BITI 2213: KNOWLEDGE BASED SYSTEM

MINI PROJECT TITLE:

Obesity Diagnosis Expert System

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Contents

1. Introduction

Expert system is a computer system simulating the decision-making ability of a human expert. It is designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if–then rules rather than through conventional procedural code. The first expert systems were created in the 1970s and then proliferated in the 1980s. Expert systems were among the first truly successful forms of artificial intelligence (AI) software.

Nutrition is the biochemical and physiological process by which an organism uses food to support its life. Nutrition needed by different person might differs by body mass index, gender, and daily activities.

Body mass index (BMI) is a value derived from the mass (weight) and height of a person. The BMI is defined as the body mass divided by the square of the body height, and is expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. The BMI is a convenient rule of thumb used to broadly categorize a person as underweight, normal weight, overweight, or obese based on tissue mass (muscle, fat, and bone) and height.

1.1 Problem Background

The number of cases of obesity is increasing uncontrollably. According to studies done by National Health and Morbidity in 2019, Malaysia has the highest prevalence of obesity among adults in South East Asia.

Hence, this KBS is created based on giving suggestions on daily diet according to the body type of user. In this system, we assumed that not only people with obesity will become the user, but also those who takes health seriously. There will be suggestions for underweight users to obesity users according to their information given.

2. Objective:
   A. To create an expert system that make calculations of a person's BMI,
   B. Categorize the body type of the user,
   C. Make suggestions on daily calory and nutrition intake.

3. Methodology:

1 Doing researches on calculating BMI, body type (underweight / normal weight / overweight), daily calory intake and daily nutrition intake.

2 Designing the expert system.

3 Implementation of code on CLIPS software.

3.1 Data Collection and Facts

Data for indicating body type and nutrition values suggestions are collected from internet that are researched by professionals. The sources of the values are recorded at the reference.

4. Tree Graph and Rules

Get User Information

Rule read age and gender:

IF user's name already exist,

THEN use predefined values.

Rule read new age and gender:

IF user's name not exist,

THEN read new information.

BMI

Rule BMI status underweight:

IF BMI < 18.5,

THEN body status is underweight,

AND suggest "Please gain some weight to maintain a healthy body".

Rule BMI status HealthyWeight:

IF BMI >= 18.5,

AND BMI < 25.0,

THEN body status is healthy weight,

AND suggest "Good, keep your body weight".

Rule BMI status Overweight:
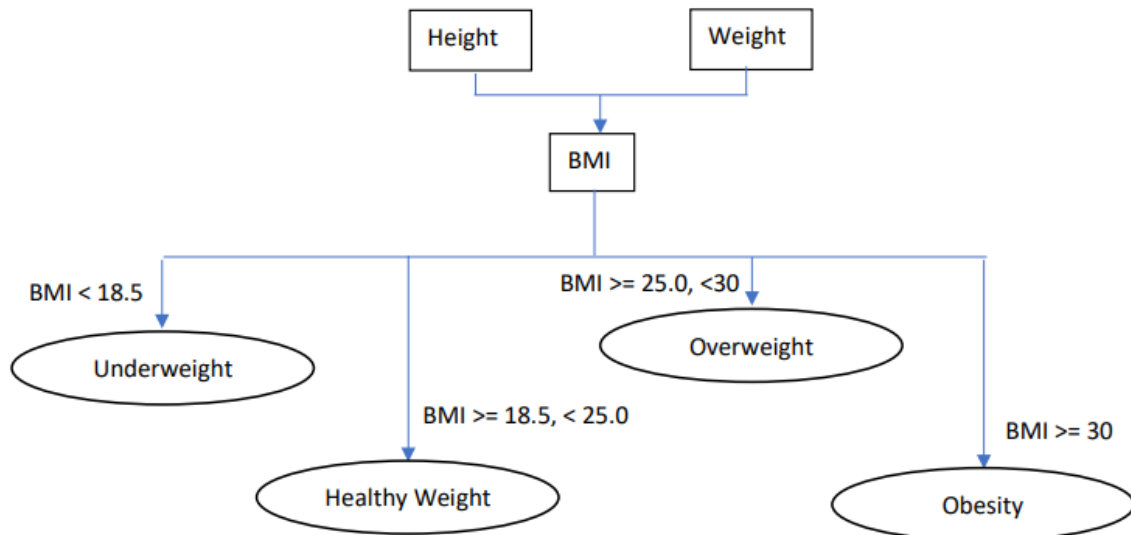
IF BMI >= 25.0,

AND BMI < 30.0,

THEN body status is overweight,

AND suggest "We strongly suggest you to lose some weight"

Rule BMI status obesity:

IF BMI > 30,

THEN body status is obesity,

AND suggest "We strongly suggest you to lose some weight".

Fibre

Rule Fiber Calculation Child:

IF Age < 18,

THEN Fiber = 31g.

Rule Fiber Calculation Adult Female:

IF Age >= 18,

AND Age <50,

AND Gender is Female,

THEN Fiber = 25g

Rule Fiber Calculation Adult Male:

IF Age >= 18,

AND Age <50,

AND Gender is Male,

THEN Fiber = 38g

Rule Fiber Calculation Elder Female:

IF Age >= 50,

AND Gender is Female,

THEN Fiber = 21g

Rule Fiber Calculation Elder Male:

IF Age >= 50,

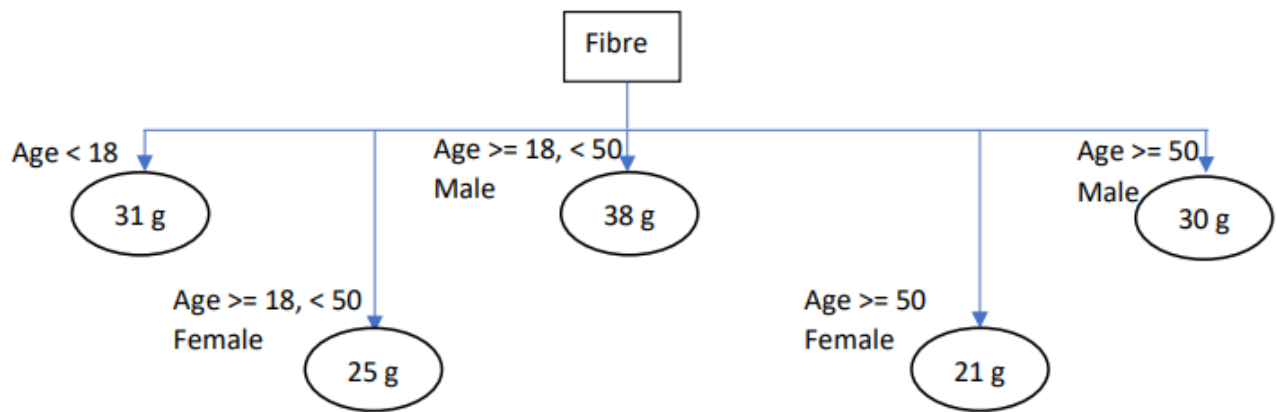**AND** Gender is Male,

THEN Fiber = 30g

Fibre Calculation:

Calcium

Rule Calcium Calculation 1:

IF Age < 1,

THEN Calcium = 270mg.

Rule Calcium Calculation 2:

IF Age <= 3,

AND Age > 1,

THEN Calcium = 500mg.

Rule Calcium Calculation 3:

IF Age <= 8,

AND Age > 3,

THEN Calcium = 700mg.

Rule Calcium Calculation 4:

IF Age <= 11,

AND Age > 8,

THEN Calcium = 1000mg.

Rule Calcium Calculation 5:

IF Age <= 18,

AND Age > 11,

THEN Calcium = 1300mg.

Rule Calcium Calculation 6:

IF Age <= 50,

AND Age > 18,

AND Gender is Female

THEN Calcium = 1000mg.

Rule Calcium Calculation 7:

IF Age <= 70,

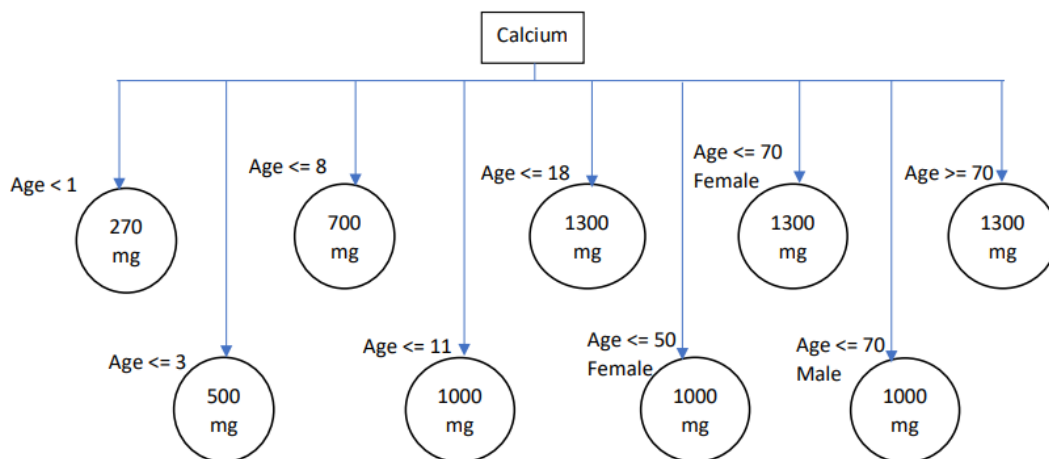**AND** Age > 50,

AND Gender is Female,

THEN Calcium = 1300mg.

Rule Calcium Calculation 8:

IF Age <= 70,

AND Age > 18,

AND Gender is Male,

THEN Calcium = 1000mg.

Rule Calcium Calculation 9:

AND Age > 70,

THEN Calcium = 1300m

5. Coding

The full coding of the expert system is submitted with this report at ulearn. To execute this system :

1. load the .clp file in CLIPS System
2. type *(reset).* This is to initialize the predefined data
3. type *(assert (main))* or *(assert(initial-fact))*
4. type *(run)*

6. Result and Discussion

From the codes, there are predefined template to store user's data and some predefined data:

```
(deftemplate patient_data
        (slot name)(slot age)(slot gender)(multislot measurement)(slot activityfactor))

(deffacts patient
        (patient_data (name "WONG KAI JUN")(age 23)(gender Male)(measurement 167 68)(activityfactor 1.3))
        (patient_data (name "LIEW SZE WEN")(age 34)(gender Female)(measurement 158 43)(activityfactor 1.5))
        (patient_data (name "LOW PEI ZUO")(age 13)(gender Male)(measurement 153 83)(activityfactor 1.2)))
```

Where

"WONG KAI JUN" aged 23, Male, height 167cm, weight 68kg and activity factor of 1.3.

"LIEW SZE WEN" aged 34, Female, height 158cm, weight 43kg and activity factor of 1.5.

"LOW PEI ZUO" aged 13, Male, height 153cm, weight 83kg and activity factor of 1.2.

Existing User

By entering a predefined value ("WONG KAI JUN") for the name, the system gives suggestions using the existed values associated with the name:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                  Welcome to Obesity Diagnosis Expert System
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

What is your name? :WONG KAI JUN

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                          Result
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Dear Mr.WONG KAI JUN
Your BMI is :24.38
It is consider as Healthy-Weight
Good, keep your body weight

Your suggested daily nutrient intake :
Calories : 2097.875
Protein (at least) : 54.4 grams
Calcium (at least) : 1000 mg
Fiber (at least) : 38 grams
Carbohydrate (at least) : 262.23 grams
```

To update the predefined value, use *(assert(modify-data))* command. A list of attributes will show up, the user needs to choose one of the attribute and input the new data, then the system will provide new suggestion based on the input. Example of new suggestion after update data:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                         Result
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Dear Mr.WONG KAI JUN
Your BMI is :27.96
It is consider as Overweight
We strongly suggest you to lose some weight

Your suggested daily nutrient intake :
Calories : 2227.875
Protein (at least) : 62.4 grams
Calcium (at least) : 1000 mg
Fiber (at least) : 38 grams
Carbohydrate (at least) : 278.48 grams
```

After updating the data, the BMI value change from 24.38 to 27.96. The new suggestion is suggest Mr. WONG KAI JUN to lose some weight.

New User

By entering a unrecognized name ("KAW ZI JIAN") from the system, the user is required to enter their information as their data is not available:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                    Welcome to Obesity Diagnosis Expert System
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

What is your name? :KAW ZI JIAN
Please enter your gender (Male/Female):Male
Please enter your current age :52
Please enter your current height (in cm):170
Please enter your current weight (in kg):108

Please select your activity range
1. Sedentary (Little to no exercise )
2. Light exercise (1-3 days per week)
3. Moderate exercise (3-5 days per week)
4. Heavy exercise (6-7 days per week)
5. Very heavy exercise (twice per day, extra heavy workouts)
Enter your choice here : 2
```

Result according to the data of user

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                            Result
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Dear Mr.KAW ZI JIAN
Your BMI is :37.37
It is consider as Obesity
We strongly suggest you to lose some weight

Your suggested daily nutrient intake :
Calories : 2453.75
Protein (at least) : 86.4 grams
Calcium (at least) : 1000 mg
Fiber (at least) : 30 grams
Carbohydrate (at least) : 306.71 grams
```

7. Conclusion

In conclusion, this expert system can help to determine if a person is obesity without the need of an expert. The person only need to provide his/her age, gender, weight and height to the obesity diagnosis expert system will do all the calculation to clarify what is the body status of the person as well as the daily nutrients suggested in order to maintain their good health.

References

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2. B, S. (2017, October 12). *How Much Fiber Should I Eat Per Day?* Retrieved from healthline: https://www.healthline.com/health/food-nutrition/how-much-fiber-per-day

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6. https://en.wikipedia.org/wiki/Expert_system

7. https://en.wikipedia.org/wiki/Body_mass_index

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Youtube Link For Presentation

https://youtu.be/CLhHOUhAUGA