Machine Understanding: Machine Perception and Machine Perception MU

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The unique book "Machine Understanding: Machine Perception and Machine Perception MU" presents the latest research results in the newly founded research area called the machine perception MU. In this book, the selected new concepts such as the 3D object classes, the picture classes, the perceptual transformations and new processing and reasoning methods are presented within the machine understanding framework, where the sensory data are regarded as the important part of the understanding process. In this very new approach, contrary to research in classical machine perception, research is focused on perception that leads to understanding. With the advent of sensory networks, capable of perceiving many different data, the new possibilities of exploration of new methods of building knowledge, based on categories of the sensory objects and sensory concepts, emerged. In machine perception MU categories of the sensory objects and sensory concepts were introduced to deal with the problem of the data that come from the different sensory channels such as the auditory channel or tactile channel. These sensory categories are capable to grasp the essence of the multisensory data and build the new structure of multisensory knowledge. Machine perception is a term introduced by Nevatia for denoting the research area where researchers investigate the possibility to build the systems that can be endowed with human perceptual ability. Although sharing the same term 'machine perception', research in machine perception MU is based on the very different approach by placing it in the broader context of research in machine understanding. In machine perception MU, perception is regarded as the part of understanding process and there is no clear demarcation line between the perceptual reasoning and reasoning that leads to understanding. Our research is the first attempt to combine the visual and non-visual knowledge in the form of the visual and non-visual concepts used in the complex reasoning process that leads to understanding. Research in machine understanding opens the very new perspective of research aimed at building of robots as the machine endowed with the ability to perceive the environment and understand the world. Machine understanding is the term introduced by authors to denote understanding by the machine (SUS) and is referring to the new area of research the aim of which is investigating the possibility of building the machine with the ability to understand. SUS, as the machine that is designed to have the ability to think and understand, learns both knowledge and skills in the process of learning, called the knowledge implementation, and is based on further development of the shape understanding system (SUS) that was described in our previous books. Understanding in machine understanding is regarded as the ability to solve the complex visual and non-visual problems, as well as the ability to explain the solution and the problems connected with understanding of the different real world phenomena. In machine perception MU, the perceptual problems are divided into two categories: the interpretational perceptual problems and the visual problems. The interpretational perceptual problems, solved by application of the IN-perceptual transformation, are perceptual problems that are associated with seeing and understanding. Visual problems are problems that are usually given by the sequence or the set of objects, the visual representatives of the problem. Depending on the level of processing, the perceptual problems are divided into the low-level perceptual problems, the middle-level perceptual problems or the higher-level perceptual problems. Shape classes, 3D object classes and picture classes play an important role in machine perception MU. Shape classes are the basic visual categories used during the visual thinking and visual reasoning process. In this book shape classes are defined based

on the notation of the perceptual operator and application of the CF-perceptual transformation, which is used to derive the specific classes during learning of the visual knowledge. The 3D object classes that are the natural extension of the shape classes play the similar role in learning of the visual concept of the 3D objects. Picture classes reflect the important perceptual property that shows that perception is related to the perceptual visual field, where the object is perceived as an image. The perceptual transformations, presented in this book, were introduced by authors for the purpose of solving of the perceptual problems (visual intelligence tests) and applying visual intelligence tests to test the perceptual ability of a machine. Perceptual transformations play an important role in machine perception MU, both, during interpretation of an image and solving a visual problem. The perceptual transformations are divided into the PS-perceptual transformations, the IN-perceptual transformations, the CF-perceptual transformations, the GR-perceptual transformations and the GO-perceptual transformations. The perceived image is assigned to the structural and ontological picture classes by application of the IN-perceptual transformation that utilizes one or more than one processing transformation. In this book processing transformations are presented in the visual form rather than using pseudo mathematical notation that in many computer vision literatures obscures the clarity of the presented material. The reasoning process is also presented in the new form by showing only the stages of application of the perceptual transformations (processing transformations) and visual illustration of the reasoning process. The common view within machine perception community is that if a machine could be designed which could "see", its computer program could constitute the implementation of a theory of how seeing is achieved by humans. In machine understanding MU the different view is promoted. If a machine could be designed in such a way that it could "see", its computer program could constitute the implementation of a theory of how seeing is achieved by a machine. This seeing could be based on the totally different mechanism than this that is responsible for human seeing.

This book is addressed to the undergraduate and graduate students, the computer scientists, researchers in robotics, AI, computer vision, perception as well as the designers and educators who are interested in application of the machine in designing the IQ tests. The uniqueness of the research topics of this new book should draw attention of the researchers from many areas of computer science, cognitive science or philosophy.