Assignment 4

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1 Theory

1. Case-based reasoning is both a cognitive approach for modelling human behaviour, as well as an engineering approach for developing and implementing intelligent systems for problem solving. The philosophy of case-based reasoning is that "similar problems have similar solutions". The approach uses of a collection of previously solved problems in what is called a case base. Classical machine learning approaches (regression, clustering, neural nets etc) does not take advantage of earlier solved cases. Instead, they generate relevant knowledge about the domain and classes there and then.

2. The approach has taken great inspiration of the cognitive procedures of the human mind. It lies in human nature to use situation specific experience knowledge when solving new problems. Reasoning by remembering is used to take inspiration from previous solutions, which is also an aspect that CBR takes advantage of.

3. Surface similarity is based on surface features and is applicable to different case representations using standard value types. An example could be the similarity between two cars, i.e which brand they are, what year they were produced, etc. Structural similarity is on the other hand more dependent on the case representation and uses domain knowledge to retrieve solutions. It is defined as the most common structure of cases and the modification rules needed to determine it. An example of structural similarity is using taxonomies to derive similarities.

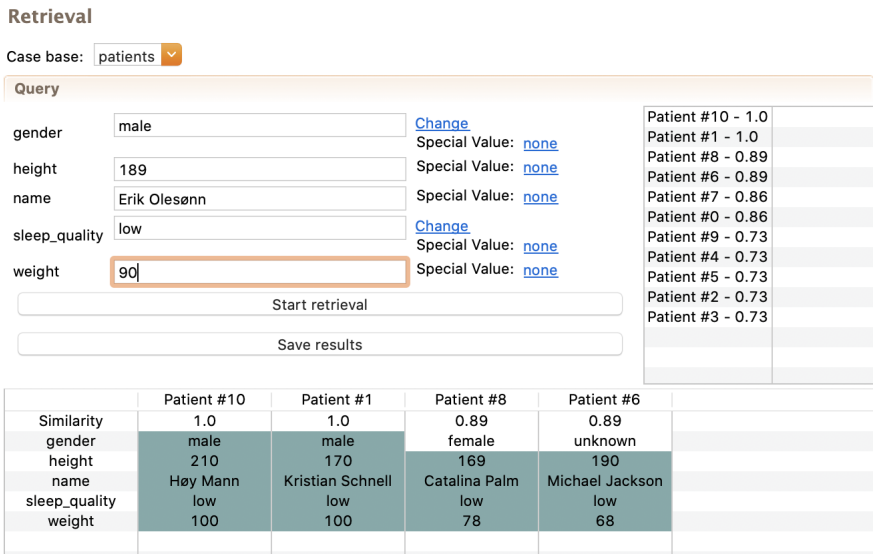
4. When dealing with cases that are made up of attributes with heterogeneous characterization and query spaces, we have to take advantage of the general domain knowledge. The abstract nature of the cases demands knowledge-intensive case based reasoning. The role of the general domain knowledge is to enable a CBR system to reason with semantic and pragmatic criteria. The system models the general domain knowledge into semantic networks consisting of concepts and relations between them. The model represents the real life situation the system is to reason about. An example of a knowledge-intensive case based reasoning may be the model

of a car, with semantic concepts like the sub classes of a vehicle (van, car), the functions of the car (transportation), the parts of the car (engine, wheel, fuel system). The cases are then instances these concepts (which furthermore have concepts like status).

5. Knowledge can be distributed flexibly between containers. We have similarity measures, which is the retrieval of similarities between cases. Here one can use similarity functions to compute the distance between attributes of two instances. Furthermore, we have the Case base, which can be viewed upon as some sort of database of experience. Another container is the adaptation knowledge, which is used whenever the solution of a retrieved case has to be adapted for the current problem. Lastly, we have the vocabulary, which are what all the other knowledge containers are composed of (terms, attributes and concepts).

2 Practical

One of the retrieval queries performed are shown below. As we can see, two of the top four retrievals had a similarity score of 1.0. This can be explained by the global similarity function, heavily weighting both gender, weight and sleep_quality. These three attributes are fairly similar for the query patient and the top two results. As for the third and fourth retrieval result, the similarity drops a bit. This can be explained by the difference in gender and weight.



	Patient #10	Patient #1	Patient #8	Patient #6
Similarity	1.0	1.0	0.89	0.89
gender	male	male	female	unknown
height	210	170	169	190
name	Høy Mann	Kristian Schnell	Catalina Palm	Michael Jackson
sleep_quality	low	low	low	low
weight	100	100	78	68

On the right we can see the similarity measures for the entire case bank. As we can see, there are fairly high similarities for all cases. This may be because there aren't many attributes, and I defined natural, but not very large, ranges

for the values. Hence, there is not much room for diversity. One could maybe assign more diversity in the weighting and similarity functions to create more specific retrievals.

When it comes to the CBR cycle (*retrieve, reuse, revise,* and *retain*) the myCBR program is a nice tool. The first step is shown above, giving a clean and tidy overview of the similar cases for your retrieval queries. The program makes it possible to add descriptions for the different instances, which can be used for describing the different approaches taken with each patient. In this way, we can *reuse* the previous solutions, with a nice way of finding them. The revision of the solution will have to be more qualitative, depending on the individual performing the found approach/solution. Medicine is also a critical area, in which we are reliable upon experts within the field when practicing it. Thus, there is not much room for simulation approaches in this case. The *retain* part of the cycle can be performed by simply saving the new instance to the case bank along with a fitting descriptive text of the patient and the approach taken. Furthermore, weights and similarity functions may be adapted based on the success of the retrievals.