

K. R. POPPER AND LOGICAL TOOLS FOR KNOWLEDGE DISCOVERY
IN LIFE SCIENCES AND SOCIOLOGY

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The following ideas of K.R. Popper proved to be very fruitful for epistemology and the logic of knowledge discovery (KD): the idea of three worlds, falsification as criterion of demarcation, the scheme of knowledge development ($P_1 \rightarrow TT \rightarrow P_2$), the idea of propensity, the idea of the necessity of argumentative language as an instrument of rational decision making, the conception of the logic of the social sciences as situational logic.

Intelligent systems (IS), applied to open subject fields in life sciences and sociology, serve as instruments for KD. An IS contains a problem solver, a base of facts (BF), and a knowledge base (KB), which are used for machine learning on positive and negative examples (instances). In IS discussed in this paper the problem solver realizes a specific class of plausible reasoning JSM-reasoning, which implements a synthesis of three cognitive procedures: formalized analogues of J.S. Mill's methods of agreement and of difference, conclusions by analogy, and abduction; by means of the latter, hypotheses generated by the first two procedures are accepted, if the result of applying the inductive methods (hypotheses about positive or negative causes of effects under consideration) explain the initial state of the BF. JSM-reasoning is an ampliative mode of reasoning generating new knowledge about BF and KB of the IS. KB consists of the axioms for the data structure, axioms of the subject field, and rules of plausible reasoning.

JSM-reasoning uses predicates of similarity, defined, respectively, on positive facts and negative facts representing phenomena under consideration. It generates automatically possible falsifiers of hypotheses, used in conclusions by analogy and in abduction. Thus, Popper's world 1 is represented by the BF, world 2 is imitated by cognitive JSM-reasoning, and the role of world 3 is played by the KB. IS is a man-machine system for the solution of the problem P_1 with the help of the KB (TT) and for the correction of the proposed decision in the course of machine learning (EE), the result being new knowledge and the formulation of a new problem P_2 .