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CLINICAL CONSULTATION SYSTEMS: DESIGNING FOR THE PHYSICIAN AS COMPUTER USER

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ABSTRACT

The barriers to successful implementation of consultation systems for physicians have been frequently discussed. Our research has been directed at the development of computer techniques that will heighten the acceptance of high performance decision making tools. We discuss two current projects at Stanford Medical School that address both practical and theoretical issues in the design and construction of clinically useful systems.

INTRODUCTION

Our interest in the development of clinical consultation systems began in the early 1970's when we began to examine the barriers to acceptance of computer-based decision aids by physicians. It was clear that diagnostic accuracy was not enough to guarantee the successful implementation of a program[1]; other issues such as mode of interaction, transparency of the "reasoning" behind a system's advice, and integration of a system into the physician's daily routine also seemed to be crucial determinants of acceptance. We were particularly interested in explanation and were drawn to the techniques of artificial intelligence as potential methods for developing consultation programs that could justify their advice. An experimental system known as MYCIN was developed[2]. It demonstrated that "production rules", if translated into English, could provide explanations that were usually understandable, even by a physician who was not familiar with computer techniques. The program also performed at a level comparable to experts in its domain (antimicrobial therapy selection)[3]. Despite its success, however, MYCIN lacked other elements that are key to the acceptance of consultation systems. Our current research is directed at building on the lessons of MYCIN while continuing to address both theoretical and practical computer science issues.

THE ONCOCIN PROJECT

ONCOCIN is an oncology chemotherapy consultant program that was introduced in the Stanford Oncology Clinic in July of this year. Our goal in this work has been to demonstrate that state-of-the-art artificial intelligence techniques are capable of producing an acceptable consultation system if the application domain is carefully selected and human engineering issues are adequately addressed. Despite the significant theoretical issues that remain for the development of diagnostic consultants (e.g., management of reasoning involving temporal disease trends, customized explanations appropriate for different kinds of users, improved management of uncertainty in the face of inadequate or conflicting data), ONCOCIN deals with a clinical problem and a medical environment for which current techniques appear to be adequate.

ONCOCIN's task is to assist oncologists with the management of cancer patients undergoing structured (protocol) treatment for their disease. The knowledge of treatment plans has been formalized in protocol documents which have been extracted and encoded using artifical intelligence representation techniques similar to those used in MYCIN[4]. Unlike MYCIN, however, ONCOCIN communicates with the physician through a high-speed interface program which simulates the process of flow-sheet data recording that is already required of Stanford oncologists. Thus the physician has substituted an efficient computer-based function for a task that was previously handled manually. In the process, he or she receives management advice and explanations for dose or drug changes suggested by the program. ONCOCIN's recommendations may easily be overriden by the oncologist, so the ultimate decision regarding patient management rests, as it should, with the primary physician.

THE EXPERT EXPLANATION PROJECT

Although MYCIN provided considerable insight into methods for generating explanations by a computer-based consultant[5], we also became aware of the limitations of its explanations. In particular, MYCIN has no sense of discourse or context and it gives the same explanation to all users, regardless of their expertise or the interaction that has gone before. Furthermore, regurgitation of rules is not always satisfactory, particularly when a user's understanding depends upon insight into the physiologic or causal processes that justify a single rule. Our newest project, then, is looking both at the psychological issues involved in determining whether an explanation is

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appropriate or effective and at fundamental computer science problems regarding the optimal representation of knowledge to facilitate the justification of an expert system's reasoning. We have been encouraged in this work by a recent survey of physicians[6] which indicates that an explanation facility may be among the most important capabilities of a clinically acceptable consultant program.

The psychological studies will permit the analysis of explanations offered by human clinical consultants to physicians who have requested advice. A formal experimental design has been devised to help delineate design considerations for consultation programs.

Computer science research is underway in parallel. We have begun work in the area of calcium metabolism, working closely with an expert endocrinologist from the Stanford faculty. The emphasis in the developing system is to devise methods for encoding knowledge at various levels of detail so as to facilitate customized explanations in accordance with the expertise of the user and the nature of previous questions.

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