Lecture Notes in Artificial Intelligence 517

Subseries of Lecture Notes in Computer Science
Edited by J. Siekmann

Lecture Notes in Computer Science
Edited by G. Goos and J. Hartmanis

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Temporally Distributed Symptoms in Technical Diagnosis

Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest

Series Editor

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CR Subject Classification (1991): I.2.1, I.2.4, I.5.2

ISBN 3-540-54316-3 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-54316-3 Springer-Verlag New York Berlin Heidelberg

Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.
2145/3140-543210 - Printed on acid-free paper

Preface

Existing diagnostic expert systems usually operate under a set of simplifying working assumptions which limit their universal applicability. A common assumption concerns the treatment of time-dependent information: the device to be diagnosed is assumed to have a static behavior, i.e. the relation between inputs and outputs is constant over time. In most realistic application domains this assumption is violated and both the normal, intended function of the device and the potential malfunctions are complex behaviors over time. This thesis addresses the problem of systematically treating information about fault symptoms which are spread out over periods of time.

These symptoms are characterized by a specific order of events, and in the general case a single snapshot of the device state does not contain sufficient information to recognize an occurrence of the symptom. Instead one has to plan a measurement sequence that consists of several observations at more than one time point.

Starting with a classification of the various types of dynamic faulty behavior we identify one class (temporally distributed symptoms [TDSs]) for which current expert system technology is particularly deficient. For this class we design a representation language that allows TDSs to be specified in a declarative manner. Based on this representation we discuss the problem of giving a meaningful definition of a "successful match of a measurement sequence against a TDS specification". We then operationalize our definition in the form of an algorithm which plans such an observation sequence based on the TDS specification.

Finally, we demonstrate that our solution is a generic, paradigm-independent building block for diagnostic expert systems by embedding it into the frameworks of both an associative/heuristic and a model-based diagnostic system.

This book is based on my doctoral dissertation, accepted in fulfilment of the requirements for the degree of Dr. rer. nat. at the University of Kaiserslautern.

I am indebted to many people who helped greatly in the preparation of the thesis and the research leading up to it. First and foremost, I thank my advisor, Prof. Dr. M.M. Richter, for always asking the right questions and thus drawing my attention to new and interesting aspects of my work that I would otherwise have overlooked. Second, a huge thanks to my wife, Scarlet, who unfailingly kept me going even when this meant yet another spoiled evening or weekend. Her continuous motivation was a critical

prerequisite for my work. Third, this thesis is the end-product of a complex evolution that benefited greatly from uncountable discussions with my co-advisor, Prof. Dr. W. Dilger, and many colleagues. Among them Peter van Beek, Rainer Decker, Oskar Dressler, Hartmut Freitag, Thomas Guckenbiehl, Henry Kautz, Frank Maurer, Robert Rehbold, Gisela Schäfer-Richter, Peter Struss, and Hans Voss deserve special mention. Fourth, Klaus Becker, Sabine Kockskämper, Hans Lamberti, Johannes Stein, and Stefan Wess carried out much of the actual implementation work and helped me in the debugging of my conceptual design by putting their fingers on all the vague spots. Finally, all the people in the expert systems group at the University of Kaiserslautern provided an extraordinarily pleasant working environment.

Kaiserslautern — Klaus Nökel
March 1991

Table of Contents