A View on the Current State of the MedFrame/CADIAG-IV Project

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Abstract

CADIAG-IV is a data-driven fuzzy diagnostic expert system for computer-supported consultation in internal medicine based on the PC-based medical expert system shell MedFrame. MedFrame provides a medical institution with a set of powerful tools for developing knowledge bases and inference mechanisms and applying them as expert systems in clinical routine. CADIAG-IV is the first expert system completely based on MedFrame, significantly extending the usage of fuzzy concepts compared to its predecessors CADIAG-II and -III. After the implementation of the MedFrame core components, a high level inference engine for rule-based knowledge bases has been implemented and used for the realization of the CADIAG-II/-III inference process. In addition, the CADIAG-II/RHEUMA knowledge and patient data have been transferred from the original IBM host system to MedFrame. Currently, the realization of the CADIAG-IV inference, the integration of additional MedFrame components, and the implementation of the user interfaces is in progress. The results achieved so far confirm the applicability, correctness, and performance of the MedFrame concept and the CADIAG re-implementation.

Keywords:

Medical expert system, MedFrame, CADIAG, Fuzzy logic, Rheumatology.

Methods

MedFrame is a medical expert system shell consisting of i) various knowledge representation formalisms to store medical knowledge and adequate inference mechanisms, ii) interfaces to add further inference mechanisms, iii) concepts for modeling and handling uncertainty in medical terminology and medical relations, iv) mechanisms for storing patient data and history, v) a graphical user interface providing knowledge acquisition components and patient administration and interpretation components, vi) interfaces to adapt the components of the graphical user interface to the requirements of particular medical domains, and vii) various components for the maintenance of the expert system shell. By offering these facilities, MedFrame provides the end user with a set of powerful tools for developing knowledge bases and also allows the application programmer to extend the possibilities of the expert system shell components, provided by the system programmer, by implementing a set of interfaces and using a collection of libraries.

CADIAG-IV is the first expert system completely based on MedFrame. Its predecessor CADIAG-II is a data-driven fuzzy medical expert system providing diagnostic hypotheses and proposing further useful examinations in response to the input of a list of symptoms, signs, and laboratory test results obtained for a patient. To deal with vagueness in medical terminology and medical relationships, CADIAG-IV extends the usage of the theory of fuzzy sets in CADIAG-II, particularly the concepts of linguistic variables and fuzzy logic, by assigning two values to every medical entity, (a) strength of evidence and (b) strength of counterevidence. Both values are fuzzy truth values in [0, 1].

Results

After the implementation of the components that extend MedFrame towards a fully-featured expert system shell, in a first step, the knowledge base of CADIAG-II/RHEUMA including the data of about 3,000 patients from the relevant clinics has been transferred from the record-oriented representation of the IBM host system WAMIS to the object-oriented model of MedFrame.

Building on the components having been developed for MedFrame, in a second step, the inference mechanism of CADIAG-II/-III has been re-implemented in an object-oriented fashion in Java. For this purpose, a very general set of inference components was developed inside of MedFrame, which are capable of dealing with any kind of rules, not only CADIAG-rules. On top of these components the CADIAG-II/-III-inference process has been implemented and compared to the results having been generated by the original CADIAG.

Conclusion

After the implementation of the rule-based inference engine, MedFrame already represents a solid framework for building medical expert systems having the potential to significantly reduce the time and cost of developing expert systems.