistemic state of the agent. In this case we should eliminate of the epistemic state all beliefs that are inconsistent with the input.
- The epistemic input does not have primacy. In this case, the agent may preserve his/her epistemic state (ideally equilibrated), because the agent could not consider that the epistemic input is more credibility than the epistemic state.

The second case motivated the development of other types of revision operators called "non prioritized". Among these, we may find the *revision by a set of sent* [5]. This is a revision operator non prioritized that demands that the external beliefs were supported in explanations. The acceptation or not of the external belief will depend of the explanation: whether the explanation is sufficiently convincing, the new belief (and its justification) will be accepted; else it will not have changes in the knowledge [5].

When an agent perceives a new epistemic input is important to distinguish two cases. Let suppose the epistemic state of an agent is represented through a set of sentences K. Suppose that α is the input sentence. The cases to consider in a epistemic change are the following:

- When α is consistent with K.
- When α contradicts K.

In the first case to maintain equilibrated the new epistemic state not seem something complicated. Only we should add α to the belief base. This is a operation of *expansion*. However, when α contradicts to K then the negation of α is inferred from K. Hence, before of to incorporate α to K, we should eliminate of K some or all the sentences that allow the deduction of $\neg\alpha$ in K. This change operation is called *contraction*. Furthermore, to complete the change in the epistemic state we should add the sentence (the epistemic input) to the contracted set. This type of operation is called *revision*.

2.3 Updating

The change operations that we have mentioned above allow to modify the agent knowledge. The goal of the operations is to dynamically model the knowledge of an agent when new information arises. For instance, consider the multi-agent system of Example 1. The robots will acquire knowledge to find the particular box. They will assume that the environment always will be the same. That is, in the environment (where the agents perform their activities) does not occur change.

Unfortunately, the previous assumption is very strong. The world, where an agent performs his/her activities, may change by its own evolution, by actions of the agent, or by actions of other agents. For this matter, the change operations that we have shown above (*expansion*, *contraction* and *revision*) allow to modify the knowledge of an agent assuming that the world is static. That is, there are changes in the knowledge but not in the world. Katsuno and Mendelzon distinguish other type of operators [11]. These are called *updating* and *erasure*. They model those changes in the world, and this involves that the environment in which the agents perform their activities is dynamic and may change by its own evolution or by actions of other agents. In the example of the Khepera robots, in the following case some changes in the world will occur: we assume that there are two Khepera robots (A and B) in the arena and that there are boxes that may be transported by the robots. In this case, whether an agent A transports a box by his/her own action and an agent B passes for second time for the place where the box was, the agent B perceives one change in the world and will update his/her knowledge.

The operations to model changes in the world are called *updating* and *erasure*. They are similar to the operations of *revision* and *contraction* that allow to model changes in the knowledge of an agent. This is the reason from which some authors clearly distinguish the **theory revision** (called theory change too) of the **theory updating**. In the theory updating are developed *update* operators and from these are formulated the *erasure* operators. In counterpart, most of the belief revision systems define *contraction* operators in order to define *revision* operators. Other difference is that the models of revision are defined syntactically (except the Grove construction [7] and the work of Katsuno and Mendelzon [12]), and the update operations are defined semantically. Next, definitions of update and revision proposed by Katsuno and Mendelzon in [11] are shown:

- Update: Consists of bringing the knowledge base up to date when the world described by it changes. For example, the incorporation into the knowledge base of changes caused in the world by the actions of a robot. The AGM postulates must be drastically modified to describe update.

- Revision: is used when we are obtaining new information about a static world. For example, we may be trying to diagnose a faulty circuit and want to incorporate into the knowledge base the results of successive tests, where newer results may contradict old ones.

Previously we have analyzed some difference between revision operators and update operators. For the goal of this work, we consider that the most important difference is the next one: the type of change operators formulated from the theory revision, characterize the changes produced in the knowledge of an agent. However, they do not give a formal mechanism to model the changes in the world. This is modeled by theory updating. The AGM model allows to model the changes in the knowledge of an agent assuming that the world does not change.

3 PREPROCESSOR OF PERCEPTIONS

As stated above, in the theory change have been proposed several operators that allow to incorporate information. These operators have similar aspects (they allow to incorporate a belief and hold the belief base consistent), but their semantics differs. That is, each type of operator defined in the literature has distinctive features. These features determine which operator to select. Next we will define a *preprocessor of perceptions*. This preprocessor could be part of the agents and will allow them to decide which operator to use in a particular situation.

Definition 1 : **(Preprocessor of perceptions)** The *preprocessor of perceptions* is a selection procedure composed by two modules, a *classifier of perceptions* and an *analyzer of senders*. It receives a set of change methods, a credibility order among agents, perceptions and it returns the change operator to be applied to consistently store the perceptions.

The purpose of this preprocessor is to select an adequate change operator to store the perceptions that the agents perceive from environment. This preprocessor could be characterized by a framework which is defined as: $< \mathfrak{L}, Op, COA >$ where $\mathfrak{L}$ is a generic language, Op is a set of change operators, and COA is a credibility order among agents.

The *preprocessor of perceptions* receives Op, COA and perceptions (sentences belong to the language $\mathfrak{L}$), and classifies the perceptions according to how they were obtained by the agent (via sensors or via interaction with others agents). This classification is performed by a *Classifier of Perceptions* that is a small part of the preprocessor (this is defined below). If the classifier has selected a operator of the theory revision, then the preprocessor should newly analyze the perception to determine that revision operator to apply. This analysis is performed by a *analyzer of senders* (described below) with help of a credibility order among agents defined in COA. As secondary effect, the analyzer adds credibility to the sentences that represent the perceptions.

Once the perceptions are classified, the preprocessor selects one of the change operators from Op, to store the new information in the belief base. Then the framework sends the selected method and the perceptions to a change machine in the agent. When the change machine receives the mentioned inputs, interacts with the belief base of the agent to store the new information. In Figure 2 a detailed scheme of the proposal is depicted.

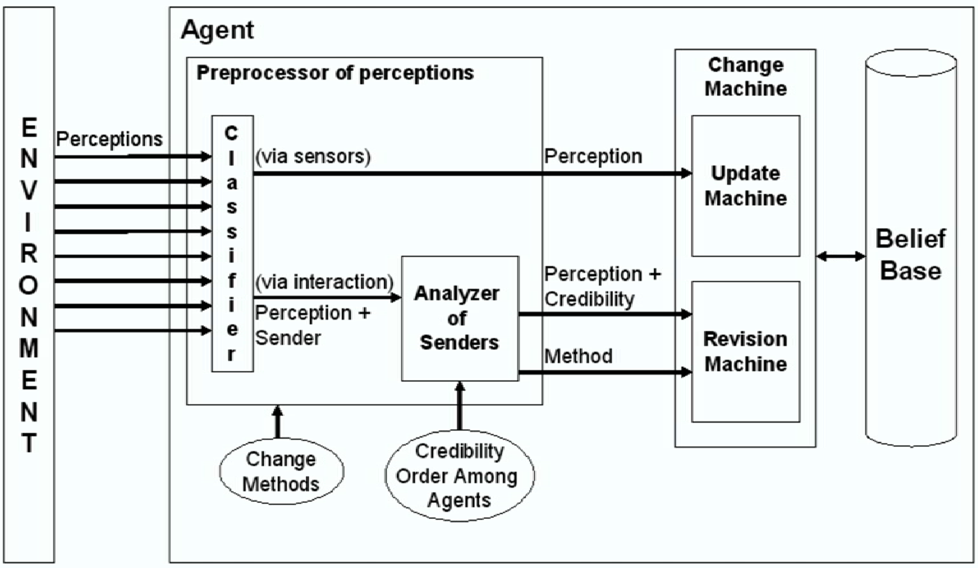

Figure 2: Detailed scheme of the proposal

As shown in Figure 2, the change machine is splitted in two parts, update machine and revision machine. Both machines interact with the belief base to consistently store perceptions, either trough an update operator or a revision operator, respectively. The update machine only receives one input, the perception. The revision machine receives two inputs, the perception and its credibility (below we will see that the sentences will have credibility too), and a method. This is because in the theory revision exists several change operators.

3.1 Classifier of Perceptions

Before determining which change operator should apply, the preprocessor should select the theory change to use. In order to achieve this, the preprocessor checks whether:

- the perceptions were obtained by sensors, (a mechanism to capture information from the environment such as infrared, video camera, etc.), or
- the perceptions were obtained by interaction with other agents.

In first case the perceptions will be classified as *"via sensors"*. Here, the preprocessor is going to consider that the operator most convenient is *updating*, because the agents detect the changes in the world through sensors. In second case the perceptions will be classified as *"via interaction"*. Here, the preprocessor is going to consider that the operator most convenient is some of the theory revision, because the perceptions are information that the agent received from other agent and maybe these perceptions do not represent some change in the world. In Figure 3 this is shown. In Definition 2 we define the module of the preprocessor that is responsible of this check.

Classification	**Selected theory by classifier**
via sensors	updating
via interaction	revision

Figure 3: How the classifier selects the adequate theory change

Definition 2 : **(Classifier of perceptions)** The *classifier of perceptions* is a small part of the *preprocessor of perceptions*. This receives the perceptions and performs a simple analysis to determine the theory change to be used, theory update or theory revision.

If the perception has been classified as *"via sensors"* then the preprocessor sends a message to the change machine (in this case, update machine) only with the perception. After this, the change machine interacts with the belief base of the agent to consistently store the new information. Otherwise, if the perception has been classified as *"via interaction"* then the preprocessor should newly analyze the perception to determine that revision operator should be applied. This is performed by a *analyzer of senders* (depicted below) with help of a credibility order among agents defined in COA. For this matter, the classifier sends to the analyzer two parameters, the perception and the identifier of its sender.

3.2 Analyzer of Senders

After the *classification of perceptions*, the preprocessor has already obtained which type operator to use, an operator of the theory revision or an operator of the theory updating. Whether revision operator has been selected, then the preprocessor should select which revision operator to apply. In order to achieve this, the preprocessor should perform a new analysis. This is performed by a module that we call *Analyzer of Senders*. This analyzer compares the credibility of the receiver agent with the credibility of the sender agent (the sender identifier is received from the *classifier of perceptions*). The comparison is based in a *credibility order among agents* defined in COA. Both, the analyzer and the order are defined to next.

Definition 3 : **(Analyzer of Senders)** The *Analyzer of Senders* is a part of the *preprocessor of perceptions*. This receives a credibility order among agents and perceptions (previously classified as *"via interaction"*), and return the revision operator to be applied based in the senders.

Definition 4 : **(Credibility Order among Agents)** Let $\mathcal{A}$ be the set of all the agents in a multi-agent system and Ag_1, Ag_2 and $Ag_3 \in \mathcal{A}$. A credibility order among agents '$\leq$' over $\mathcal{A}$ is a binary relation on $\mathcal{A}$ where $Ag_1 \leq Ag_2$ means that Ag_2 is more credible than Ag_1. Besides, $Ag_1 \leq Ag_2$ if and only if $Ag_1 \leq Ag_2$ and $Ag_2 \not\leq Ag_1$.

We assume that this order is total because for every Ag_1, $Ag_2 \in \mathcal{A}$, either $Ag_1 \leq Ag_2$ or $Ag_2 \leq Ag_1$. It satisfies the followings properties:

- Reflexive: $Ag_1 \leq Ag_1$.
- Transitive: if $Ag_1 \leq Ag_2$ and $Ag_2 \leq Ag_3$ then $Ag_1 \leq Ag_3$.
- Antisymmetry: if $Ag_1 \leq Ag_2$ and $Ag_2 \leq Ag_1$ then $Ag_1 = Ag_2$.

The mentioned analysis, that compares the credibility between receiver agent and sender agent, may return three results:

- The sender is more credible than receiver.
- The receiver is as credible as the sender.
- The receiver is more credible than sender.

Based in these results the analyzer may indicate which of type revision operator should be applied. In first case, the *analyzer of senders* will consider that the revision operators most indicated are those where the input has primacy over the belief base. For instance, *"Partial Meet Revision"* defined by AGM in [2], or *"Kernel Revision"* defined in [8]. In this work we consider that the selected operator by the analyzer should be *"Kernel Revision"* because it is more tratable over belief base.

In second and third cases, the *analyzer of senders* will consider that the revision operators most indicated are those where the input does not have primacy over the belief base. There are a lot of works related to non prioritized revision such as, *"Semi-Revision"* [9], *"Screened Revision"* [13], *"Credibility Limited Revision"* [10], *"Selective Revision"* [6] and *"Revision by a set of sentences"* [5]. In this work we consider that, in second case, the selected operator by the analyzer should be *"Selective Revision"*. Because if both agents, the receiver and the sender, have the same credibility level then the receiver should incorporate only part of the input. Besides we consider that, in third case, the analyzer should select any of the others non prioritized operators. Next in Figure 4 a brief of this will be shown.

Credibility Order	**Operators most convenient selected by analyzer**
The sender is more credible than receiver	Kernel Revision
The sender is as credible as receiver	Selective Revision
The receiver is more credible than sender	Semi-Revision, Screened Revision, Credibility Limited Revision, Revision by a Set of Sentences

Figure 4: How the analyzer selects the adequate revision operator

Observation 1: If the method to be used is the *"Revision by a Set of Sentences"* then the epistemic input should be supported by an explanation.

Once the preprocessor has analyzed the credibility among agents, the analyzer adds credibility to the perceptions. This credibility depends of the sender and the credibility order among agents. Thus, the perceptions will be pairs of the form (perception, sender identifier). This will allow that the change machine may compare the sentences through the credibility order and the identifier sender.

Once the credibilities of sentences have been added, then the *analyzer of senders* sends the perceptions, their credibilities and the selected method to the change machine (in this case, revision machine). The change machine interacts with the belief base of the agent to consistently store the new information through the method received.

Credibility of perceptions may be used by the change machine in the process of revision. That is, each method of the change machine will receive a perception and its credibility and each method will use the credibility in a different way. The credibility of the sentences may change when the contents of the belief base are modified.

Observation 2: The perceptions received by the update machine will have the greatest credibility because they determine change in the world (these sentences are obtained by agent *"via sensors"*). Hence the update machine does not need to receive their credibilities.

4 KHEPERA 2 ROBOT OVERVIEW

The *Khepera 2* robot [1], is a miniature mobile robot that allows confrontation to the real world of algorithms developed in simulation for trajectory execution, obstacle avoidance, pre-processing of sensory information, hypothesis on behaviors processing, among others. Its small size (60 mm diameter, 30 mm height), light weight (approx. 70 grams), and compact shape are ideal for micro-world experimentation. The *Khepera 2* has eight infrared sensors to sense both ambient light levels and proximity to nearby objects. It also has two DC motors that are capable of independent variable speed motion, allowing the robot to move forward, backward, and complete a variety of turns at different speeds.

The *Khepera 2* has several extension modules that can be plugged into the top of the robot. These include an arm with a gripper, a linear vision system, and a matrix vision camera. The *Khepera 2* has an on-board Motorola 68331 (25MHz) processor, 512 KB RAM, 512 KB Flash memory programmable via serial port, and rechargeable NiMH batteries that allows it up to 60 minutes of autonomy. Thus, the *Khepera 2* has sufficient sensors and actuators to ensure that it can be programmed to complete a wide variety of tasks.

4.1 The preprocessor in the Khepera robots

As stated above the Khepera robot has infrared sensors and a video camera. Besides, these robots may interact among them. These are three fashions that the Khepera robots has to perceive information from the environment. Hence, the problem that we intent to solve in this work, in the context of Khepera, consists in the following question: How does the epistemic state of an Khepera change when he/she perceives an epistemic input?.

In other words, based in the theory change, depending of the type of perception that the Khepera perceive, the robot should choose some change operator to consistently store the new information. These perceptions will be stored in the belief base thus altering the epistemic state of the agent. In order to achieve this, each Khepera could possess one *"Preprocessor of Perceptions"*.

Initially the perceptions (or epistemic input) will be classified by the preprocessor of the Khepera according to how they were obtained by the agent (*i.e.* robot). Hence, in case of the Khepera, a robot may receive perceptions of three difference ways:

- From infrared: these perceptions are those that were obtained by the proximity infrared sensors of the Khepera.

- From video camera: these perceptions are those that were obtained by the video camera of the Khepera.
- From interaction: these perceptions are those that were obtained by interaction with others agents.

In first and second case, the *classifier of perceptions* of the preprocessor classifies these perceptions as *"via sensors"*. In third case, the classifier classifies these perceptions as *"via interaction"*. If the input epistemic is classified as:

- *"via sensors"*, then we may tell that this input determines a change in the world. Hence the preprocessor of the Khepera will consider that the type operator most indicated should be some of theory updating.
- *"via interaction"*, then we may tell that this input determines a change in the agent beliefs but does not determine a change in the world. Hence the preprocessor of the Khepera will consider that the type operator most indicated should be some of theory revision.

Once this has been done, the preprocessor will perform its activities as we have detailed sections above. Next, we will present some examples that will describe the behavior of the preprocessor in the Khepera robots.

4.2 Examples

Lets suppose we have a multi-agent system with a dynamic environment as stated above in Example 1. Lets suppose in the arena there are 2 Khepera robots (Ag_1 and Ag_2). The goal of the Khepera is to find the particular box and transports it towards the store. In this context, we will depict two examples that they describe the behavior of the preprocessor in the Khepera robots. Each example describes different situations. In first example we will show the behavior of the preprocessor when an agent perceives information through interaction with other agent. In that case the new information is stored with a revision operator. In second example we will show the behavior of the preprocessor when an agent perceives information through his/her proximity infrared sensors. In this case the new information is stored with an update operator.

Example 2 *Lets suppose Ag_1 has the following belief in his/her base: 'the particular box is in the position (10, 20)'. Besides, lets suppose the agent Ag_1 starts interacting with the agent Ag_2. Through this interaction, Ag_1 perceives the following input: 'the particular box is in the position (10, 15)'. When this occurs, the preprocessor of Ag_1 receives the input perception and analyze it through the "classifier of perceptions". This classifies the perception as 'via interaction' because the input came from an interaction with other agent. Then the classifier considers that the most convenient type operator to be used should be any of the theory revision's. Hence, the classifier sends the perception and the sender identifier of Ag_2 to the "analyzer of senders". This takes the sender identifier and evaluates the credibility order between Ag_1 and Ag_2. In case that $Ag_1 \leq Ag_2$ (i.e. Ag_2 is more credible than Ag_1) the analyzer will consider that the operator to be used is "Kernel revision" [8]. In case $Ag_1 = Ag_2$ (i.e. Ag_1 is as credible as Ag_2) the analyzer will consider that the operator to be used is "Selective revision" [6]. In case that $Ag_2 \leq Ag_1$ (i.e. Ag_1 is more credible than Ag_2) the analyzer will consider that the operator to be used is "Revision by a set of sentences" [5]. After this, the preprocessor sends a message to the change machine (in this case, revision machine) with the perception and its credibility, and the selected method. Then, the change machine interacts with*

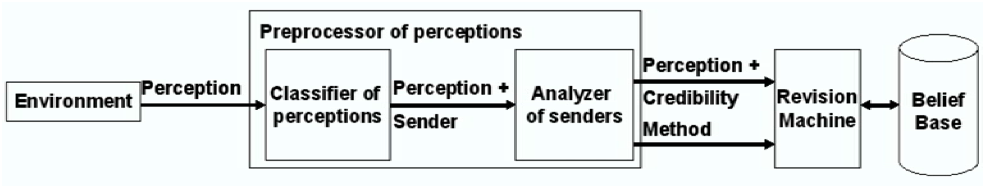

Figure 5: Passway of the perception through the preprocessor

the belief base of the agent to consistently store the new information. In Figure 5 the passway of the perception through the preprocessor is depicted.

Example 3 *Lets suppose Ag_1 has the following belief in his/her base: 'the particular box is in the position (10, 20)'. Besides, lets suppose the agent Ag_2 transports the particular box from the position (10, 20) to the position (15, 30). When Ag_1 newly finds the particular box, he/she will note a change in the world. In this situation the preprocessor of Ag_1 receives the input perception ('the particular box is in the position (15, 30)') and analyzes it through the "classifier of perceptions". This classifies the perception as 'via sensors' because the input was perceived through the proximity infrared sensors of the Khepera. Then the classifier considers that the most convenient type operator to be used should be any of the theory update's. Hence, the preprocessor sends a message to the change machine (in this case, update machine) only with the perception. After this, the change machine interacts with the belief base of the agent to consistently store the new information. In Figure 6 the passway of the perception through the preprocessor is depicted.*

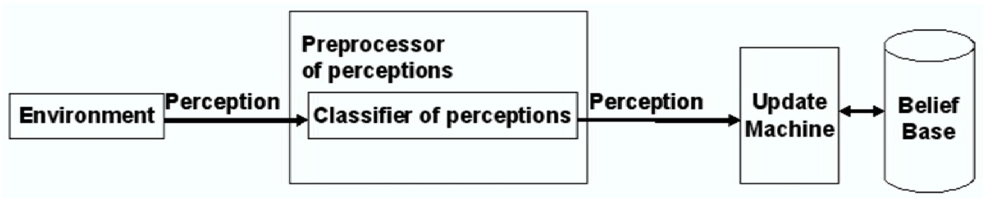

Figure 6: Passway of the perception through the preprocessor

5 CONCLUSION AND FUTURE WORK

In this work we have introduced a *preprocessor of perceptions* that could be part of an agent. The purpose of this preprocessor is to select an adequate change operator to consistently store the perceptions that the agents perceive from environment where their activities are performed. This preprocessor could be characterized by a framework which is defined as: $< \mathcal{L}, Op, COA >$ where $\mathcal{L}$ is a generic language, Op is a set of change operators, and COA is a credibility order among agents.

The *preprocessor of perceptions* receives Op, COA and perceptions (sentences that belong to the language $\mathcal{L}$), then classifies the perceptions according to how they were obtained by the agent (via sensors or via interaction with others agents). This classification is performed by a *Classifier of Perceptions* that is a small part of the preprocessor. If the classifier has selected a operator of the theory revision, then the preprocessor should newly analyze the perception to determine that revision operator should be applied. This analysis is performed by a *analyzer of senders* with help of a credibility order among agents defined in COA. As secondary effect, the analyzer adds credibility to the sentences that represent the perceptions. This credibility depends of the sender and the credibility order among agents. The credibility of the sentences may change when the contents of the belief base are modified.

This preprocessor is very useful because it will allow to the agents to decide which operator to use in some determined case. That is, in different situations the preprocessor will use different change operators to consistently store the new information perceived from the environment. As future work, we plan to define properties over the framework that characterizes to the preprocessor and we think to fix $\mathcal{L}$ in a more expressive language than a propositional one. Besides, we will focus our work in the credibility of the sentences and in the *Revision by a set of sentences*.

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