

Subject: Pattern Recognition

Subject Code: 21CST829

Time: 10:00 - 12:30 Hrs

Full Marks: 30

Figures at the right margin indicate marks. All parts of a question must be answered in sequence.

1. Answer the following questions [4×2]

- A person has built a k -NN classifier that yields 100% accuracy on training data. When he/she deploys his/her model on the client-side, it is found that the model is not accurate. Which thing might go wrong? Note that the model has successfully deployed, and no technical issues are found at the client-side except the model performance
- Write the shape of the cluster for each of the following condition in a multivariate Gaussian case (2D data points): (i) a diagonal Σ with $\sigma_1^2 = \sigma_2^2$ and (ii) a diagonal Σ with $\sigma_1^2 \ll \sigma_2^2$.
- Write the discriminant function for the two category case. How many discriminant functions do you need to find out the decision boundaries for a c -class classification task in a three-dimensional feature space?
- You are given the following data points from two different classes.
Class 1 points: (2,3),(3,2),(4,2),(3,5),(5,4),(4,7)
Class 2 points: (5,2),(5,5),(5,7),(6,4),(7,9),(10,6)
What will be the nature of decision boundary between these two classes? Justify your answer.

2. Answer the following questions [2×3.5]

- Consider a given two-class classification task on a two-dimensional space, where data in both the classes are distributed according to Gaussian distribution with $\mu_1 = [0.5, 1.25]$, $\mu_2 = [3.25, 3.5]$, and

$$P(x|w_1) = P(x|w_2) \quad P(w_1) \\ P(w_2)$$

$$\Sigma_1 = \Sigma_2 = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$$

$$c = \frac{\sum}{T}$$

Assuming $p(w_1) = p(w_2) = \frac{1}{2}$, classify the data point $x = [2.25, 2.75]$ into class w_1 or w_2 .

- Suppose you have collected the following data points from two different classes.

Class 1 points: (1,6),(2,7),(3,3),(4,10),(5,9),(11,2)

Class 2 points: (6,3),(7,4),(9,2),(8,3),(10,4),(9,5)

Classify two new samples (3,11) and (10,3) using k -nearest neighbor algorithm with $k = 3$.

3. Answer the following questions [3×5]

- What is meant by discriminant function? Derive the discriminant functions for minimum-error-rate classification for following two cases: (i) $\Sigma = \sigma^2 I$ and (ii) $\Sigma_i = \text{arbitrary}$.

- Consider a two-class, 2-D classification task, where the feature vectors in each of the classes w_1 , w_2 are distributed according to

$$p(x|w_1) = \frac{1}{(\sqrt{2\pi\sigma_1^2})^2} \exp\left(-\frac{1}{2\sigma_1^2}(x - \mu_1)^T(x - \mu_1)\right), \quad p(x|w_2) = \frac{1}{(\sqrt{2\pi\sigma_2^2})^2} \exp\left(-\frac{1}{2\sigma_2^2}(x - \mu_2)^T(x - \mu_2)\right)$$

with $\mu_1 = [1, 1]^T$, $\mu_2 = [1.5, 1.5]^T$, $\sigma_1^2 = \sigma_2^2 = 0.2$. Assuming all classes to be equiprobable, design

a Bayesian classifier that minimizes the average risk with loss matrix $L = \begin{bmatrix} 0 & 1 \\ 0.5 & 0 \end{bmatrix}$.

- (c) Consider a three-class classification task in the 3-dimensional space, where the classes are modelled by Gaussian distributions with means $\mu_1 = [0, 0, 0]$, $\mu_2 = [1, 2, 2]$, and $\mu_3 = [3, 3, 4]$

$$\Sigma_1 = \Sigma_2 = \Sigma_3 = \begin{bmatrix} 0.8 & 0.2 & 0.1 \\ 0.2 & 0.8 & 0.2 \\ 0.1 & 0.2 & 0.8 \end{bmatrix}$$

Classify the feature vector $x = [0.1, 0.5, 0.1]$ using minimum distance classifier and Bayes classifier for the following cases and comment on the results.

~~case 1:~~ $p(w_1) = p(w_2) = p(w_3)$

~~case 2:~~ $p(w_1) = 0.25$, $p(w_2) = 0.5$ and $p(w_3) = 0.25$

$$\frac{p(w_1)}{p(w_2)} = \frac{(x - \mu_1)^T \Sigma^{-1} (x - \mu_1)}{(x - \mu_2)^T \Sigma^{-1} (x - \mu_2)} = \frac{(x - \mu_1)^T \Sigma^{-1} (x - \mu_1)}{(x - \mu_2)^T \Sigma^{-1} (x - \mu_2)}$$

***** All the Best *****



Computer Science and Engineering Department, MNIT, Jaipur
End Term Examinations, May 2022

Subject: Pattern Recognition
Dated: 23 May, 2022

Time: 14:30 - 17:00 Hrs

Subject Code: 21CST829
Full Marks: 50

Answer ALL questions.

Figures at the right margin indicate marks. All parts of a question must be answered in sequence.

1. (a) What are texture features? Write two methods using which you can extract texture information from a given image. [2]
- (b) Suppose you are given a set of training images of three different classes and your task is to extract important features from each image using gray level co-occurrence matrix (GLCM). What will be size of the GLCM? What type of features you would derive from these images? Also, discuss the procedure to be followed for feature extraction. Assume there are 256 gray levels in each image. [4]
- (c) For a 2-class one-dimensional problem, the prior probabilities are $P(\omega_1) = 1/4$ and $P(\omega_2) = 3/4$. The class conditional distributions are $p(x|\omega_1) = \mathcal{N}(0, 1)$ and $p(x|\omega_2) = \mathcal{N}(1, 1)$. Calculate the threshold boundary value x_t which gives the probability of minimum error. [4]
2. (a) Write the advantages of hierarchical clustering over k -means clustering. Also, write different cluster distance measures used in hierarchical clustering. [2]
- (b) Is there any possibility that k -means clustering algorithm trap at local optimum? If your answer is yes, then how do you avoid such issues? [2]
- (c) Use k -means algorithm and Euclidean distance to cluster the following examples into three clusters: $x_1 = (2, 10)$, $x_2 = (2, 5)$, $x_3 = (8, 4)$, $x_4 = (5, 8)$, $x_5 = (7, 5)$, $x_6 = (6, 4)$, $x_7 = (1, 2)$, $x_8 = (4, 9)$. Suppose the centers of each cluster are x_1 , x_4 , and x_7 . Run the algorithm for one epoch only and at the end show: (i) the new clusters (i.e., examples of each cluster) and (ii) the centers of new clusters. [6]
3. (a) What is small sample size (SSS) problem? How do you overcome this problem? [2]
- (b) What is mean-square error (MSE) based criterion function? Discuss one procedure to optimize the criterion function. [3]
- (c) Given the following set of 2D data points:
Class 1 points: (10,10), (0,-10), (5,-2)
Class 2 points: (5,10), (0,5), (5,5)
Design an optimal hyperplane using perceptron batch algorithm. Assume necessary data required.

4. (a) The following expression,

$$J_1 = \frac{1}{n_1 n_2} \sum_{y_i \in Y_1} \sum_{y_j \in Y_2} (y_i - y_j)^2$$

clearly measures the total within-group scatter. Show that this within-group scatter is [5]

$$J_1 = \frac{1}{n_1} S_1^2 + \frac{1}{n_2} S_2^2 + (m_1 - m_2)^2$$

where, n_1 and n_2 denote the number of samples belong to Class 1 and Class 2, respectively.

- (b) Given the following 2D data set

Class 1 points: (1,4), (3,2), (1,3)

[5]

Class 2 points: (-3,1), (2,-2)

Obtain its lower dimensional representation (1D) using principal component analysis (PCA).
Analyze the step-wise results.

5. (a) Suppose you are asked to solve a c -class classification problem using both SVM and feed-forward neural network (FNN). How many SVM and FNN models do you require to accomplish the task? Justify your answer.

- (b) Given the following two-dimensional data points

$$\{(1, 1), (1, 0), (-1, 0), (-1, -1)\} \in C_1 \text{ (-ve class)}$$
$$\{(4, 7), (7, 4), (4, 2), (2, 4)\} \in C_2 \text{ (+ve class)}$$

Design an optimized hyperplane using SVM.

[7]

***** All the Best *****

POSSESSION OF MOBILE IN EXAMS IN UFM PRACTICE

Name _____

Enrollment No. _____

Malaviya National Institute of Technology Jaipur

End Term Examination, 2022

M. Tech. I Year (II Semester)/ Ph.D.

Course Title: Nature Inspired Algorithms

Maximum Time: 2:30 Hour

Course Code: CIL733

Maximum Marks: 50

Ques. 1 [6 Marks] Minimize the following function using particle swarm optimization.

$$f(x) = (x_1 + x_2)^2 \quad -5 \leq x_1, x_2 \leq 5$$

Consider the following parameters for the algorithm

Population size=4

Number of iterations= 03

Number of dimensions D= 2

Ques. 2 [5 Marks] How exploration and exploitation is controlled in grey wolf optimization algorithm? Justify your answer with examples and diagram. Also mention the parameters which controls the exploration and exploitation.

Ques. 3 [10 Marks] Consider the database instance of an Iris plant with 4 attributes: sepal length, sepal width, and petal length and petal width. There are two classes of the plant based on the attribute values which are depicted in table below. Assume the domain of each attribute is same (0-10 cm).

Apply basic PSO algorithm on the given data set instance to cluster it into given classes.

Take the population size= 5

Number of dimensions =4

sepal length (cm)	sepal width (cm)	petal length(cm)	petal width(cm)	Class
5.1	3.5	1.4	0.2	Iris-setosa
4.9	3.0	1.4	0.2	Iris-setosa
4.4	2.9	1.4	0.2	Iris-setosa
7.0	3.2	4.7	1.4	Iris-versicolor
6.6	3.0	4.4	1.4	Iris-versicolor
5.6	3.0	4.1	1.3	Iris-versicolor

Number of Iterations = 3

Ques. 4 [5 Marks] Consider the following population to Minimize Bukin fucntion $f(x) = 100(x_2 - 0.01x_1^2 + 1) + 0.01(x_1 + 10)^2$

$$\text{Population } P = \begin{pmatrix} 1 & 2 \\ 0 & 3 \\ -1 & 4 \end{pmatrix} \quad \text{where each element } -1 \leq x_i^j \leq 4$$

Write the python code to minimize the above problem using grey wolf optimization.

PTO

Ques. 5 [7+7 +4= 18 Marks] Consider the data sample of product reviews as given below. Each product is uniquely identified with its product Id. The dataset contains 5 million entries with size 8 GB. Answer the following queries.

product/productId: B000JVER7W
review/text: Great product tried others and this is a ten compared to them. Real easy to use and sync's easily. Definite recommended buy to transfer data to and from your Cell.

- I. Write an efficient parallel program to extract the features from the "review/text" section of the data as given in Table 1. Assume the dictionaries including positive, negative, neutral, noun, and adjectives as required.
- II. Write a parallel program to cluster the data in two groups namely positive and negative using particle swarm optimization.
- III. Find the number of Mappers and Reducers which will be executed if the program is run on a cluster of 6 nodes, considering the size of input split as 64MB.

Table 1: Feature Sample

Review	Count of positive words	Count of negative words	Count of Adjectives	Count of Nouns	Count of neutral word.
R1
R2
R3
....

Ques. 6 [3 + 3 = 6 Marks] There is a factory located at each of the two places P and Q. From these locations, a certain commodity is delivered to each of the three depots situated at A, B and C. The daily requirements of the each depot is a, b and c units of the commodity, respectively while the production capacity of the factories at P and Q are p and q units, respectively. Further, the cost of transportation from any factory to any depot is given below:

	A	B	C
P	c_{pa}	c_{pb}	c_{pc}
Q	c_{qa}	c_{qb}	c_{qc}

- I. Formulate the above problem as an optimization problem.
- II. It is proposed to solve the above optimization problem using GA. Decide the genotype for the chromosome structure to do this.

Max. Marks: 50

Attempt all questions.

Time: 150 Minutes

1. (a) Consider the following grammar and generate the CKY parsing table for the sentence "I eat sushi with chopsticks with you" : [3]

$S \rightarrow NP VP$	$VP \rightarrow Verb\ NP$	$NP \rightarrow you$
$NP \rightarrow NP PP$	$VP \rightarrow VP PP$	$PP \rightarrow Prep\ NP$
$NP \rightarrow sushi$	$NP \rightarrow chopsticks$	$Verb \rightarrow eat$
$NP \rightarrow I$	$Prep \rightarrow with$	

- (b) Convert the following grammar in Chomsky Normal Form (CNF): [6]

$$S \rightarrow ASB \quad A \rightarrow aASa \mid a \mid \epsilon \quad B \rightarrow SbS \mid A \mid bb$$

2. (a) Consider the following senses of the words:

Word: ash

Sense 1 Tree of the olive family with pinnate leaves, thin furrowed bark and gray branches.

Sense 2 The solid residue left when combustible material is thoroughly burned or oxidized.

Sense 3 To convert into ash

Word: coal

Sense 1 A piece of glowing carbon or burnt wood.

Sense 2 charcoal.

Sense 3 A black solid combustible substance formed by the partial decomposition of the vegetable matter without free access to air and under the influence of moisture and often increased pressure and temperature that is widely used as a fuel for burning

Which one is the winner sense using Lesk's algorithm of "ash" for the sentence "On burning coal we get ash". [4]

- (b) What are the various things that need to be extracted from the question while Question Processing in Question-Answering systems. Explain with suitable examples. [4]

3. (a) Consider the following table of test results of seven questions which gives ranked answers as output. Compute the accuracy of the system using Mean Reciprocal Rank method. [2]

Question Number	1	2	3	4	5	6	7
Correct Answer Number	4	3	6	2	8	1	2

- (b) Compute the ROUGE-2 score for the following text: [2]

Human Summary: Water spinach is a commonly eaten leaf vegetable of Asia.

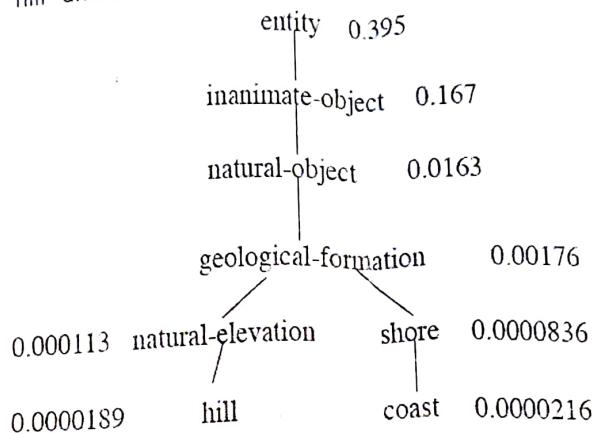
System Summary: Water spinach is a leaf vegetable commonly eaten in tropical areas of Asia.

4. Consider the following sentences (1,2,3,4) as set of reference sentences from document collection and sentence number 5 as a query sentence. Consider value of lambda (λ) 0.4 . Use cosine similarity to compute similarity between sentences. Find the maximal set of sentences to be selected in set of summary sentences (find only 3 sentences in final summary set) using maximal marginal relevance. [5]
- Doc 1/sentence 1 new home sales top forecasts
 Doc 2/sentence 2 home sales rise in july
 Doc 3/sentence 3 increase in home sales in july
 Doc 4/sentence 4 july new home sales rise
 Doc 5/sentence 5 sales home is very bad

5. (a) Consider the training data given below for machine translation from English to French. Assume uniform initial translation probabilities. Compute translation probabilities and normalized alignment probabilities after one iteration. [5]

	1		2		3	
English	play	cricket	the	cricket	cricket	team
French	jouer	croquet	la	grillon	croquet	equipe

- (b) Consider following sub tree with probabilities. Compute sim_{path} , $\text{sim}_{\text{Resnik}}$ and sim_{Lin} between "hill" and "shore". [3]



6. Consider the following Tagged sentences:

Rahul	can	play	chess
N	M	V	N

Karan	should	clean	table
N	M	V	N

will	Shyam	play	chess
M	N	V	N

Karan	should	beat	Rahul
N	M	V	N

Use Hidden Markov Model (HMM) to predict the probability of tagging the sentence "Rahul should beat Karan" with tag sequence "N M V N". [5]

7. Suggest a novel methodology that can handle co-references in English Text and evaluate it also. Explain it properly using a suitable example. [5]
8. Design and evaluate a novel recognition system capable of recognizing temporal expressions of the kind appearing in emails or conversations. Sample text is given below: [6]
 "I am free next week. Let's meet on Saturday." "Are you free on Tuesday?"

Department of Computer Science & Engineering, MNIT, Jaipur
Natural Language Processing 21CST822 MTE, April 2022

Max. Marks: 30

Time: 90 Minutes

Attempt all questions.

1. Write regular expressions for the following languages:
 - a. Find the regular expression for all string containing no more than three a's over input alphabets $\Sigma = \{a, b, c\}$ [1]
 - b. The set of all strings from the alphabet p, q such that each p is immediately preceded by and immediately followed by a q [1]
 - c. All strings that start at the beginning of the line with an integer and that end at the end of the line with a word [1]
2. Find the first splitting node, (using ID3) for the dataset given in following table. [4]

Sr. No.	District	House Type	Income	Previous Customer	Class
1	Suburban	Detached	High	No	Nothing
2	Suburban	Detached	High	Yes	Nothing
3	Rural	Detached	High	No	Responded
4	Urban	Semi-detached	High	No	Responded
5	Urban	Semi-detached	Low	No	Responded
6	Urban	Semi-detached	Low	Yes	Nothing
7	Rural	Semi-detached	Low	Yes	Responded
8	Suburban	Terrace	High	No	Nothing
9	Suburban	Semi-detached	Low	No	Responded
10	Urban	Terrace	Low	No	Responded
11	Suburban	Terrace	Low	Yes	Responded
12	Rural	Terrace	High	Yes	Responded
13	Rural	Detached	Low	No	Responded
14	Urban	Terrace	High	Yes	Responded

3. We are given the following corpus:

<s> You are Rio </s>
<s> Rio You are </s>
<s> You are Rio </s>
<s> You like yellow orange Rio </s>

Using a bigram model with add-one smoothing, what is $P(\text{Rio}|\text{are})$ and $P(<\text{s}> \text{ You like yellow Rio} </\text{s}>)$? Include <s> and </s> in your counts just like any other token. [4]

4. Compute minimum edit distance in between "william cohen" and "william cohon". (consider all operations costs as same i.e. 1 for each operation) [show complete table][3]

5. Using linear regression method compute salary in \$ 1000s of a person with 17 years of experience. [3]

Exp.	3	8	9	13	3	6	11	21	1	16
Sal.	20	40	50	60	20	30	40	80	10	70

6. Computer the class of test document using Naïve Bays Classifier. [3]

Training	Doc	Words	Class
	1	Rio sport great India Proud	P
	2	India sport bad player	P
	3	Sam injustice poverty India	N
	4	Rio games feel good sport	P
Test	5	India injustice Sam Rio	?

7. Computer the cross entropy loss for both classes for the following observation: [3]

$$X=[4, 1, 0, 2, 3.12, 4.2]$$

$$W=[3.5, -6, -1.2, 0.4, 3.5, 0.3]$$

$$b=0.15$$

8. Use gradient descent learning used in logistic regression to updates the weights and bias after one iteration for the sample $x_1=4$ (count of positive lexicon) $x_2=3$ (count of negative lexicon), initial values of $w_1=1.2$ $w_2=-3.1$, $b=1.5$ and iearning rate is 0.1 . [3]

9. Consider the data of terms with their context counts given below. Computer final PPMI matrix for these rows. [4]

Term(rows)/Context(Columns)		Automobile	Computer	Money	Household	Politics	
1	Car	2	0	1	0	3	6
2	Auto	3	1	0	0	1	5
3	Insurance	1	0	4	3	0	8
4	Window	1	2	1	2	1	7
5	Computer	0	2	1	0	0	3
6	Technology	1	3	1	1	1	7

8 8 8 6 6 36.

Malaviya National Institute of Technology Jaipur
Department of Computer Science and Engineering
M.Tech II sem Mid Term Exam 2021-22
CST735 – Information Retrieval & Data Mining

Marks: 40

Time: 1:30 hrs

Q1. Explain Boolean Model. Also rank the following documents for query q: “Delhi AND Mumbai OR (NOT inflow)” and following documents using basic Boolean model:

D1: “Delhi is the capital of India”

D2: “Mumbai is the commercial capital of India”

D3: “Delhi is the large city while Mumbai is having million dollar inflow and outflow” [2+2]

Q2. A document space is defined by five terms: “machine learning”, “deep learning”, “hyperparameter”, “overfitting”, “dataset”. A set of 3 documents are defined as:

D1: (“deep learning”, “hyperparameter”, “dataset”)

D2: (“machine learning”, “overfitting”, “dataset”)

D3: (“machine learning”, “deep learning”, “overfitting”, “dataset”)

Query is “dataset overfitting”. Rank the document using vector space model (use tf-idf for weights). [3+2]

Q3. What is extended Boolean model? Explain with example of ranking for Query: “gold AND silver OR truck” and documents are:

D1: “shipment of gold damaged in a fire”

D2: “delivery of silver arrived in a silver truck”

D3: “shipment of gold arrived in a truck”

[2+3]

Q4. The following R's & N's represent relevant (R) and non-relevant (N) returned documents in a ranked list of 20 documents retrieved in response to query from a collection of 10,000 documents. The top of the ranked list (the document the system think is most likely to be relevant) is on the left of the list. The list shows relevant documents. Assume that there are 8 relevant documents in total in the collection.

R R N N N N

N N N R N

R N N N R

N N N N R

- What is the precision of the system on the top 20?
- What is F1 on the top 20?
- What is the interpolated precision at 33% recall?
- Assume that these 20 documents are the complete result set of the system. What is the MAP of the query?

[1+1+2+2]

Q5. Consider an information need for which there are 8 relevant documents in the collection. Contrast two systems (two queries each) run on this collection. Their top 20 results are judged for relevance as follows (the leftmost item is the top ranked search result):

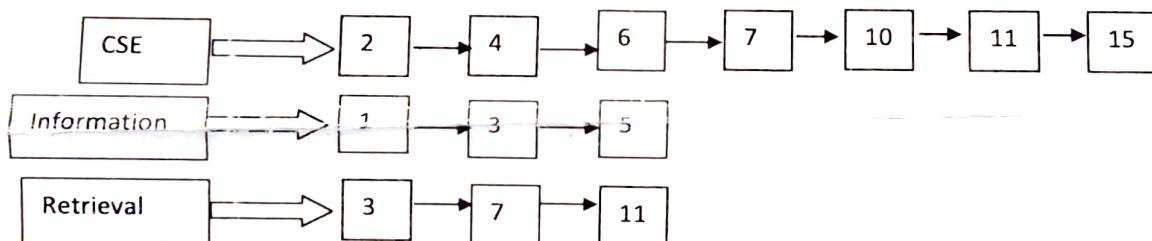
System 1	-	Q1	R N R N N N N N R R N N N R R R R N N N
		Q2	R N R N N N N N R N N N N N R R R R R N
System 2	-	Q1	N N N R R N R N N R R R R N N N R R N N N
		Q2	R N N N R N N R N R R R R N N N R R N N N

Answer the following:

- a. Define and compute F1score of each system.
- b. What is the Average Precision and MAP of each system?
- c. Compute and Draw Graph for Average interpolated precision at 11 standard Recall points for both the system.
- d. Define MRR. Calculate for System1 [2+2+2+1]

Q.6 A) Give an example of uncertainty and vagueness issues in Information retrieval [3]

B) Explain the merge algorithm for the query "Information Retrieval"? What is the best order for query processing for the query "CSE AND Information AND Retrieval"? What Documents will be returned as output from the 15 documents? [3]



7 A .Classify the test document d6 into C1 OR C2 using Naïve Bayes classifier. The documents in the training set and the appropriate class label is given below. [5]

	Docid	Words in document	c= c1	c= c2	
Training Set	d1	Positive	Yes	No	C1
	d2	Very positive	Yes	No	C1
	d3	Positive very positive	Yes	No	C1
	d4	Very negative	No	Yes	C2
	d5	Negative	No	Yes	C2
Test Set	d6	Negative positive very positive	?	?	

A) The search engine ranked results on 0-5 relevance scale: 2, 2, 3, 0, 5. Calculate the NDCG metric for the same. [2]

POSSESSION OF MOBILE IN EXAMS IN UFM PRACTICE

Name Shyamili

Enrollment No. 2021P165133

Malaviya National Institute of Technology Jaipur

Mid Term Examination, 2022

M. Tech. I Year (II Semester)

Course Title: Nature Inspired Algorithms

Maximum Time: 1:30 Hour

Course Code: CIL733

Maximum Marks: 30

Ques. 1 [8 Marks] Minimize the Schumer Stieglitz optimization function using Genetic Algorithm. Assume mutation probability as .01 and crossover point as 2. The function is defined as follows:

$$f(x) = \sum_{i=1}^D x_i^4 \quad \text{for } -100 \leq x_i \leq 100$$

Consider the following parameters for the algorithm

Population size=6

Number of iterations= 04

Number of dimensions D= 6

Ques. 2 [6 Marks] PSO is the basic swarm based technique which consider the local learning and global learning to optimize solutions for any problem. What are the basic modifications suggested by researchers in PSO to improve its performance. What is the effect of constriction (C1, C2, and w1) factor on PSO velocity update equation? Explain by example.

Ques. 3 [5 Marks] Write the screen display for the following script and associated functions

<pre>%Script x = 4 y = 3 z = [2 4 5 3 1]; for i = 1:2:5 if (i <= 2) back1 = fcn1(i,x,y,z) elseif (i > 3) disp('done') else back2 = fcn2(i,y,x,z) end end</pre>	<pre>function [out2]=fcn1(j,y,x,k) out2 = [0 0 0 0 0] for i=1:3:5 out2(i) = fcn2(i,x,y,k); end</pre>	<pre>function [out1]=fcn2(j,d,s,k) switch (k(j)) case {1,2} out1 = d+9 case {3,4} out1 = 2*s otherwise out1 = d+s end</pre>
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Ques. 4 [4 Marks] Generate the offspring using following parents by applying the 2 point crossover operator of genetic algorithm, followed by mutation (assume mutation probability, Pm as 0.1).

Parent 1: 9 8 7 2 3 1 5 6 4 0

Parent 2: 0 1 2 3 4 5 6 7 8 9

Ques. 5 [7 Marks] Write the python code to minimize the Alpine function using grey wolf optimization algorithm. Assume the initial value of parameters.

$$f(x) = \sum_{i=1}^D x_i \sin(x_i) + 0.1 x_i \quad -10 \leq x_i \leq 10$$

M. Tech (CSE/CSIS)/PhD 21CST905 Research Methodology (2021-22 Spring)

Time: 1 hours 30 minutes Marks: 30

Note: Attempt any five questions.

- 1 Consider an 8 bit computing system with 3 bits reserved for fractional part and one bit reserved for sign. For this system
 - (a) Determine range and resolution.
 - (b) Given a binary number 01011.010, what is the maximum number that can be added to it without resulting in overflow. [3+3]
- 2 Given two vectors $v_1 = 2i + 3j - k$ and $v_2 = ai + bj + ck$
 - (a) Determine unit vector in direction of v_2 if $c = a + b$ and v_1, v_2 are orthogonal.
 - (b) Determine angle between v_1, v_2 if $a:b:c = 1:-1:2$ [3+3]
- 3 (a) Max-Min normalisation of a sequence of data maps numbers in a given sequence S to a new sequence S' such that S' has a minimum at zero and maximum at one. Derive the formula to achieve max-min normalisation.
(b) Given a sequence S = {12, 18, 23, 74, 80}, determine S' after normalisation. [3+3]
- 4 (a) Given a m -bit binary number, determine how many numbers can be constructed just by changing two bits only.
(b) An unbiased coin is flipped n times. Determine the probability that number of heads shall be almost 2.
(c) If four dices are thrown (each dice has six faces marked with numbers 1,2,3,4,5,6), what is the probability that product of the numbers would be 60. [2+2+2]
- 5 (a) Define the four statistical scales of measurement
(b) List the various ways to visualize frequency distributions and describe the unique characteristic that is brought out by each of them
(c) How does Correlation overcome limitation of Covariance? [2+2+2]
6. Following is the score board of players A and B in past 8 matches:

A	54	53	52	51	50	49	48	51
B	53	52	51	50	49	48	47	50

Calculate the summary statistic of both the players in terms of their centrality measures and variations. [3+3]