Chapter 7.11

A Neural Network Approach Implementing Non–Linear Relevance Feedback to Improve the Performance of Medical Information Retrieval Systems

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ABSTRACT

In this chapter, a non-linear relevance feedback mechanism is proposed for increasing the performance and the reliability of information (medical content) retrieval systems. In greater detail, the user who searches for information is considered to be part of the retrieval process in an interactive framework, who evaluates the results provided by the system so that the user automatically updates its performance based on the users' feedback. In order to achieve the latter, we propose an adaptively trained neural network (NN) architecture that is able to implement the non- linear feedback. The term "adaptively" refers to the functionality of the neural network to update its weights based on the user's content selection and optimize its performance.

INTRODUCTION

The rapid progress in publishing articles and the huge amount of data being stored, accessed and transmitted in the biological and medical domain has led to the advent of applications that perform Natural Language Processing (NLP) in order to enable researchers, doctors and other actors in the aforementioned domain to search and retrieve the relevant content. In this context, the traditional approaches of searching, retrieving and organiz-

ing the medical data, using only text annotation, cannot describe the medical content with high efficiency. For this reason, several content-based retrieval mechanisms and approaches have been proposed, some of which work by extracting high level semantic features of the content.

Despite, however, the fact that semantic segmentation has attracted much attention recently, other features that describe the content such as keywords or categories are usually used for implementing content-based retrieval algorithms. To reduce the limitations emerged by using low-level descriptors and simultaneously to increase the performance of content-based algorithms, the human can be considered as a part of the retrieval process, in an interactive framework. This means that initially the user evaluates the results, provided by the system and then the system adapts its performance according to the user's demands. In this framework, a feedback is established from the user to the system based on the most relevant articles, which is usually called relevance feedback. Such an approach, apart from eliminating the gap between high-level and low-level features, it also reduces the problems related to the subjectivity of humans, which often interpret the same medical content in a different way.

To address the content interpretation and classification, new adaptive and interactive management schemes should be introduced, which are capable of updating the system response with respect to the current user's information needs and preferences. One way to achieve adaptability of the system response to the users' needs is to modify the similarity measure used for ranking data. In this way, retrieval, organization and transmission of the information are updated in accordance with the humans' perception of the content through a dynamic real time learning strategy based on the users' interaction.

One of the interactive learning techniques is *relevance feedback* (originated from text-based information retrieval systems), which adapts the response of a system according to the relevant information feedback to it so that the adjusted response is a better approximation to the user's information needs. Usually, relevant information is provided by the user in an *interactive framework*, who evaluates the results according to his/her demands and preferences. Relevance feedback has been widely used in text-based information retrieval systems (J. Rocchio, 1971). Although it is not restricted to description environments where similarity measures are used, in databases where similarity-based queries are applied (Y. Ishikawa, 1998), relevance feedback refers to the mechanism which updates the similarity measure with respect to the relevant/irrelevant information, as indicated by the user. Relevance feedback confronts the subjectivity of humans in perceiving medical content and also eliminates the gap between high-level semantics and low-level features, which are often used for content description and modeling (Y. Rui, 1998). The following figure (Figure 1) presents a block diagram of a relevance feedback scheme.

To perform the relevance feedback mechanism a degree of importance should be assigned to each content descriptor, i.e., a different weighed factor to each element of the feature characterizing the medical content. After the first retrieval, the user assigns a degree of appropriateness for each article, which actual indicates the similarity degree of the respective article to the query. The weights are dynamically adapted based on the users' feedback, who selects the most appropriate articles among those retrieved by the system. Furthermore, we propose an enhancement to the relevance feedback mechanism by introducing nonlinearities in the parametric distance. This is implemented by an adaptively trained neural network classifier, the weights of which are adjusted according to the users' feedback. In this case, the network weights define the degree of importance for each descriptor, while the network output indicates the similarity of the examined article to the query one. The network weights are updated each time a new users' selection takes place so

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