MNAOMIA: Reasoning and Learning from Cases of Eating Disorders in Psychiatry

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Case-based reasoning (CBR) is an artificial intelligence methodology for the processing of empirical knowledge.

The system presented in this electronic poster is the **MNAOMIA** (*mnaomai* means *to remember* in Greek) CBR system. It is applied to the domain of **eating disorders** in psychiatry. Its aim is to provide assistance to the clinical work performed by the staff of a clinical unit specialized in this disorder.

For that purpose, CBR had to be improved in several ways. The challenges that had to be taken up by MNAOMIA were driven by the application domain :

1. **Knowledge-variety** : the knowledge used by the clinicians when they reason is both **theoretical** (learnt from books, or other documentary sources) and **empirical** (learnt from the patient cases they meet during their practice).

   Globally, the knowledge-base of MNAOMIA, which is called a **memory** in CBR, is represented by a network of nodes, each containing an **entity** (either a case, a concept, a prototype or a model).

   Cases are empirical ontologies representing objects existing in the application domain, such as patient cases. **Concepts** are empirical ontologies learnt by the system from the cases. They are linked to other concepts by abstraction/generalization links, and so the memory has a hierarchical organization.

   Prototypes are theoretical ontologies representing typical examples in the application domain, described by the experts, such as the typical anorexic patient. **Models** are theoretical ontologies representing systems or sub-systems of the application domain.
2. **Task-adaptivity** : several cognitive tasks are performed by the clinical staff, the main ones being : **diagnosis, treatment planning, follow-up** and **clinical research**.

   So the memory of MNAOMIA is organized around specialized models of the theoretical memory called the **points-of-view**. Each point-of-view models a single cognitive task. Following, MNAOMIA is capable to perform all these tasks.

   Nevertheless, such a memory organization is not sufficient to achieve the adaptation to all kinds of tasks. The composition of the memory is also important, and this is why MNAOMIA's memory contains several types of entities.
3. **Knowledge-discovery** : to perform clinical research assistance, empirical knowledge must be learnt from the cases. In MNAOMIA, this knowledge discovery takes the form of an **incremental concept learning** during the performance of other tasks, such as diagnosis, treatment planning or follow-up.

   Incremental concept learning permits to build concepts, which are **clusters** of similar cases, when the cases are presented incrementally. It also permits to organize the concepts hierarchically by abstraction or generalization links inside each point-of-view. There are several concepts hierarchies learnt by the system, one for each cognitive task.
4. **Evolution-in-time** : to perform the patients follow-up, in particular, a **representation of time**, as well as **reasoning about time**, are necessary. In this domain, the data from the patients cases describe the state of the patient at a given time, and these descriptions can be repeated through time. So the knowledge representation language is able to represent not only attribute-value pairs and relation-node pairs, but also **time-points** and **time-intervals** associated with them. This case representation is necessary to perform the **follow-up** task, but it is also useful for the other cognitive tasks. For that purpose, the incremental concept learning learns concepts over time, also called **trends**.

The current case-base of MNAOMIA contains more than 150 cases, each described by a variable number of description elements (between 700 to several thousands), and 50 prototypes.

What this poster proposes to demonstrate is that the cognitive model underlying case-based reasoning enables it to be improved in many ways, particularly for a complex medical application. Moreover, results from this application show that case-based reasoning, when it is enhanced, provides a fruitful assistance to the clinical work. Although MNAOMIA benefits from a general formalization, it is probable that an application to another domain of medicine would require yet other improvements.

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