UNIVERSITY OF JOHANNESBURG

FACULTY OF MANAGEMENT
NOVEMBER 2014 EXAMINATION

DEPARTMENT OF APPLIED INFORMATION SYSTEMS

MODULE : **ARTIFICIAL INTELLIGENCE**

CODE : AKI41-1

DATE : NOVEMBER 2014 EXAMINATION

DURATION : 3 HOURS

TIME :

TOTAL MARKS : 100

EXAMINER : BARNABAS.N. GATSHENI, PhD

(EXTERNAL) MODERATOR: ZENZO NCUBE, PhD

NUMBER OF PAGES : 4 PAGES

INSTRUCTIONS TO CANDIDATES:

- Question papers must be handed in.
- This is a closed book assessment.
- Read the questions carefully and answer only what is asked.
- Number your answers clearly.
- Write neatly and legibly
- Structure your answers by using appropriate headings and sub-headings.
- The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

Please answer 4 questions.

QUESTION 1 / VRAAG 1

i) Give the procedure for implementing the distance weighted nearest neighbour algorithm and then state one advantage and one disadvantage of this method. (4)

ii) You are given that there is poor public transport system and that there is high private car use which results in accidents and also in traffic jams.

a) Draw a Bayesian network for this problem. (3)

b) Write a joint probability distribution for the Bayesian network in (a). (1)

Table 1:

Examples	B1	B2	B3	Classification
1	T	T	F	Yes
2	T	F	T	Yes
3	F	T	T	Yes
4	F	F	T	No

iii) Use the candidate elimination method to compute a version space using data in Table 1. (8)

iv) You are given a set of training examples Table2 of the target concept Buy Stock. Each day is described by the attributes: *Rain fall and Rand* . Use the Naïve Bayes Classifier and these training examples to predict the target value (yes or no) of the target concept Buy stock for the new instance:
$\langle$ *Rain fall = high, Rand = strong*$\rangle$.

Table2.

Day	Rainfall	Rand	Buy Stock
D1	High	Weak	No
D2	High	Strong	No
D3	High	Weak	No
D4	High	Weak	Yes
D5	Normal	Weak	Yes
D6	Normal	Strong	No
D7	Normal	Strong	Yes
D8	High	Weak	No
D9	Normal	Weak	Yes

The formula for the naïve Bayes is: $v_{NB} = \frac{\arg\max}{v_j \in V} P(v_j) \prod_i P(a_i \mid v_j)$

Where $(a_1, a_2 ..... a_n)$ are attribute values, where v is a class within class space V. (9)

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QUESTION 2 / VRAAG 2

i) In a bid to get the best model for a given task, state 4 different ways that can be used to create models in artificial intelligence: (4)

ii) With the help of a diagram, explain the concept of k nearest neighbor method. (5)

iii) The sequence of target values is "TF". Write a string that represents this hypothesis. You have been given the hypothesis consisting of 2 rules.

IF $fees = T \wedge passes = F$ THEN $unemployed = T$; IF $passes = T$ THEN $unemployed = F$ (5)

iv) Calculate the entropy of sample S in Table 3. (3)
The entropy is given by $Entropy(S) \equiv -p_{\oplus} \log_2 p_{\oplus} - p_{(-)} \log_2 p_{(-)}$

Information gain is given by: $Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{S_v}{S} Entropy(S_v)$

Where A is the attribute.

v) In Table 3 which attribute must be the root for the decision tree? (8)

Table 3: This is training data for predicting days for playing tennis

Day	Temperature	Humidity	Wind	PlayTennis
D1	Hot	High	Weak	Yes
D2	Hot	High	Weak	No
D3	Cool	Normal	Weak	Yes
D4	Cool	Normal	Strong	Yes
D5	Cool	Normal	Strong	No

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QUESTION 3 / VRAAG 3

i. Describe fully the process followed in classifying an instance using case-based reasoning. (6)

ii. Use a well labelled graph to show how support vector machines (SVM) can separate two nonlinearly separable classes of data. (5)

iii. Compare N-fold cross-validation (CV) with bootstrap validation. (4)

iv. State 2 roles played by the fitness function in genetic algorithms? (2)

ii) The tree in Figure 1 and tree in Figure 2 are parent programs.

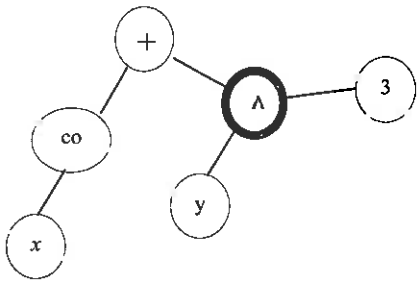

Figure 1

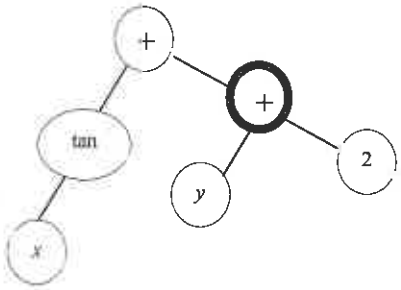

Figure 2

a) Write the functions for Figure 1 and Figure 2. (2)
b) Perform crossover between the given two tree programs? (4)
c) Write the functions for the 2 new tree programs? (2)

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QUESTION 4 / VRAAG 4

i) Compare generalization with rot learning in artificial intelligence? (2)
ii) Explain in detail the reason why the operational data collected from a company can be a valuable asset. (4)
iii) We want the training data to satisfy these SVM constraints:
$w.x_1 + w_0 \geq +1$ for $t_i = +1$
$w.x_2 + w_0 \leq -1$ for $t_i = -1$
iv) Show that the margin in support vector machines is given by $\frac{2}{\| w \|}$ (6)

Given that equations (a) and (b) describe distance weighted nearest neighbour algorithm, put in your own words how this classification works.

$$\hat{f}(x_q) \leftarrow \frac{\arg\max}{v \in V} \sum_{i=1}^{k} w_i \delta(v, f(x_i)) \quad \text{(a)}$$

where v is a discrete target function, V is fine set discrete valued target functions

$$w_i \equiv \frac{1}{d(x_q, x_i)^2} \quad \text{(b)} \quad (4)$$

v) We wish to maximize $f(x) = 2x + 2y$ subject to the constraint $x^2 + y^2 = 1$.

Use the Lagrange multipliers λ_i to find the global minima? (9)

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