



Second Semester Examination
2017/2018 Academic Session

May/June 2018

EEM348 – PRINCIPLE OF INTELLIGENT SYSTEMS
(PRINSIP SISTEM PINTAR)

Duration: 3 hours
(Masa: 3 jam)

Please ensure that this examination paper consists of **ELEVEN (11)** pages and **ONE (1)** page of printed appendices material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEBELAS (11)** muka surat dan **SATU (1)** muka surat lampiran yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This question paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry the same marks.

Arahan: Kertas soalan ini mengandungi **EMPAT (4)** soalan. Jawab **SEMUA** soalan. Semua soalan membawa jumlah markah yang sama.]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

1. (a) What kind of mistakes might expert system make and why? Why is it easier to correct mistakes in expert systems than in conventional programs?

Apakah jenis kesilapan yang mungkin sistem pakar buat dan mengapa? Mengapa ia lebih mudah untuk membetulkan kesilapan dalam sistem pakar berbanding dalam program konvensional?

(25 marks/markah)

- (b) Describe the success factors of expert system.

Jelaskan faktor-faktor kejayaan sistem pakar.

(25 marks/markah)

- (c) Below are the production rules system used to identify several animals.

Di bawah adalah sistem hasil aturan yang digunakan untuk mengenalpasti beberapa binatang.

R1 IF the animal has hair
THEN it is a mammal

R2 IF the animal gives milk
THEN it is a mammal

R3 IF the animal has feathers
THEN it is a bird

R4 IF the animal flies
the animal lays eggs
THEN it is a bird

- R5 IF the animal is a mammal
the animal eats meat
THEN it is a carnivore
- R6 IF the animal is a mammal
the animal has pointed teeth
the animal has claws
the animal's eyes point forward
THEN it is a carnivore
- R7 IF the animal is a mammal
the animal has hooves
THEN it is an ungulate
- R8 IF the animal is a mammal
the animal chews cud
THEN it is an ungulate AND
it is even-toed
- R9 IF the animal is a carnivore
the animal has a tawny colour
the animal has dark spots
THEN it is a cheetah
- R10 IF the animal is a carnivore
the animal has a tawny colour
the animal has black stripes
THEN it is a tiger
- R11 IF the animal is an ungulate
the animal has long legs
the animal has a long neck
THEN it is a giraffe

R12 IF the animal is an ungulate
the animal has a white colour
the animal has black stripes
THEN it is a zebra

R13 IF the animal is a bird
the animal does not fly
the animal has long legs
the animal has a long neck
the animal is black and white
THEN it is an ostrich

R14 IF the animal is a bird
the animal does not fly
the animal swims
the animal is black and white
THEN it is a penguin

R15 IF the animal is a bird
the animal is a good flier
THEN it is an albatross

- (i) Given these facts are initially as below. By using forward chaining method, identify the rules fired and which animal is identified.

Diberi fakta permulaan seperti di bawah. Dengan menggunakan kaedah rantaian kehadapan tentukan aturan tertembak dan binatang mana yang akan dikenalpasti

the animal gives milk
the animal chews its cud

the animal has long legs
the animal has a long neck

(25 marks/markah)

- (ii) Given the facts as below. By using backward chaining method, identify the rules fired and which animal is identified.

Diberikan fakta seperti di bawah. Dengan menggunakan kaedah rantaian kebelakang tentukan aturan tertembak dan binatang mana yang dikenalpasti.

the animal has hair
the animal has claws
the animal has pointed teeth
the animal's eyes point forward
the animal has a tawny colour
the animal has dark spots

(25 marks/markah)

2. (a) Explain the statement below

Terangkan pernyataan di bawah

'Fuzzy logic is multi-valued'

'Logik kabur adalah pelbagai-nilai'

Your description must include the continuum, spectrum and range terms.
Penerangan anda mestilah mengandungi terma kontinum, spektra dan julat.

(15 marks/markah)

- (b) Define the meaning of crisp set and fuzzy set based on
Definisikan maksud set rapuh dan set kabur berdasarkan

- (i) mathematical representation
pernyataan matematik

(20 marks/markah)

- (ii) graphical illustration
ilustrasi grafik

(5 marks/markah)

- (iii) Based on your answer in b(ii), illustrate your fuzzy set with 'very very' hedge.

Seterusnya, berdasarkan jawapan anda dalam bahagian b(ii), gambarkan set kabur anda dengan memasukkan kecenderungan 'sangat sangat'.

(5 marks/markah)

- (iv) Based on your answer in b(ii), illustrate your fuzzy set with 'more or less' hedge.

Seterusnya, berdasarkan jawapan anda dalam bahagian b(ii), gambarkan set kabur anda dengan memasukkan kecenderungan 'lebih atau kurang'.

(5 marks/markah)

- (c) An article in Design of Experiment in Engineering and Material Sciences describes an experiment conducted to investigate the formulations of primer paint that can be used on aluminum panels. The two factors studied by the engineer were the impurity of mixture content and temperature. The system used two ranges of impurity of mixture content (unit) and three ranges of temperature (Celsius). The response variable is the strength of paint towards heat (unit).

All related linguistic variables, linguistic values and rules are given as follows:

Satu artikel di dalam Rekabentuk Kajian dalam Sains Bahan dan Kejuruteraan menerangkan satu kajian yang dibuat bagi memeriksa formulasi cat primer yang boleh digunakan ke atas panel aluminium. Dua faktor yang dikaji oleh jurutera ialah ketidaktulenan bagi campuran bahan

dan suhu. Sistem tersebut menggunakan dua selang bagi ketidaktulenan bagi campuran bahan (unit) dan tiga selang bagi suhu (celcius). Pembolehubah tindak balas ialah kekuatan cat terhadap haba (unit).

Kesemua pembolehubah linguistik, nilai linguistik dan hukum diberikan seperti berikut:

$\mu_{mixture\ content}^{small}(x) = 0, \forall x \geq 40;$	$\mu_{mixture\ content}^{small}(x) = 1, x \leq 20;$
$\mu_{mixture\ content}^{huge}(x) = 0, \forall x \leq 35;$	$\mu_{mixture\ content}^{huge}(x) = 1, x \geq 65;$
$\mu_{temperature}^{high}(x) = 0, \forall x \leq 40;$	$\mu_{temperature}^{high}(x) = 1, x \geq 85;$
$\mu_{temperature}^{medium}(x) = 0, \forall x \leq 20 \ \& \ \forall x \geq 65;$	$\mu_{temperature}^{medium}(x) = 1, x = 35;$
$\mu_{temperature}^{low}(x) = 0, \forall x \geq 30;$	$\mu_{temperature}^{low}(x) = 1, x \leq 20;$
$\mu_{strength}^{little}(x) = 0, \forall x \geq 35;$	$\mu_{strength}^{little}(x) = 1, x \leq 10;$
$\mu_{strength}^{fair}(x) = 0, \forall x \leq 20 \ \& \ \forall x \geq 80$	$\mu_{strength}^{fair}(x) = 1, 40 \leq x \leq 65$
$\mu_{strength}^{massive}(x) = 0, \forall x \leq 60$	$\mu_{strength}^{massive}(x) = 1, x \geq 85$

Rule 1: **IF** impurity of mixture content is small
AND temperature is low
THEN strength is little

Rule 2: **IF** impurity of mixture content is huge
AND temperature is medium
THEN strength is fair

Rule 3: **IF** impurity of mixture content is huge
OR temperature is high
THEN strength is massive

Hukum 1: **JIKA** ketidaktulenan adalah kecil
DAN suhu adalah rendah
MAKA kekuatan adalah sedikit

Hukum 2: **JIKA** ketidaktulenan adalah tinggi
DAN suhu adalah sederhana
MAKA kekuatan adalah biasa

Hukum 3: **JIKA** ketidaktulenan adalah tinggi
DAN suhu adalah tinggi
MAKA kekuatan adalah banyak

Let say, the impurity of mixture content is 81 (unit) and temperature is 27 (Celsius). Calculate the strength of paint (unit) using graph paper with;

Katakan, ketidaktulenan campuran bahan adalah 81 (unit) dan suhu adalah 27 (Celsius). Kirakan kekuatan cat terhadap haba (unit) dengan menggunakan kertas graf dengan;

- (i) Mamdani method
kaedah Mamdani
- (ii) Trapezoidal/triangular membership function
fungsi keahlian Trapezoidal/triangular
- (iii) Min and max methods for AND and OR operations
kaedah Min and max untuk operasi AND and OR
- (iv) Maximum method for aggregation
kaedah Maximum percantuman
- (v) Centroid for defuzzification.
kaedah Centroid untuk nyah-kabur.

(50 marks/markah)

3. Answer the following questions about Evolutionary Computation (EC):
Jawab soalan-soalan berikut berkenaan Penghitungan Berevolusi (EC):

- (a) Briefly explain the basic philosophy of Genetic Algorithm (GA). Your explanation should begin with the concept of Darwin's Theory of Evolution, the processes of surviving the prominent chromosomes until the process of obtaining the most optimum results.

Terangkan secara ringkas falsafah asas Algoritma Genetik (GA). Penerangan anda haruslah bermula dengan konsep Teori Evolusi Darwin, proses-proses dalam mengekalkan kromosom yang menonjol sehingga ke proses dalam mendapatkan keputusan yang paling optimum.

(30 marks/markah)

- (b) From the philosophy given in (a), list out all steps involved in GA.

Daripada falsafah diberikan dalam (a), senaraikan kesemua langkah-langkah yang terlibat dalam GA.

(10 marks/markah)

- (c) Assuming that we want to solve an equality $a + 2b + 3c + 4d = 30$ for $a, b, c,$ and d using GA. Given that the fitness function is $f(x)$, where the objective is to minimize the function $f(x) = ((a + 2b + 3c + 4d) - 30)$, and all $a, b, c,$ and d are integers ranging between 0 to 30. Design the solution and explain each step using steps given in (b).

Dengan mengandaikan bahawa kita hendak menyelesaikan satu kesamaan $a + 2b + 3c + 4d = 30$ untuk $a, b, c,$ dan d menggunakan GA. Diberikan bahawa fungsi kecergasan adalah $f(x)$, di mana tujuannya adalah untuk meminima fungsi $f(x) = ((a + 2b + 3c + 4d) - 30)$, dan kesemua $a, b, c,$ dan d adalah integer antara 0 dan 30. Rekabentuk penyelesaian dan terangkan setiap langkah menggunakan langkah-langkah yang diberikan di (b).

(60 marks/markah)

4. Answer the following questions about Artificial Neural Network (ANN):

Jawab soalan-soalan berikut berkenaan Rangkaian Pembuatan Neural (ANN):

- (a) What is the major difference between Artificial Neural Network (ANN) and Convolutional Neural Network (CNN)? Why CNN is said to be one of Deep Learning techniques whereas ANN is not. Explain your answer.

Apakah perbezaan ketara di antara Rangkaian Pembuatan Neural dan Perlingkaran Rangkaian Neural? Kenapa CNN dikatakan sebagai satu kaedah di dalam Pembelajaran Mendalam sedangkan ANN tidak? Terang jawapan anda.

(20 marks/markah)

- (b) Supervised learning, unsupervised learning and reinforcement learning are three different types of machine learning algorithms. Explain and give an example application for each one of these.

Pembelajaran Terselia, Pembelajaran Tidak Terselia dan Pembelajaran Peneguhan adalah tiga jenis algoritma pembelajaran mesin. Terangkan dan berikan contoh aplikasi bagi setiap satu daripada algoritma ini.

(30 marks/markah)

- (c) Consider the network given in Figure 4.1 This network is initialized with the weights as indicated. We wish to train this network through two iterations using the backpropagation learning algorithm on the two patterns given in Table 4.1 . Throughout, we assume a sigmoidal transfer function with $\lambda = 1$, a learning rate $\eta = 1.2$, a momentum $\alpha = 0.8$, k is the iteration/pattern index, m is the input layer, n is the output layer, x is the input, and y is the output.

Pertimbangkan rangkaian yang diberikan pada Rajah 4.1. Pemberat mula adalah seperti yang dinyatakan. Kita berkeinginan untuk melatih rangkaian ini melalui dua ulangan menggunakan kaedah pembelajaran perambatan-balik ke atas dua corak yang diberikan dalam Jadual 4.1 di. Sepanjang proses ini, kita mengambil kira satu fungsi pindah sigmoid dengan $\lambda = 1$, kadar pembelajaran $\eta = 1.2$, momentum $\alpha = 0.8$, k adalah bilangan lelaran/indeks corak, m adalah lapisan masukan, n adalah lapisan keluaran, x adalah masukan, dan y adalah keluaran.

Table 4.1: Patterns for backpropagation training neural network

Jadual 4.1: Corak-corak untuk pembelajaran perambatan-balik rangkaian neural

Pattern index	x_1^k	x_2^k	y_1^k	y_2^k
1	-0.5	0.5	0.1	0.9
2	0.5	-0.5	0.9	0.1

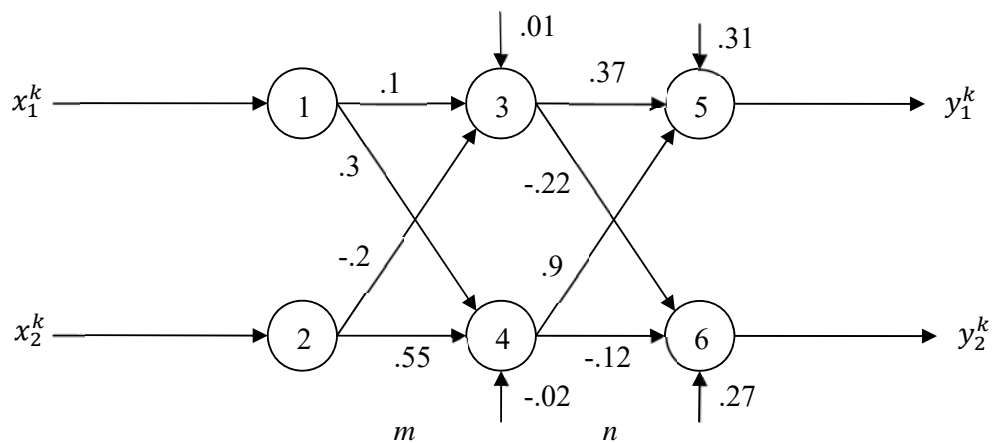


Figure 4.1: The initial architecture of the network

Rajah 4.1: Binaan awal rangkaian

(50 marks/markah)

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APPENDIX ALAMPIRAN A

Course Outcomes (CO) – Programme Outcomes (PO) Mapping
Pemetaan Hasil Pembelajaran Kursus – Hasil Program

Questions Soalan	CO	PO
1	CO1	PO1
2	CO2	PO2
3	CO3	PO2
4	CO4	PO2
5	-	-
6	-	-