MILEVA IN A FEW WORDS

What is the purpose of Mileva?

Mileva is a type of artificial intelligence that belongs to the family of cognitive types of artificial intelligence. Like all artificial-intelligence systems, Mileva works by using a reference framework, modelling the universe in which it operates, and by drawing on the data it analyses.

Mileva specialises in modelling interactions between heterogeneous actors, **thus solving the problem of analysing integrated complex situations**, in order to provide answers to a given question. Mileva allows a decision maker to identify the forces at work on a given issue, **their interactions**, and existing weak signals. It takes a holistic approach based on multiple closed sources (the data provided by the decision maker) and access to open data such as Google. Mileva takes into account many parameters, determining proximities, risks, and ruptures.

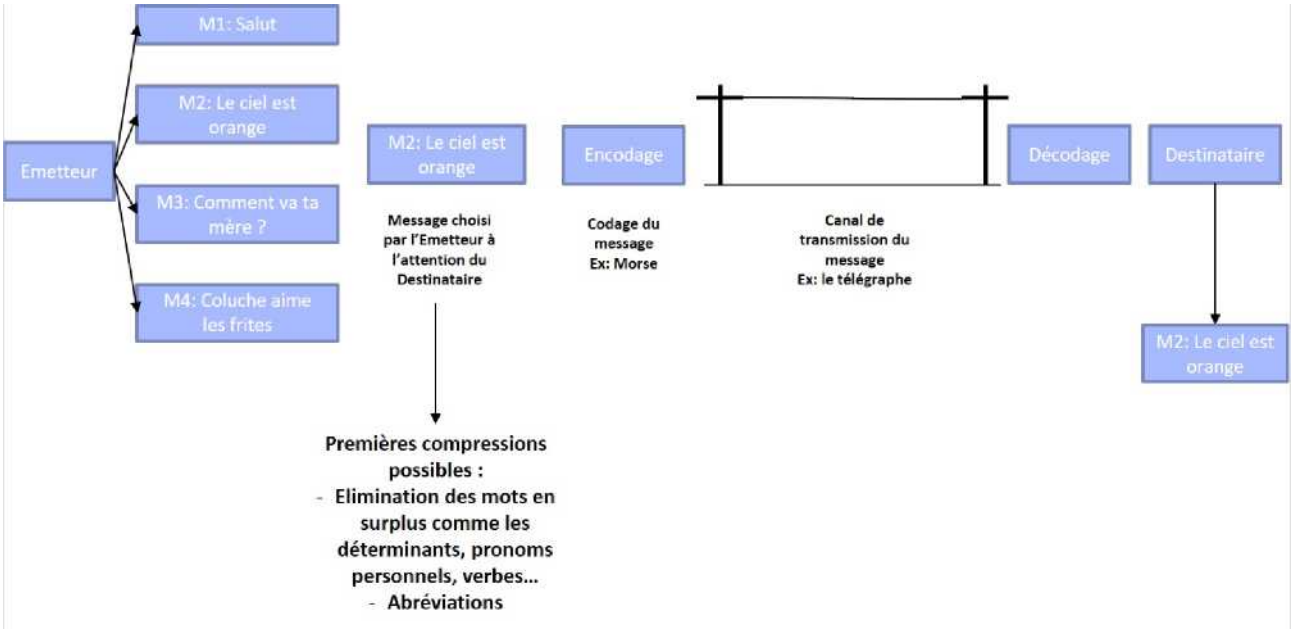
How Mileva works

I Information theory

The mathematical theory of information and communication is a theory published by Claude Shannon in 1948.

Originally, this theory applied to a communication system consisting of a transmitter, a transmission channel, and a receiver.

Its purpose is to transmit information effectively, quickly, and economically. The easiest way to do this is to **reduce** the length of the message as much as possible, keeping only the main information by eliminating certain redundant determiners (the, a, etc.), pronouns (I, you, they, etc.), or by using abbreviations.



Claude Shannon's communication system (in French)

While looking at the structure of language, Claude Shannon noticed that certain letters occur more often than others. For example, in the French language, the letter "e" has a frequency of 12.26%, while "w" has a frequency of 0.04%.

Similarly, there are different frequencies of bigrams, trigrams, etc. For example, the sequence "es" has a frequency of 3.05%, while "dq" has a frequency of 0.01%. Thus, the essential information contained in texts is extracted by sorting the most common letters, without losing its meaning.

For example, the phrase "le ciel est orange" ("the sky is orange") becomes "ciel orng".

The documents thus compressed contain only the information necessary to retain their meaning. This can be ascribed a "level of information", which is measured by a mathematical formula that yields a mathematical value known as **"entropy"**. Thus, the entropy helps determine the information level of a document, that is, the essential information contained in a document.

Furthermore, the entropy helps determine whether the information in a document is new compared to information previously collected.

Indeed, just as letters appear more or less often in a text, so information recurs more or less often within a defined search area. Thus, it is possible to extract key data from a search area in the same way we extract essential information from a document by removing redundancies (words and characters that are unnecessary because they occur frequently). It should be noted that the special

case of entropy maximisation amounts to calculating Bayesian probabilities. Information theory is not far removed from the world of probabilities.

II The question

Mileva answers a natural-language question (e.g. Who will be the next president of the French Republic?) that is asked in a simplified form (e.g. future president France).

Mileva will only give a precise answer to a question if the latter corresponds to the fundamental issue targeted. It is therefore important to determine what is the issue being addressed in order to ask the question correctly. The choice of words is essential: two similar, almost identical, questions will yield differently nuanced results. In order to answer the question raised, Mileva needs a search area in which to conduct its data analysis.

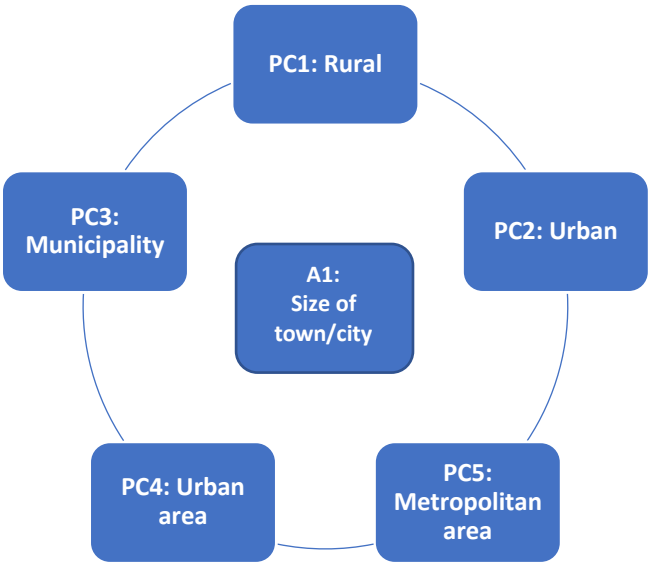
III Search area

A search area is a set of documents collected by Mileva to address the issue raised; it is an information base. This search area can be defined "spatially" (e.g. google.com, google.ru, or an internal database, etc.) and temporally (e.g. the period from 2003 to 2015). It is the data contained in this search area that are analysed in order to provide answers to the question posed.

IV Reference framework, agent, and keywords

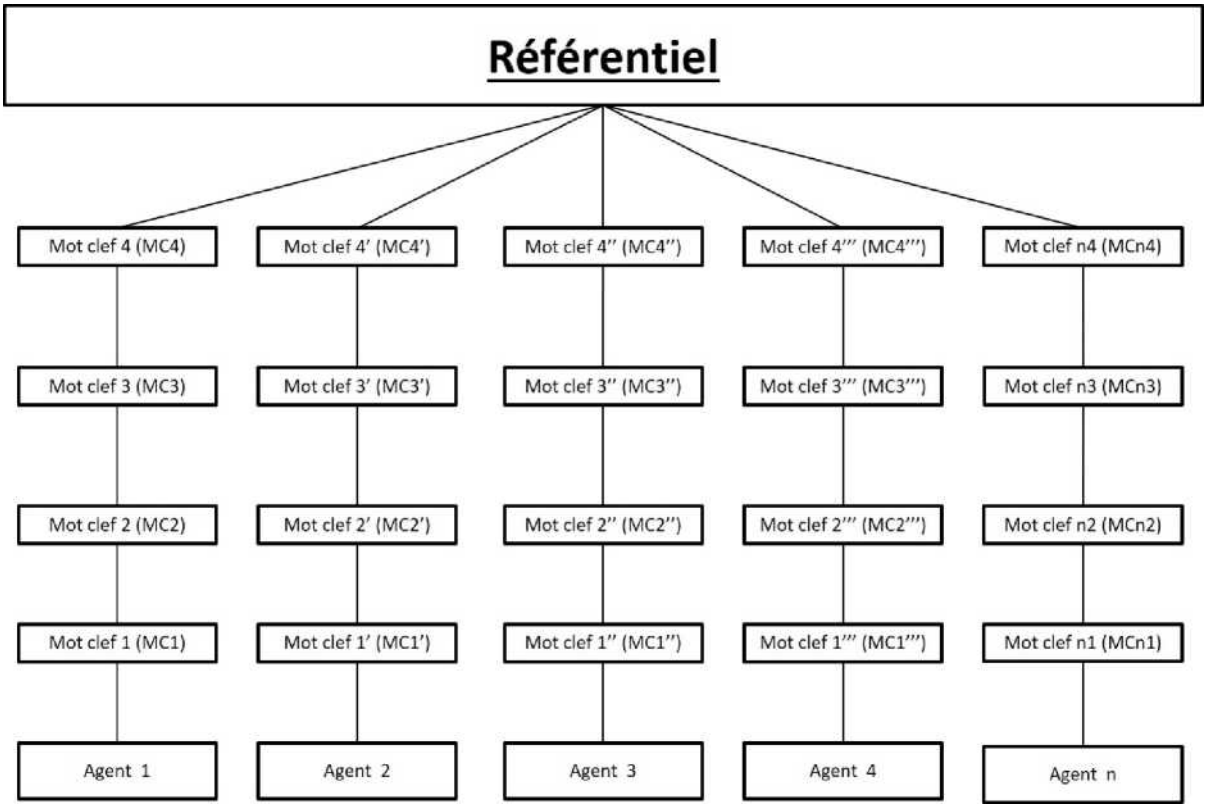
In order to answer a question, Mileva needs to be provided with elements for understanding the field to which the question belongs. For example, who are the actors involved? What are the threats and opportunities? What are the working methods?

These elements are called “agents” and make up the structure of Mileva’s “reference framework”. The system does not have a predetermined understanding of what these agents are, so the latter need to be defined using keywords specific to and defining each of these agents. The reference framework is therefore a matrix made up of agents and keywords, and constitutes a representation of the universe of the question submitted to Mileva. Using the keywords, the artificial-intelligence system will learn what each agent covers. Each keyword refers to a specific agent.



Agent 1 defined by its keywords

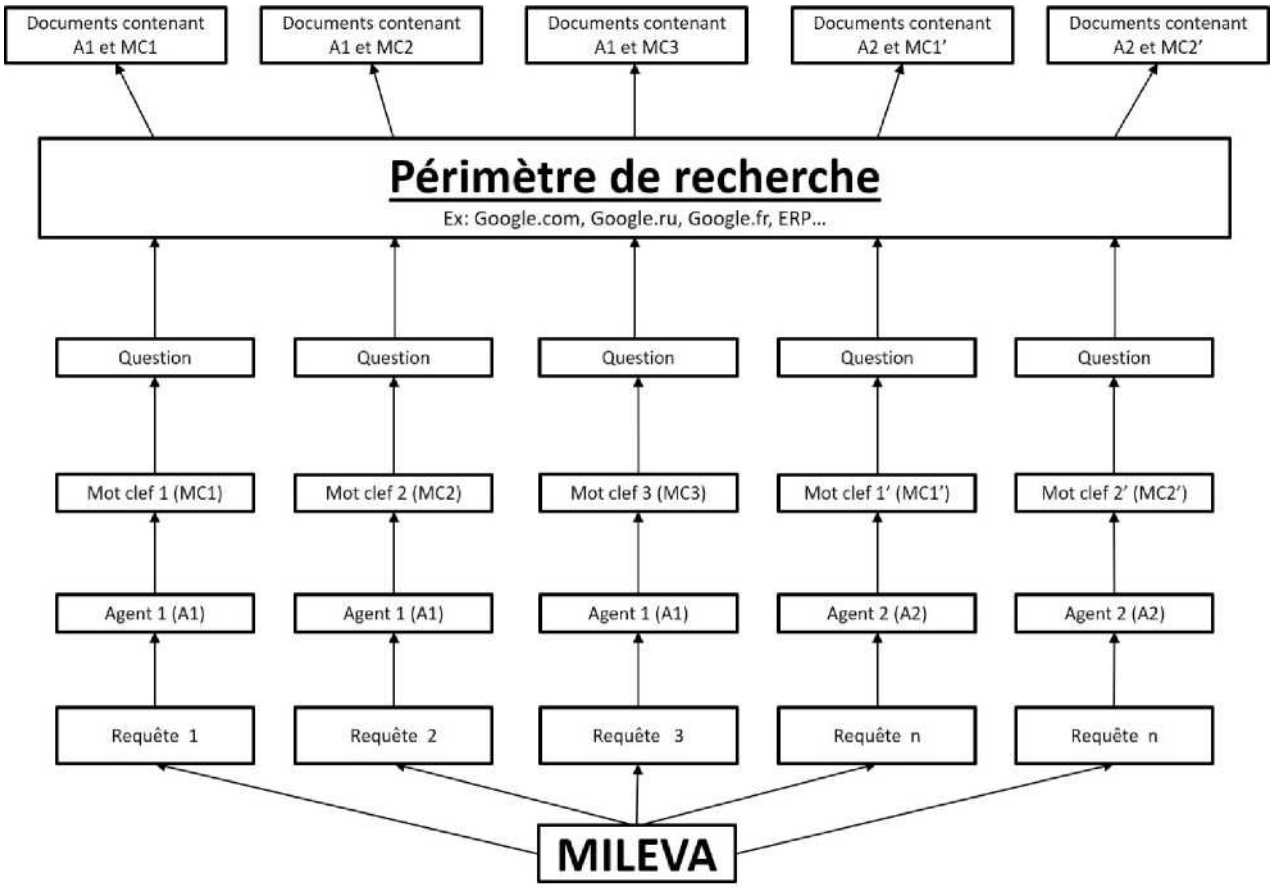
This reference framework needs to describe, as precisely as possible, the universe of the question posed (human actors involved, risks, opportunities, tools, legal framework, political framework, economic framework, environmental framework, etc.) in the form of agents (concepts or actors) defined by keywords. This reference framework is built by the user, who can call on an expert in the field concerned. This is a key step in working with Mileva. Indeed, agents are essential because it is they who, through their interactions, provide the answers to the question submitted.



Reference framework (in French)

V Queries

Once the reference framework has been built, Mileva sends queries within the search area in order to explore and analyse it. The system runs thousands of queries in the form of "agent + keyword + question" to retrieve documents that help identify links between agents.



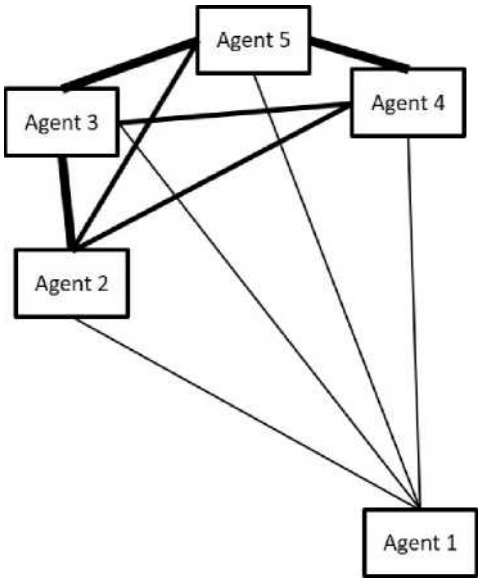
Search area (in French)

To this end, Mileva analyses its search area on the basis of its reference framework, using information theory. It extracts new and therefore essential information from the documents it has at its disposal within the search area set. It then identifies the interactions between the agents (concepts) in its reference framework. Concretely, the information retrieved with each new query is compared to the results of previous iterations in order to establish whether or not it is new.

VI Links between agents

These links are defined by the amount of information exchanged: the more information exchanged, the stronger the link between the two agents concerned.

The strength of these links makes it possible to then position them in relation to each other and thereby decide which agents should be taken into account when answering the question raised. Thus, an agent with strong links to many agents will be a part of the answer.

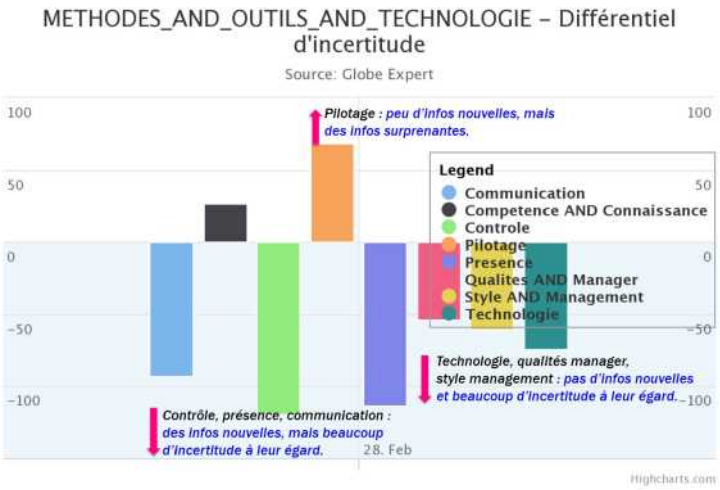


Modelling the links between agents

Once the relations between agents have been calculated, the learning phase is over. Mileva will now be able to allow the agents to operate within this information universe and determine optimal behaviours in answer to the question asked or to possible decisions. These agents, each with its own knowledge base and specific characteristics, interact with each other until all possibilities are exhausted – or an equilibrium threshold is reached – thereby identifying relationships of proximity and influence, critical risks, but also a set of behaviours: surprising, unpredictable, etc. To this end, Mileva uses so-called evolutionary mathematical models. The interaction between agents is born out of these models.

VI Result analysis

Mileva produces results in the form of indicators (maps, graphs, stats) representing mathematical values. They are all elements that need to be analysed, cross-referenced, and put into perspective, like clues in a game of Cluedo. That is how the question posed is answered.



Example of an indicator produced by Mileva

VII Biases: a particular point of attention

Like any structure that includes human intervention, Mileva is subject to bias. This is not a flaw, but the very nature of a tool that has been developed by humans and analyses an environment and situations resulting from human action.

The way in which the question is phrased, and the choice of agents and keywords in the reference framework may involve bias. In addition, the data on which Mileva works are subject to biases linked to the search area, which is limited in space and time.

For all these reasons, **extremely complex statistical mathematical models are used to measure these biases** and allow the user to access only reliable results.

To sum up, Mileva is an artificial-intelligence system which belongs to the family of cognitive types of artificial intelligence. It reveals the basic structure and building blocks of complex situations. It allows users to see possible ways in which these may evolve and the level of probability of their occurrence. In this sense, it is a reflection and decision-making tool.