Chapter 6
Machine Learning (ML) as a Diagnostic Task

ABSTRACT
This chapter discusses a revised definition of classification (diagnostic) test. This definition allows considering the problem of inferring classification tests as the task of searching for the best approximations of a given classification on a given set of data. Machine learning methods are reduced to this task. An algebraic model of diagnostic task is brought forward founded upon the partition lattice in which object, class, attribute, value of attribute take their interpretations.

INTRODUCTION
Classification as a logical meta-procedure plays an important part in thinking processes. The efficiency of using knowledge depends on what classifications will be formed and what relations will be considered. Classification (as a procedure) lies in the foundation of our knowledge. With the use of it, knowledge is obtained, ordered, transformed in a systematic construction. Every science begins with the classification, because it permits not only systematizing facts but explaining them through establishing the causal relationships between classes of objects and their properties. We believe that non-interrelated classifications do not exist.

One can find the examples of interconnected classifications in the functioning of both living organisms and technical devices, say, automata or robots capable to adaptive behavior. In principle the adaptation
of an organism or an automaton to some environment is a classification of its reactions into groups in accordance with the environment influences. Also comprehending the sense of phrases (sayings) is based on the classification of interconnected relations between such parts of phrases as words, word combinations and phrases themselves.

The history of creating the Law of Periodicity of chemical elements, of course, is an excellent illustration of classification process. It is known that much time was required for realizing the fact that the elements can be classified in accordance with the Law of Periodicity.

The first steps in grouping elements were made in 1817, when German chemist Döbereiner showed that the atomic weight of strontium has the average value between the atomic weights of other two elements - calcium and barium. He established other triads of similar elements - (chlorine, bromine, and iodine), (lithium, sodium, and potassium). Then other chemists showed that the elements can be united into the groups, which include more than three elements. Fluorine was added to the triad of chlorine, bromine, and iodine, and magnesium to the triad of calcium, strontium, and barium. Then, oxygen, sulfur, selenium, and tellurium were in 1854 united into one group. Into another group entered nitrogen, phosphorus, arsenic, antimony, and bismuth. In 1862, French chemist Emile de Shankurtua arranged elements in ascending order of their atomic weight and assumed that the properties of elements are functionally determined by their positions in this ordering.

In 1863 English chemist Reina Newlands proposed the classification of elements in ascending order of their atomic weights; moreover, he divided elements into seven groups of seven elements in each. He named his classification “the law of octaves” by analogy with intervals of musical range.

Finally very major step was made in 1869 by Russian chemist Mendeleyev, who thoroughly studied the relationship between the atomic weights of elements and their physical and chemical properties, focusing specially on valence.

Thus, the Law of Periodicity is the result of analyzing the interrelations between atomic weights of elements, their properties and valence. This system considers the coordination of these characteristics.

Considering classification as a process, we reveal two interacting tasks:

A) If a general feature of some collection of objects has been established, then it is necessary to decide whether it is possible to name this collection of objects, i.e. to explain it in terms of some phenomena or reasons, in other words, via other classifications. If the reply is positive, then the feature and the name are associated with the group of phenomena, explaining it. If the reply is negative, the feature has to be considered as useless;

B) If for some collection of objects, its name and meaning are known, then it is necessary to find a general feature equivalent to the meaning of this object collection.

An interesting fragment related to the properties of classifications has been revealed by us in a report of Patrick Geddesm to The Edinburgh Royal Scientific Society (1881) dealing with the systematization of statistical data: “Our classification must be natural, not artificial; must be capable of complete specialization, so as to include the minutest details, and capable, too, of the widest generalization; it must be universal in application, and it must be, as far as possible, simple understanding, and convenient in use” (Geddes, 1881).
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