

# Chapter 1

## Action Rules Mining in Hoarseness Disease

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### ABSTRACT

*Action rule is an implication rule that shows the expected change in a decision value of an object as a result of changes made to some of its conditional values. An example of an action rule is 'patients are expected to control their health regularly if they receive an information about free medical tests once a year'. In this case, the decision value is the health status, and the condition value is whether the information is sent to the patient. Because of some complex medical problems this paper discusses a strategy which generates action rules to using new knowledge base consisting of classification rules. As one of the testing domains for our research, we take new system for gathering and processing clinical data on patients with throat disorders, and mining action rules will suggest in simply way how to construct the decision support module for easier given diagnosis for patients.*

### INTRODUCTION

Support of decision making plays an extremely wide role in many fields, especially medicine. In medical databases many attributes can be misunderstood, unclear or missing. It could be very complicated for medical staff, because of lack of full information which can be useful in patient's diagnosis and treatment. Each medical database stores information about patient's age, gender, diagnosis, treatments, etc. It uses attributes suitable for locally collected information. Values of attributes can be disease code, treatment code, patient category, etc. One coded attribute can be replaced by several others with a small numbers of values and clear meaning. For instance, a code for broken bone indicates broken bone, the location, the type of fracture, etc. There have been a lot of methods to extract rules from complete information system in the literature, while it is much more difficult to extract rules from incomplete information system. When we look into laryngological diseases, the main symptom in almost all kind of diseases is hoarseness. Therefore it is possible to make a fast and incorrect diagnosis, which leads to treatment that means waste of time and sometimes even human life. Our proposed new method analyzes different

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symptoms for different patients and suggests actions which can be made to improve medical treatment for their faster recovery. The primary purpose of this approach is to improve diagnostic accuracy, reduce inappropriate antibiotic or steroid use, inappropriate use of antireflux medications, radiographic imaging, and promote appropriate use of laryngoscopy, voice therapy, and surgery (Traister, 2014). Evaluation of a patient with hoarseness includes very careful history of illness, physical examination, and in many cases, also laryngoscopy (Feierabend, 2009; Mau, 2010).

## **BACKGROUND**

Finding useful rules is an important task of a knowledge discovery process. Most researchers mainly focus on techniques for generating classification rules. A need for new methods with the ability to assist users in analyzing a large number of rules for a useful knowledge (Dardzinska, 2013) is still seeking. All patients, called objects, together with many symptoms and laboratory results, called attributes, form so called information. When additional attributes, describing e.g. the situation of a patient are given, this system is called a decision information system. In such case, each object can be classified into one of the several given groups. An action rule is a rule extracted from a decision system, which gives suggestions helpful in reclassification process of objects in given information system from one state to another with respect to a distinguished attribute called a decision attribute (Ras, 2006). We assume that attributes are partitioned into stable (they cannot be changed, e.g. sex, name, height) and flexible (they can change, e.g. blood pressure, level of hoarseness). In paper (Ras, 2008, 2009) a new subclass of attributes called semistable attributes was introduced. They are typically a function of time, and undergo deterministic changes. It was shown in (Ras, 2008; Dardzinska, 2013) that some semistable attributes can be treated the same way as flexible attributes.

## **MAIN FOCUS OF THE CHAPTER**

### **Issues, Controversies, Problems**

While working on real medical data, it is easy to notice that correct diagnosis under given assumptions is not easy at all and accuracy in such data can be rather low. It is caused by several problems, which can be connected with the nature of kinds of diseases. In case of larynx problems, many conditions can cause e.g. hoarseness. Evaluation of a patient with hoarseness is time consuming task. Therefore we can propose a strategy which is helpful in faster and more accurate diagnosis of patients. Under some circumstances we are also able to suggest what changes in patient's behaviour should be made to reclassify him. It can be done using action rules.

Action rules mining initially was based on comparing profiles of two groups of targeted objects (Dardzinska, 2013, 2006; Ras, 2008). An action rule was defined as a term  $r = [\omega * (\alpha \rightarrow \beta)] \rightarrow (\varphi \rightarrow \psi)$ , where  $\omega, \alpha, \beta, \varphi$  and  $\psi$  are descriptions of objects, in our case seen as patients. The term  $r$  states that when a fixed condition  $\omega$  is satisfied and the changeable behavior  $(\alpha \rightarrow \beta)$  occurs in patients registered in a database so we obtain the suggestion to move object from one state  $\varphi$  to another  $\psi: (\varphi \rightarrow \psi)$ . We

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