SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2013 SESSION

SUBJECT CODE	:	**FSB 33303**
SUBJECT TITLE	:	**ARTIFICIAL INTELLIGENCE**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**3 HOURS**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.

2. This question paper is printed on both sides of the paper.

3. Please write your answers on the answer booklet provided.

4. Answer should be written in blue or black ink except for sketching, graphic and illustration.

5. This question paper consists of TWO (2) sections, Section A and B. Answer ALL questions in Section A. For Section B, answer two (2) questions only.

6. Answer all questions in English.

7. Graph paper is appended.

**THERE ARE 8 PRINTED PAGES OF QUESTIONS, AND ONE PAGE OF GRAPH PAPER EXCLUDING THIS PAGE**

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a)   Explain briefly the following artificial intelligence branches:

      i.   Neural Networks

(2 marks)

      ii.   Genetic Algorithm

(2 marks)

(b)   State five (5) representation of rules

(5 marks)

(c)   Write a generic pseudo-code of Genetic Algorithm.

(3 marks)

(d)   Figure 1 shows a hybrid intelligent system which consists of two artificial intelligence techniques. Name these two techniques.
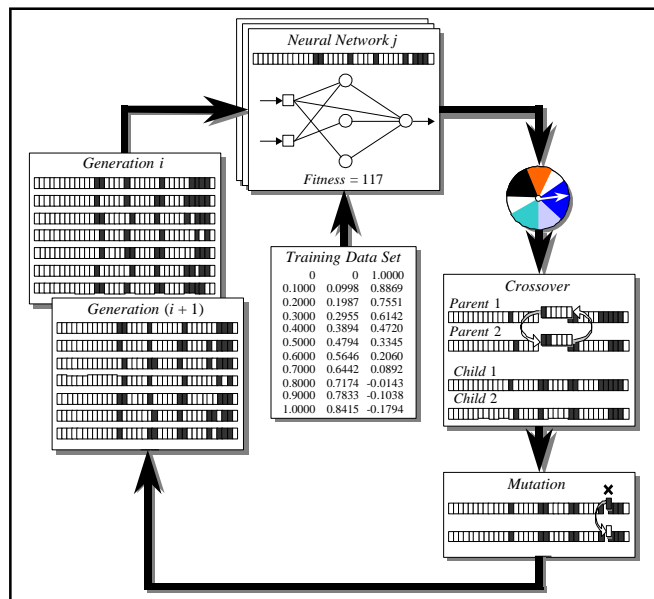
Figure 1: Hybrid Intelligent System

(2 marks)

(e) Given the Rule-based expression:

"If the temperature of the room is more than 50 degree Celcius then turn on the blower to 80% of its capacity"

Modify the expression by adding Fuzzy Logic to represent Linguistic Imprecision.

(2 marks)

(f) List four (4) steps to solve fuzzy inference in Mamdani' style and Sugeno's style

(4 marks)

Question 2

(a) Consider the fuzzy set A:

A={(1,0.100), (2,0.800), (3,1.000), (4,0.200), (5, 0.500)}.

Draw each graph and show all possible calculations (with three (3) decimal points) for below operations:

i. A^3

(2 marks)

ii. DIL(A)

(4 marks)

iii. CON(A)

(4 marks)

(b) By using illustrated figures, describe the processes of Forward and Backward Chaining inference in Rule-based Expert System.

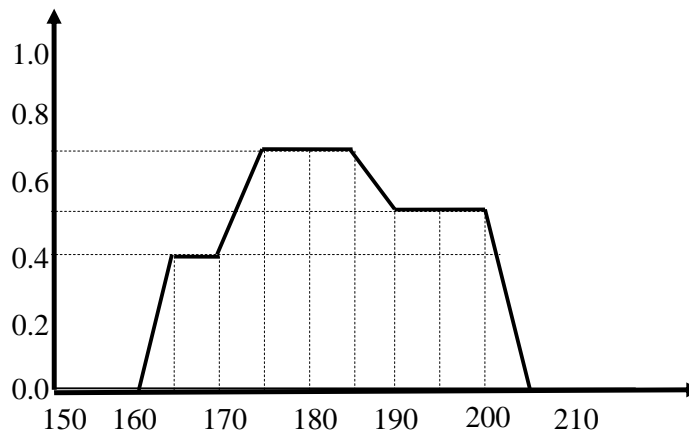(10 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer TWO (2) questions only.

Please use the answer booklet provided.

Question 3

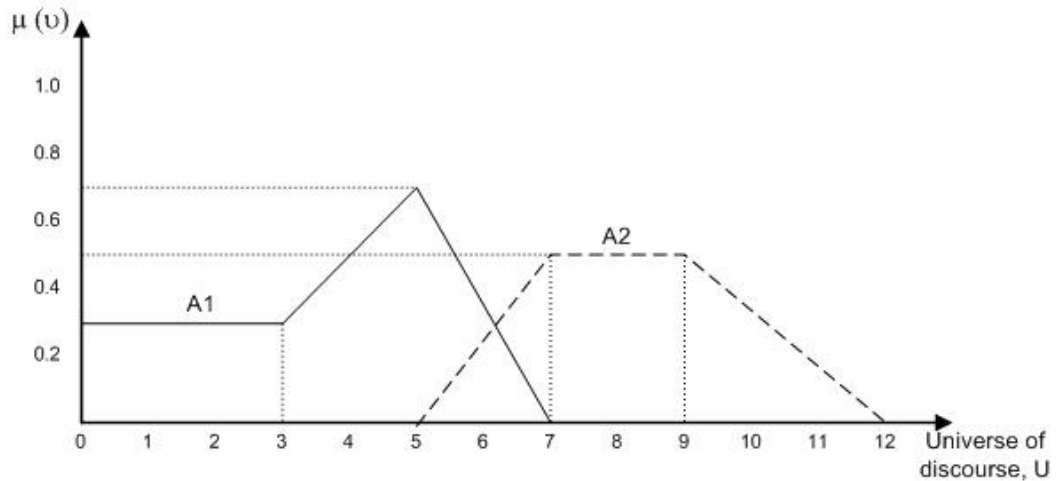(a)   Calculate the centre of gravity (COG) for the following output membership functions in Figure 2.

Degree of membership

Figure 2: Graph of membership function

(5 marks)

(b)   Write down the mathematical expression μ(u) of the membership function A1 and A2 in Figure 3. Show all detail calculations.

Figure 3: Graph of membership function

(15 marks)

(c)   The two graphs in Figure 4 represent the membership functions for **strong_wind** and **high_altitude**.
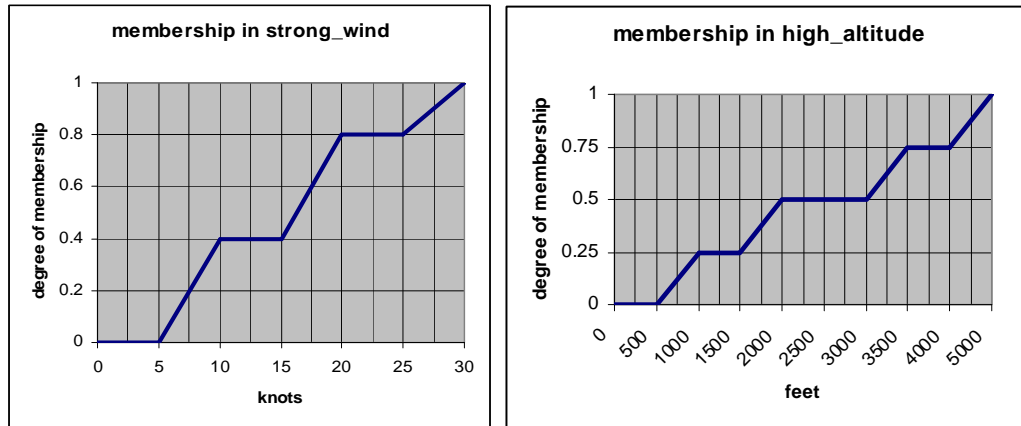

Figure 4: Membership functions for strong_wind and high_attitude

Given the rule as follow:

IF wind is very very strong_wind OR NOT altitude is less high_altitude THEN condition is bad_turbulence

If the altitude is now 4000 feet and the wind is 12 knots, determine the membership degree value of the current conditions in **bad_turbulence**? Show all your works.

Note: Use Concentration CON(F) equal to square of F to express the hedged value of VERY, LESS using the power of 0.5 and complement for NOT.

(10 marks)

Question 4

(a)   List the five (5) members of the expert system development team.

(5 marks)

(b)   State the three (3) differences between conventional systems and expert systems.

(6 marks)

(c)   State the three (3) methods used for conflict resolution.

(3 marks)

(d)   Figure 5 shows an Expert System flow chart. The rules are defined as in Table 1:
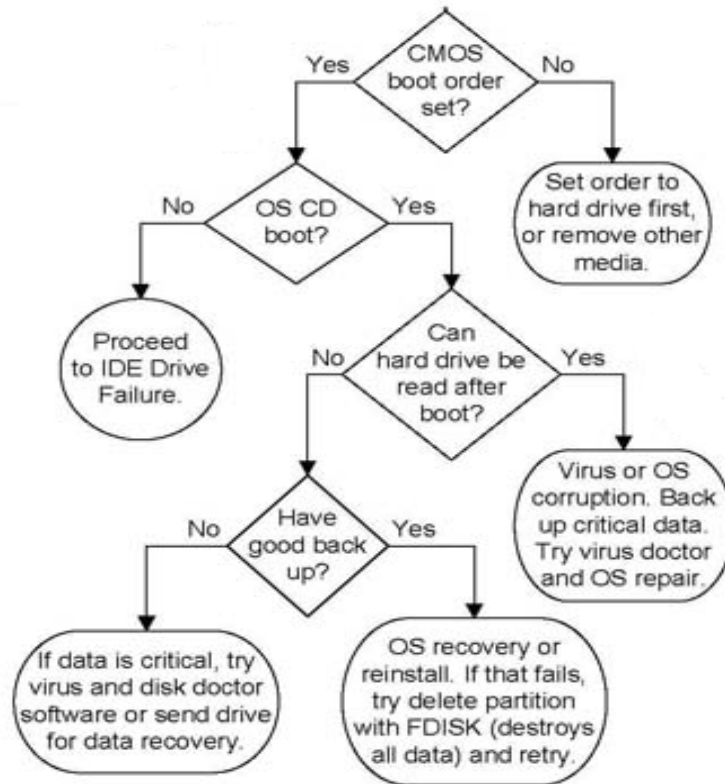
Figure 5: Hard Drive Boot and Performance Flow Chart

Table 1: Defrule's name

Defrule's name
cmos-boot-yes
cmos-boot-no
os-cd-boot-yes
os-cd-boot-no
hard-drive-yes
hard-drive-no
good-backup-yes
good-backup-no

By using the information given in Figure 5 and Table 1, complete the source codes given in Figure 6 in order to develop a complete Hard Drive Boot & Performance Expert System.

```
(defrule cont
(continue yes)
=> (reset))

(defrule start
(not (starter ?))
=>
(printout t crlf "Please answer with yes or no only!!" crlf)
(printout t "CMOS boot order set?" )
(assert (cmos-boot (read))))

(defrule cmos-boot-no
(cmos-boot no)
=>
(printout t "Set order to hard drive first, or remove  other media" crlf crlf)
(printout t "Do you want to continue diagnose the hard drive
performance? " )
(assert (continue (read))))
```

Figure 6: Program code

(16 marks)

Question 5

A company, Mok Kite Maroh Jual Mahal Sdn. Bhd. was created in 2012. At the end of 2013, the management team plans to launch their first manufactured product from their newly completed manufacturing plant Mok Kite Maroh Jual Mahal Plant in Kerteh. The plant is currently at its final stage to be fully operational and all its systems are being at the final stage of testing. However, the plan engineers are facing problem to optimize the maintenance schedule of some manufacturing units.

All these units are situated in one of the plant's clean room and they realize that it is very crucial for them to produce an adequate maintenance schedule without jeopardizing the operational and the productivity of the plant's clean room.

From the information and data gathered, the team has the following inputs and problem constraints:

- There are only three (3) equal time intervals available in 24 hours for the maintenance purposes. The first interval starts at 8.00 am;
- The maximum loads expected during the three intervals are 90, 100 and 80 Megawatt (MW) respectively;

- Maintenance of any unit starts at the beginning of an interval and finishes at the end of the same or adjacent interval. The maintenance cannot be aborted or finished earlier than scheduled;
- The net reserve of the power system in this clean room must be greater or equal to zero at any interval. Therefore, the optimum situation is that the clean room's power system should have the maximum net reserve at any maintenance period;
- The requirement and data of the units is shown in Table 2;

Table 2: Unit Data and maintenance requirements

Unit Number	Unit Capacity(Mw)	Number of Interval Required for unit maintenance
1	20	2
2	30	2
3	15	1
4	10	1
5	35	1
6	25	1
7	15	1
8	30	1

A senior engineer has been requested by his team's superior to produce the maintenance schedule for these units in this clean room. So, with the instruction given, the engineer has to study, analyze, calculate and estimate the most appropriate maintenance schedule. However, he realizes that the number of solutions in term of possible solution is extremely huge and it is not possible for him to find it within a short time. As part of the team, you have been asked to provide solutions on how to tackle this problem. After team discussion, they decided that to use artificial intelligence technique in particular Genetic Algorithm to solve this problem.

Your task is to propose the best maintenance schedule of this clean room to the senior engineer and the team. Realizing that the search space of all possible solutions is huge, you will have to implement *Genetic Algorithm* (GA) to find the best maintenance schedule. The following questions are very important to your understanding and creativity in order to solve this problem.

(a)   Explain briefly why Genetic Algorithm is the artificial intelligence technique chosen to solve the problem above instead of other technique such as Expert System.

(3 marks)

(b)   Calculate the total output in MW that the units produce when they are all operational simultaneously.

(2 marks)

(c)   Produce a pool of genes for each unit available in this problem.

(3 marks)

(d)   Describe using illustration the structure of a single chromosome.

(2 marks)

(e)   Calculate the power lost for each interval based on your chromosome in (d).

(3 marks)

(f)   From the information in (e), calculate the actual power capacity and its maximum load produced by the units in the clean room for each interval.

(3 marks)

(g)   From the information in (d) and (e), explain briefly the fitness function that you propose. Justify your answer.

(2 marks)

(h)   By using illustrated figures, explain in details how the Genetic Algorithm works for its first two generations.

(12 marks)

END OF QUESTIONS