

**CZ3005: Artificial Intelligence**

**2020 Fall Assignment 4:**

**Implementing a Talking Box with Prolog**

**Question 4:**

**Patient with a Sympathetic Doctor**

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# **Section 1. Introduction**

Prolog is a logic programming language associated with Artificial Intelligence and Computational Linguistics.

It is interesting to note that unlike other programming languages, Prolog has its roots in first-order logic, a formal logic, used to represent a powerful Knowledge-Based System (KBS). As such, logic programmers can ascribe the efficiency of the knowledge-based representation to its generic representation without having to deal with technical concepts (time, events). Additionally, it is a universal language, allowing us to express anything that can be programmed.

In this assignment, we will:

(1) Implement a *Knowledge Base System Dialogue AI* to explore the concept of separation of *Knowledge* (essential representation of the world) from the *Inference Engine* (Set of inference rules) in KBS using Prolog.

(2) As part of an additional feature, we will be implementing a *GUI* to simplify and have an active interaction with the KBS, while observing how the KBS does the update in the background.

# **Section 2. Overview**

## **2.1 Introduction to KBS**

The KBS is designed with the following considerations:

1. The KBS must be able to ask user(patient) questions.
2. The user(patient) must be able to reply “yes” or “no” only.
3. The KBS must be able to ask the user(patient) 5 or more degree of pain level.
4. The KBS must be able to ask the user(patient) 5 or more levels of mood.
5. The KBS must be able to ask questions in an appropriate demeanour based on the user’s(patient) pain and mood level.
6. The KBS must have a total of 5 diseases.
7. For each disease, there must be at least 5 or more symptoms associated to it.
8. The KBS must be able to diagnose the patient’s disease.

Some additional considerations during the design of the KBS:

1. When a user(patient) replies a “yes” to any question, KBS must be able to *assert* the given answer as true.
2. The KBS is assumed to be a *thorough* AI. In which, the KBS should be able to do a *comprehensive analysis* of various symptoms should be done before making a diagnosis.
   1. KBS should be able to iterate through all symptoms.
   2. A good heuristic or algorithm should be implemented for diseases with overlapping symptoms.
3. The KBS must be able to answer the user(patient) in a sympathetic manner.
   1. A combination of pain level and mood level should output a type of gesture.
   2. Gesture chosen should be able to distinctively show an appropriate level of sympathy.

## **2.2 Overview of KBS**

To be able to separate the knowledge base from the inference engine, the KBS has the following 5 distinct “Databases”. To ensure that the symptoms of each disease/illness is as *realistic* as possible, I have referenced them from NHS disease database [1].

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Figure 1 5 Distinct "Databases"

## **2.3 Logic flow of Sympathetic Doctor Program**

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Figure 2 Sympathetic Doctor Logic Flow

## **2.4 Further Considerations**

### **2.4.1 Pain Level and its effect on the biasness of diagnosis**

### **2.4.2 Mood Level and its effect on the degree of sympathy**

# **Section 3. Implementation and Explanation**

## **3.1 Code Explanation**

### **3.1.1 Predicates/Variables used**

### **3.1.2 Rules Used**

## **3.2 Logic Flow**

## **3.3 Rules of Diagnosis**

## **3.4 Heuristics/ Algorithm for conflicting diagnosis**

## **3.5 Helper Functions**

## **3.6 Further Considerations (Error Handling)**

# **Section 4. Demonstration of Sympathetic Doctor Dialogue AI**

# **Section 5: Additional Implementation (GUI) with Google Speech Recognition Engine**

## **5.1 Motivation for GUI Implementation (Additional Feature)**

## **5.2 Overall System Architecture Diagram of the GUI Implementation**

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Figure 3 System Architecture Diagram of Implemented GUI

## **5.3 Set up and Installation**

## **5.4 Implementation of the GUI**

## **5.5 Screenshot of GUI Implementation**

## **5.6 Demonstration of Sympathetic Doctor Dialogue AI with GUI (YouTube Link)**

# **Section 6. Conclusion**

# Works Cited

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| [1] | A. K. A. C. Piyush Ranjan, "How can Doctors Improve thier Communication Skills?," *NCBI,* vol. 9, no. 3, pp. 01-04, 2015. |
| [2] | NHS, "NHS inform," [Online]. Available: https://www.nhsinform.scot/illnesses-and-conditions/immune-system/allergies. [Accessed 19 November 2020]. |