KaiMAX - Mission-Critical Road Accident Management Expert System

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Domain: Healthcare and Medical

Abstract

The rule-based expert system is developed using JESS Rule Engine and can predict the severity of a road accident; thereby recommending steps to be followed for the proper management of this unexpected disaster. This expert system is designed to take certain health related parameters from the accident victim; derive inferences about those vital parameters and make recommendations to the user of the system. (victim or the healthcare professional)

This system predicts the severity of the accident by evaluating these four parameters; namely, criticality of injury occurred, degree of mental trauma, state of unconsciousness and intensity of bleeding (if occurs). This system also suggests the steps that the victim or the healthcare professional can take. The system can accurately detect the abnormality in blood pressure levels and average heart rate readings of an accident victim.

Nowadays, ambulances are incorporating smart equipment in them which performs complex diagnostics of the victim even before he/she is admitted to the hospital. Insightful observations on-the-go can help manage the different patients arriving at the hospital during the same time. The system can schedule the admission of different patients into the hospital rooms based on the severity of their physical and mental conditions. This strategy can fully utilize the limited number of resources and optimize it to the best possible solution. The victim who needs immediate attention will be scheduled first.

This system can be integrated with various sensors in the ambulance which can act as dynamic inputs to the expert system. This would render the system autonomous because the system would be able to read the inputs automatically and give the desired output.

Structure of the System – All factors do not carry the same weightage and are tweakable easily as per the requirements. The overall rating system is strict as it is required that victims who have experienced the maximum degree of injury should be admitted first.

The system is designed to interact with the victim or his/her healthcare professional by letting them enter certain scores and readings pertaining to the victim; it then computes the final severity score of the victim using weighted averages and recommends if he/she should be considered as an emergency or not. The various input values to the system are:

1) Name of the victim
2) Age of the victim
3) Gender of the victim
4) Systolic Blood Pressure reading

5) Diastolic Blood Pressure reading
6) Average Heart Rate of the victim
7) Score indicating the degree of Critical Injury incurred by the victim (1-10)
8) Score signifying the severity of Bleeding (1-10)
9) Score indicating the degree of Mental Trauma (1-10)
10) Value denoting whether the victim is unconscious or not (Yes or No)

Once we get all the scores of the victim, we now run the rule engine, which has rules pertaining to different combinations of values of these factors. It computes the final rating of a victim based on the value of all these factors and gives the recommendation. As mentioned before, the different weights given to the four vital factors depending on their logical importance towards the severity are as follows:

- Degree of Critical Injury: 55%
- Severity of Bleeding: 25%
- Degree of Mental Trauma: 20%
- Unconscious or not Unconscious: (Additional 10%)

Knowledge Base: The Knowledge Base used by my system consists of the following:

Facts:

Questions: This consists of the questions that are asked and these questions have an ID and type to distinguish them; which specifies what type of answer the system is expecting. The various questions can be seen from this snippet of code:

```
(printout t "Please type the name of the victim and press <Enter> " crlf)
   (bind ?name (read))
   (printout t "Please input the age of the victim and press <Enter> " crlf)
   (bind ?age (read))
   (printout t "Please input the gender of the victim and press <Enter> (M or F) " crlf)
   (bind ?sex (read))
   (printout t crlf "Let us assess severity of the accident and begin the evaluation of physical condition for " ?name "." crlf)
   (printout t "Please provide the required information and KaiMAX will recommend you the further steps that should be followed " crlf crlf))

;Facts containing the questions to be asked
(deffacts questions
   "The questions that are asked to the user by the system."
   (question (ident avgHR) (type number)
      (text "What is the average heart rate of the victim now?"))
   (question (ident bloodPressureSystolic) (type number)
      (text "Please tell me the higher reading of the victim's blood pressure? "))
   (question (ident bloodPressureDiastolic) (type number)
      (text "Please tell me the lower reading of the victim's blood pressure? "))
```

```
(question (ident unconsc) (type Yes-No)
    (text "Is the victim unconscious or unable to move? (Yes or No) "))
(question (ident bleeding-intensity) (type number)
    (text "How intensively is the victim bleeding right now (0-10)?"))
(question (ident criticalinjury-degree) (type number)
    (text "Has the victim badly injured the sensitive parts of his/her body(head, neck, spine,
etc)? Please indicate the severity of critical injury (0-10)?"))
(question (ident mentalTrauma) (type number)
    (text "Specify the degree of Mental Trauma experiences  by the victim? (0-10)")))
```

Templates:

Please refer the code for the detailed description of each slot in the template.

1. Victim Template: This stores all the information regarding the victim
    ```
    (deftemplate victim
        ; Input the name of the victim
        (slot victimName)
        ; Input the age of the victim
        (slot age (type INTEGER))
        ; Either Male or Female
        (slot sex (allowed-values M F))
        ; Systolic is the higher number in B.P. reading
        (slot bloodPressureSystolic (type INTEGER))
        ; Diastolic is the lower number in B.P. reading
        (slot bloodPressureDiastolic (type INTEGER))
        ; Average Heart Rate
        (slot avgHR (type INTEGER))
        ; Tells whether the victim is unconscious or not (Yes/No)
        (slot unconsc (allowed-values Y N))
        ; Signifies the severity of bleeding (rate of blood loss)
        (slot bleeding-intensity (type INTEGER))
        ; Indicates the criticality of injury occured
        (slot criticalinjury-degree (type INTEGER))
        ; Degree of Mental Trauma the victim is suffering from
        (slot mentalTrauma (type INTEGER)))
    ```

2. Question Template: This holds all the questions in the format they have to be asked to the user
    ```
    (deftemplate question
        (slot text)
        (slot type)
        (slot ident))
    ```

3. Answer Template: This stores the answers that are provided by the user corresponding to the questions
    ```
    (deftemplate answer
        (slot ident)
    ```

```
    (slot text))
```

4. Severity Template: This stores the final accident severity which is given to the victim after the computation with all the details provided
```
(deftemplate severity
    (slot score))
```

5. Recommendation Template: This holds the final recommendation which has a slot for showing the final rating and a slot which contains the final recommendation
```
(deftemplate recommendation
    (slot severity-score)
    (slot explanation))
```

Test Cases:

Valid Cases: You can try out any test case with the values of the important parameters between 0 – 10 as shown below.

1)


```
********************* Welcome to KaiMAX *********************
The Mission-critical Road Accident management eXpert system!

Please type the name of the victim and press <Enter>
Daniel
Please input the age of the victim and press <Enter>
29
Please input the gender of the victim and press <Enter> (M or F)
M

Let us assess severity of the accident and begin the evaluation of physical condition for Daniel.
Please provide the required information and KaiMAX will recommend you the further steps that should be followed

Please tell me the lower reading of the victim's blood pressure?  82
Please tell me the higher reading of the victim's blood pressure?  118
What is the average heart rate of the victim now? 97
Has the victim badly injured the sensitive parts of his/her body(head, neck, spine, etc)? Please indicate the severity of critical injury (0-10)? 7
How intensively is the victim bleeding right now (0-10)? 8
Specify the degree of Mental Trauma experiences  by the victim? (0-10) 7
Is the victim unconscious or unable to move? (Yes or No)  Yes

The victim's blood pressure levels are normal. No action required on this aspect at least.
The victim's average Heart Rate is in the normal range. No action required on this aspect at least.

*** The road accident severity score for this victim is: 7.900000000000001
Recommendation: Physical injury and mental trauma of an acceptable degree have been encountered by the victim. He/she will become fit as a fiddle with proper dressing of wounds, painkillers, a
nd some counselling

Road Safety Tip: Be courteous towards fellow road users - keep your temper and resist the temptation to retaliate.
Be Healthy. Stay Safe!
Hope to not see you again!
Thank you for using KaiMAX...
```

2)


```
********************* Welcome to KaiMAX *********************
The Mission-critical Road Accident management eXpert system!

Please type the name of the victim and press <Enter>
Roxanne
Please input the age of the victim and press <Enter>
29
Please input the gender of the victim and press <Enter> (M or F)
F

Let us assess severity of the accident and begin the evaluation of physical condition for Roxanne.
Please provide the required information and KaiMAX will recommend you the further steps that should be followed

Please tell me the lower reading of the victim's blood pressure?  94
Please tell me the higher reading of the victim's blood pressure?  138
What is the average heart rate of the victim now? 101
Has the victim badly injured the sensitive parts of his/her body(head, neck, spine, etc)? Please indicate the severity of critical injury (0-10)? 9
How intensively is the victim bleeding right now (0-10)? 9
Specify the degree of Mental Trauma experiences  by the victim? (0-10) 8
Is the victim unconscious or unable to move? (Yes or No)  No

The victim is experiencing pre-hypertension. The condition may become worse if not taken care of at this moment.
The victim is suffering from arrythmia. Abnormalities in the heart rate indicate risks of an heart attack and should be brought to notice of the healthcare professional.

*** The road accident severity score for this victim is: 8.8
Recommendation: Several injuries of extreme nature have been incurred by the victim. He/she must be attended straightaway at the hospital

Road Safety Tip: Avoid all distractions - Keep both eyes on the road and hands on the steering wheel!
Be Healthy. Stay Safe!
Hope to not see you again!
Thank you for using KaiMAX...
```

3)


```
********************* Welcome to KaiMAX *********************
The Mission-critical Road Accident management eXpert system!

Please type the name of the victim and press <Enter>
Laura
Please input the age of the victim and press <Enter>
56
Please input the gender of the victim and press <Enter> (M or F)
F

Let us assess severity of the accident and begin the evaluation of physical condition for Laura.
Please provide the required information and KaiMAX will recommend you the further steps that should be followed

Please tell me the lower reading of the victim's blood pressure?  102
Please tell me the higher reading of the victim's blood pressure?  160
What is the average heart rate of the victim now? 59
Has the victim badly injured the sensitive parts of his/her body (head, neck, spine, etc)? Please indicate the severity of critical injury (0-10)? 10
How intensively is the victim bleeding right now (0-10)? 10
Specify the degree of Mental Trauma experienced by the victim? (0-10) 10
Is the victim unconscious or unable to move? (Yes or No)  Yes

The victim's blood pressure levels are abnormal. These readings should be notified to the concerned doctor as soon as possible.
The victim is suffering from arrythmia. Abnormalities in the heart rate indicate risks of an heart attack and should be brought to notice of the healthcare professional.

*** The road accident severity score for this victim is: 10.65
Recommendation: It's an Emergency!.. Immediately rush the victim to an intensive care unit of the nearest hospital or else it can prove to be fatal!

Road Safety Tip: Be courteous towards fellow road users - keep your temper and resist the temptation to retaliate.
Be Healthy. Stay Safe!
Hope to not see you again!
Thank you for using KaiMAX...
```

Expected Output:

The system will give the accident severity score and will recommend whether the victim needs immediate attention. The advice should be strictly followed as the lif of the victim depends on it.

Instructions to run the System:

- Save the "accidentManagement_Rapunzel.clp" file in the "Jess71p2\bin\" folder on your local system.
- Go to the command line interface for Jess and execute the file using the batch command along with the correct location of the file on the system.
- (batch "accidentManagement_Rapunzel.clp")