The Synthesis of Artificial Intelligence, Medical Knowledge, and Mental and Emotional Concepts—An Ongoing Project

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1. Goal

To construct a knowledge-based expert system with integrated mental and emotional concepts in the field of medical knowledge.

2. Introduction

Current hospital information systems support clinicians documenting medical charts. Classifying diagnoses with the International Classification of Diseases, 10th Revision (ICD-10) and encoding procedures with national procedure catalogs have become important because hospitals are funded on the basis of such data. Quality management uses quality indicators extracted from medical records. Such indicators and codings are often erroneous because of misunderstandings on the part of encoding staff as well as the ambiguity of catalogs. Automatic encoding from patient letters or operation records lacks (like all current natural language processing programs) a deeper understanding of what really has been done and what should have been done. Implementing a model of self, emotion, sexuality, dreaming, and learning into expert systems seems to be important not only because of a better human-computer interface, but also because it would be a better way of storing and retrieving pertinent information. An implicit awareness of time (e.g., what is the duration of a specific operation, how do lab results of hepatitis serology change during infection), space (e.g., what consequences does the diameter of a brain tumor have), emotion (e.g., what is a depression) on the part of the program is essential. Redundancy, memory loss, and inconsistencies in knowledge bases are then constitutive components of these programs.

3. Background

Prior work dealt with encoding descriptions for clinical classification [1] systems as well as medical expert systems such as HEPAXpert [2] or RHEUMexpert [3]. Successful expert systems like QMR [4] and ILIAD [5] have achieved wide acceptance. Minski [6] establishes a model of the mind as a collaborative work of many specialized subprograms while Lenat [7] developed a 12-dimensional context space which is crucial for understanding any given sentence or any context. One of the

earliest Artificial Intelligence (AI) software tried to simulate a psychotherapy session (ELIZA, [8]). The re-discovery of artificial neural nets [9] stimulated the discussion on computers and consciousness.

4. Design Considerations

Starting from existing knowledge bases, text corpora, and thesauri, a semantic integration will be attempted. Mental and emotional concepts of self, emotion, sexuality, dreaming, and learning as well as concepts of time and space will be implemented (Figure 1). We will use the Unified Medical Language System (UMLS) [10], including the ICD-10. The International Classification of Primary Care (ICPC-2), HEPAXpert and RHEUMexpert, and a natural language processor (NLP) will also be used. Aspects of the OpenGALEN [11] project will be taken into account.

5. System Description

The program itself will be a knowledge-based expert system with the use of fuzzy logic for representing interdependencies in a semantic network. Semi-automatic machine learning will be attempted. Input and output is text-based only in a first step. The prototype is designed to be implemented in EXCEL with macros and some C++ routines running on a standard PC.

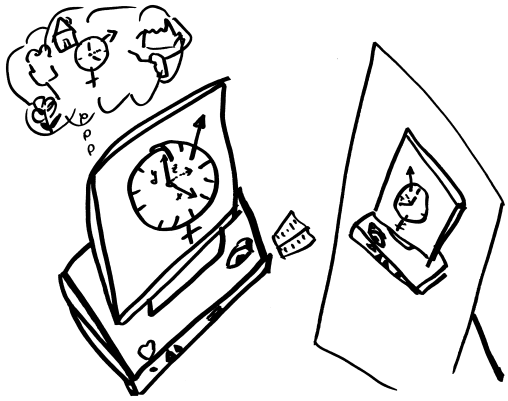

Figure 1: The clock face symbolizes time, its three hands the x, y, and z coordinates of space, ♀ and ♂ stand for sexuality, the mirroring symbolizes the self, the heart stands for emotion, the book for learning. The objects within the "cloud" represent dreaming (of oneself and of other real world objects such as a flower, a house, a tree, etc.).

6. Status Report

Since this is an ongoing project it is still in the designing phase. Currently we are carrying out a literature review and trying to harmonize knowledge bases in use. The integration of the dimensions time and space, self, emotion, sexuality, dreaming, and learning into the program will be elaborated.

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