
Preface

This book is the first edited book that deals with the special topic of signals and images within case-based reasoning (CBR).

Signal-interpreting systems are becoming increasingly popular in medical, industrial, ecological, biotechnological and many other applications. Existing statistical and knowledge-based techniques lack robustness, accuracy, and flexibility. New strategies are needed that can adapt to changing environmental conditions, signal variation, user needs and process requirements. Introducing CBR strategies into signal-interpreting systems can satisfy these requirements. CBR can be used to control the signal-processing process in all phases of a signal-interpreting system to derive information of the highest possible quality. Beyond this CBR offers different learning capabilities, for all phases of a signal-interpreting system, that satisfy different needs during the development process of a signal-interpreting system.

In the outline of this book we summarize under the term “signal” signals of 1-dimensional, 2-dimensional or 3-dimensional nature.

The unique data and the necessary computation techniques require extraordinary case representations, similarity measures and CBR strategies to be utilised.

Signal interpretation (1D, 2D, or 3D signal interpretation) is the process of mapping the numerical representation of a signal into logical representations suitable for signal descriptions. A signal-interpreting system must be able to extract symbolic features from the raw data e.g., the image (e.g., irregular structure inside the nodule, area of calcification, and sharp margin). This is a complex process; the signal passes through several general processing steps before the final symbolic description is obtained.

The structure of the book is divided into a theoretical part and into an application-oriented part.

The first chapter gives an introduction to case-based reasoning and describes the special problems associated with signal-interpreting systems and why CBR is especially appropriate to solve the well-known bottleneck when

developing signal-interpreting systems. At the end of this chapter an outlook to new developments is given.

The chapter is followed by a chapter on similarity. This chapter gives a fresh view to similarity and describes how important the concept of similarity is for many application including information retrieval, pattern recognition, computer vision and technical diagnosis. It reviews similarity under the aspects of using similarity for reasoning and explains the advantages of the different properties of the different similarity measures. While doing that it also takes into account the different possible data representations and the requirements following from that to the similarity measures.

Although similarity is a widely used concept in human reasoning it is often not clear how to assess the similarity. Therefore learning of similarity is important aspect to achieve the expected performance of a system. Chapters 3 and 4 describe two different methods for learning the similarity. While Chap. 3 describes a new approach for learning the weight of the attributes in Chap. 4 induction of similarity is proposed.

Structural similarity is an important concept in computer vision and design. A lot of effort has been put into the development of different structural similarity measures and into the development of computational efficient algorithm. Chapter 5 reviews structural similarity measures and gives a classification of the different measures.

Memory organization plays an important role in CBR. Different memory structure have been developed that help to organize a large case base so that a case can be efficiently retrieved from the case base. Chapter 6 gives an excellent overview and classification about what has been achieved so far.

Performance evaluation also under sparse data set is another important aspect. A method for performance evaluation that bridges between CBR and statistics is given in Chap. 7

In the second part of the book special signal-related applications are described and how subtasks of a CBR system such as retrieval, image segmentation or memory organization are solved for this kind of applications.

Chapter 8 describes an agent-based approach for environmental monitoring. The interpretation of 1-dimensional medical signals is described in Chap. 9. The application of prototypical cases for medical diagnosis is described in Chap. 10. The use of the case-based reasoning process for building the model of a watershed-based image segmentation system is described in Chap. 11. The last three chapters deal with the different aspects of image retrieval that is one subtask of CBR. Methods for image retrieval of biomedical images are described in Chap. 12. Chapter 12.8 faces on the special problems when dealing with different multimedia sources and Chap. 14 uses a dissimilarity-based representation for the retrieval.

The book is made for scientist and computer science experts from industry, medicine, and biotechnology who like to work on the special topics of CBR for signals and images. Although CBR is often not a standard lecture at universities we hope we can inspire PhD students to deal with this topic.

The hope is that in the next edition of that book we will see more inspiring work dealing with the challenging topic of CBR.

The main conferences on CBR are the International Conference on Case-Based Reasoning, ICCBR and the European Conference on Case-Based Reasoning, ECCBR. Special emphasis on CBR for signals and images is given at the International Conference on Machine Learning and Data Mining in Pattern Recognition, MLDM and the Industrial Conference on Data Mining ICDM-Leipzig. We are curious to see what new ideas you can present for CBR on signals and image. Looking forward to welcome you at one of our next event.

Leipzig, April 2007

Petra Perner



<http://www.springer.com/978-3-540-73178-8>

Case-Based Reasoning on Images and Signals

Perner, P. (Ed.)

2008, X, 436 p., Hardcover

ISBN: 978-3-540-73178-8