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LOGIC IN COGNITIVE SCIENCE

According to a brief and very general definition Cognitive Science is an interdisciplinary scientific study of how information is represented and transformed in a human nervous system. “Information”, “representation” and “transformation” are keywords here. Many disciplines bring considerable contribution to Cognitive Science. Logic is one of them. Logic investigates these rules which allow us to recognize valid reasonings and distinguish them from those that fail to fulfill the condition of validity. Thus logic investigates some representation (or representations) of reasoning. Significant part of information transformed in nervous system is related to reasoning and inference. This fact opens special perspectives on applying Logic in Cognitive Science both in representing as well as in transforming information. Any formal logical system constitutes a kind of representation of a class of propositions considered as sentence content. In this way each logical system provides a representation of a broad class of belief states. At the same time any inference relation, related to a given logical system, represents a transformation of some type of information. As a consequence it would be hard to find logical investigations which could not be applied in Cognitive Science. Such an idea guided us while we were preparing the present volume.

The conference “Argumentation as a Cognitive Process” held in May 13–15, 2010 in Toruń, Poland. It gathered many specialists from Cognitive Science. Many of them presented logical results related to Cognitive Science. The present volume consists of selected papers contributed to the conference.

The volume opens with the paper “Five theories of reasoning. Interconnections and applications to mathematics” by Alison Pease and

Andrew Aberdein. The paper focuses on Peirce's development of abductive reasoning, Toulmin's argumentation layout, Lakatos's theory of reasoning in mathematics, Pollock's notions of counterexample and argumentation schemes constructed by Walton, and explore some connections between, as well as within, the theories.

The paper "A norm-giver meets deontic action logic" by Robert Trypuz and Piotr Kulicki presents a formal system of deontic action logic motivated by a specific methodology of creating norms. According to the methodology, a norm-giver before establishing a set of norms should create a picture of the agent by creating his repertoire of actions. Then, knowing what the agent can do in particular situations, the norm-giver regulates these actions by assigning deontic qualifications to each of them.

Andrzej Wiśniewski in his paper "Propositions, possible worlds, and recursion" present an interesting result concerning the relation between possible worlds and language. He proved that, under some natural assumptions, there always exist decidable sets of possible worlds, which are not assigned to any sentence of a language.

The paper "Qualitative decision theory via channel theory" by Gerard Allwein, Yingrui Yang and William L. Harrison present a reconstruction of parts of decision theory in terms of channel theory. The authors introduce a logic for describing actions separate from the logic of preference over actions. The structures introduced by channel theory that represent the decision problems can be seen to be an abstract framework. This framework is very accommodating to changing the nature of the decision problems to handle different aspects or theories about decision making.

Victor K. Finn and Maria A. Mikheyenkova in their paper "Plausible reasoning for the problems of cognitive sociology" investigate the plausible reasoning class (called the JSM-reasoning in honour of John Stuart Mill). It implements interaction of three forms of non-deductive procedures: induction, analogy and abduction.

The paper "A formal approach to exploring the interrogator's perspective in the Turing test" by Paweł Łupkowski presents a formal approach to Turing test. The author uses the tool developed within Inferential Erotetic Logic (so called erotetic search scenarios) to build a model of Turing test and investigate the interrogator's perspective and role in the test.

Jiří Raclavský, Petr Kuchyňka in their “Conceptual and derivation systems” investigate derivation system — an extension of Materna’s conceptual system. Derivation systems differ from conceptual systems especially in including derivation rules. The authors show close connections among the realms of objects, their concepts, and reasoning with concepts.

Mariusz Urbański in his paper “Logic and cognition. Two faces of psychologism” outlines two concepts of psychologism in logic: the one which Frege and Husserl fought against and the new psychologism, or cognitivism, which underlies a cognitive turn in contemporary logic. Four issues such cognitively oriented logic should be interested in are indicated. They concern: new fields opened for logical analysis, new methods and tools needed to address these fields, neural basis of logical reasoning, and an educational problem: how to teach such logic? Several challenging questions, which arise in the context of these issues, are listed.

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