Date of Examination: 13/03/2023

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Spring 2022

Year: 4th Semester: 2nd

Course Number: CSE 4255

Course Name: Telecommunication

Samit

Time: 3 (Three) hours **Full Marks: 70**

Instruction: *There are seven (7) questions. Answer any five (5) questions. Marks allotted are indicated in the right margin.*

Question 1. [Marks: 14]

a) What is LATA? What are the main components of inter-LATA services? How does a subscriber make a connection with another subscriber in inter-LATA services? [5]

b) Describe the need for switching and design a three-stage switch of 100 x 100 using Clos criteria. [5]

c) You are trying to design a cellular network that will cover an area of at least 2800 km^2. There are K=300 available voice channels. Your design is required to support at least 100 concurrent calls in each cell. If the co-channel cell centre distance is required to be 9 km, how many base stations will you need in this network? Also find the signal-to-co-channel interference ratio with path-loss exponent is 4. [4]

Question 2. [Marks: 14]

a) What are the purpose of Trunking and GOS? Discuss the blocked calls cleared and blocked calls delayed system used to measure GOS. [5]

b) Describe the frequency reuse concept in cellular system. Prove that for a hexagonal geometry, the co-channel reuse ratio is given by $Q = \sqrt{(3N)}$, where $N = i^2 + ij + j^2$ and all symbols have their usual meaning. [5]

c) Suppose that a mobile station is moving at a speed of 72 km/hr along a straight line between base stations BS_1 and BS_2 with path loss 4. The received power at a reference distance 1 km is equal to 15 W. Let a cell radius of 1.5 km is the distance at which the power is at the threshold and a 3 second handoff time. [4]

i) Determine the minimum required margin Δ to assure that calls are not lost due to weak signal condition during handoff.

ii) Describe the effects of the margin Δ on the performance of cellular systems.

Question 3. [Marks: 14]

a) What is adjacent-channel interference? Discuss the problem of near-far effect. How can it be solved? [4]

b) Show that cell sectoring decreases co-channel ratio, trunking efficiency, increases SIR which in turn decreases the cluster size and hence increase the capacity. [4]

c) A city has a population of 3 million people that are evenly distributed over an area of 1000 km^2. We know that a percentage of the population is subscribed to a cellular system. Assume that the cellular system is an Erlang B system with a total band of 14 MHz, full duplex channel bandwidth of 40 kHz, covers the city using hexagonal cells with radius 2 km, and a cluster size of 7 cells. Assume that each user makes 1 call each 2 hours with average call duration of 1 minute and the desired probability of call blocking is 0.005. Find: a) The total number of cells in the system, b) The number of channels per cell, c) The total number of channels in the system, d) Traffic intensity per cell, e) Maximum carried traffic for the whole system, and f) The total number of users who can use the system. [6]

Question 4. [Marks: 14]

a) Write short note on following topics (any two): [4]
   i) 3G vs 4G
   ii) GPRS vs EDGE
   iii) HLR vs VLR

b) Describe GSM transmission technique and show that GSM connection can provide a data transmission speed of up to 270.8 Kbps. [5]

c) If we consider the trailing bits, stealing bits, guard bits, and training bits in a GSM frame as overhead, and the rest of the bits as data, then what is the percentage overhead in a GSM frame? What is the duration of a bit in GSM? If a user is allocated one time slot per frame, what is the delay between successive transmissions in successive frames? [5]

Question 5. [Marks: 14]

a) What is satellite? What feature of the geostationary orbit sets it apart from the LEO and MEO? How does satellite remain stable in orbit? [5]

b) Derive in details the free-space loss (FSL) from Friis' equation and prove that [5]
$FSL = -20\log(f) + 20\log(d) - 10\log(A_t A_r) + 169.54\ dB$
And all symbols have their usual meaning.

c) A microwave transmitter has an output of 0.1 W at 2 GHz. Assume that this transmitteris used in a microwave communication system where the transmitting and receiving antennas are parabolas, each 1.2 m in diameter. [4]
   i) What is the gain in dB of each antenna in decibels? 17.22

ii) Taking into account antenna gain, what is the effective radiated power of the transmitted signal?

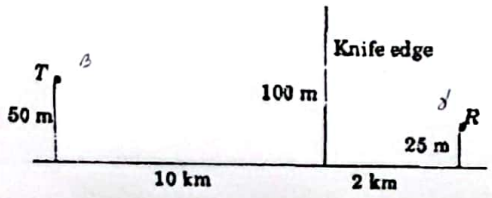
iii) If the receiving antenna is located 24 km from the transmitting antenna over a free space path, find the available signal power out of the receiving antenna in dB units.

Question 6. [Marks: 14]

a) Briefly discuss Fresnel zone and calculate the radius of the nth Fresnel zone with appropriate diagram. [4]

b) Describe the knife edge diffraction model and show that the phase difference between direct signal and diffracted signal $\emptyset = 2\pi/\lambda[\frac{h^2((d1+d2)}{2d1d2}]$. [4]

c) Given the following geometry, determine (a) the loss due to knife-edge diffraction, and (b) the height of the obstacle required to induce 6 dB diffraction loss. Assume f = 900 MHz. [6]



$G_d(dB)$	v
0	≤ -1
20 log(0.5-0.62v)	[-1,0]
20 log(0.5 $e^{-0.95v}$)	[0,1]
20 log(0.4-(0.1184-(0.38-0.1v)²)$^{1/2}$)	[1, 2.4]
20 log(0.225/v)	> 2.4

Question 7. [Marks: 14]

a) Discuss in brief that the mobile radio channel can be modeled as a linear time varying channel. [5]

b) Describe the Doppler shift effect with appropriate diagram and its impact on the characteristics of the mobile wireless channel. [4]

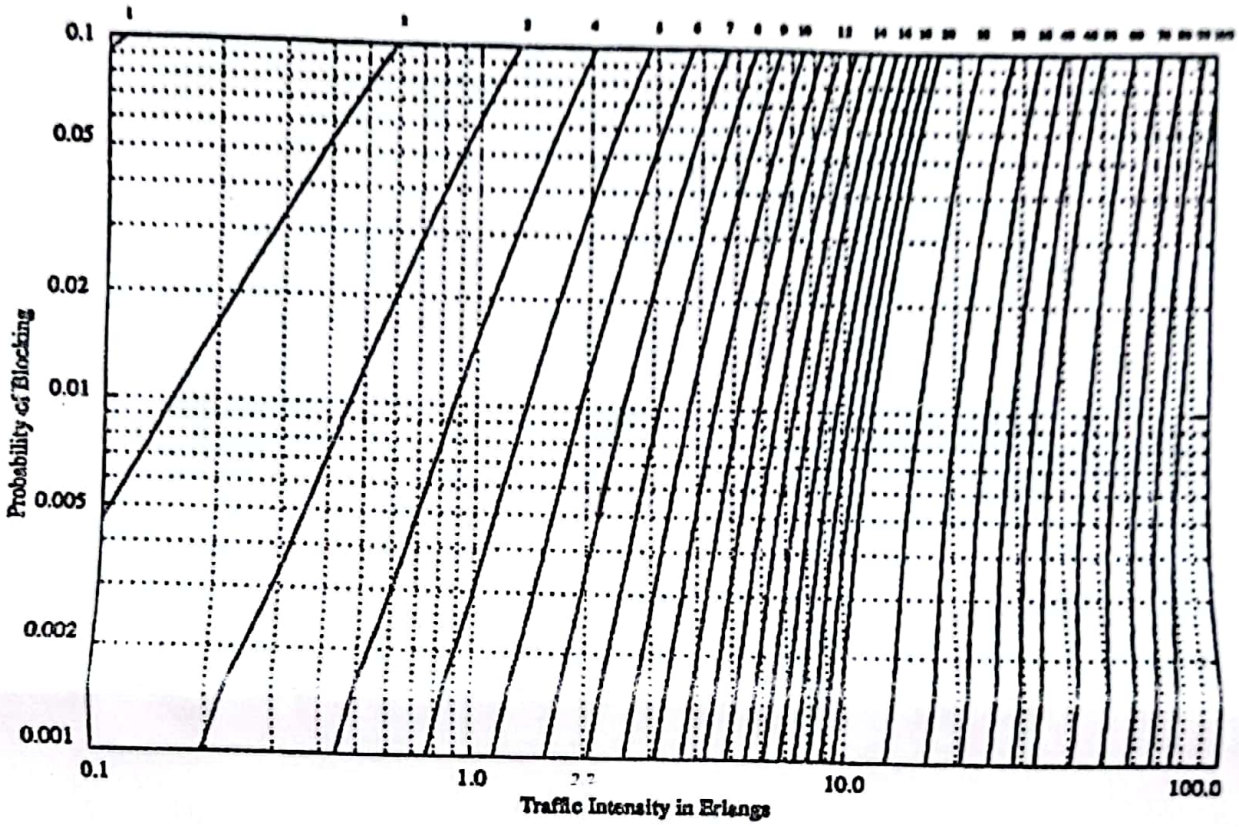
c) Calculate the total excess delay, mean delay and RMS delay spread for a channel whose PDP is specified as follows: [5]

Relative delay [μsec]	Average relative power [dB]
0.0	-3.0
0.2	0.0
0.5	-2.0
1.6	-6.0
2.3	-8.0
5.0	-10.0

From the above calculation of PDP, would the channel be regarded as a wideband channel for a binary data system with data rate of 25 Kbits/sec? What is the maximum data rate for the system to be ISI-free?

Appendix

Erlang-B Chart:



Date of Examination: 16/03/2023

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Spring 2022

Year: 4th Semester: 2nd

Course Number: CSE4213

Course Name: Pattern Recognition

Time: 3 (Three) hours **Full Marks: 70**

[Instruction: There are 7 (Seven) questions, from which you have to answer any 5 (Five) questions, including Question no. 1 (One), which is mandatory for everyone.]

Question 1. [Marks: 14]

a) Consider the following four data points given for two classes. Find the decision boundary equation to separate them using **perceptron criterion function** for **batch update strategy**. Set the initial learning rate =1 and initial weight=0.5 and *Phi* function ≡ [x_1^2 x_2^2 x_1+x_2 x_1*x_2]. Note: Show up to two iterations for weight update. [5+2]

ω_1: (2, 3)^t, (1, 5)^t

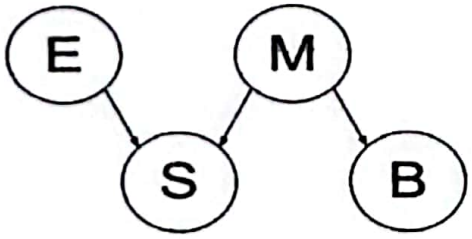
ω_2: (3, 1)^t, (-2, -4)^t

Also, how do the generative learning algorithms differ from the discriminative learning algorithms?

b) A Bayesian network and corresponding conditional probability tables are shown below. Compute the following probabilities. [2+2+3]

$P(E)$	
$+e$	0.4
$-e$	0.6

$P(S\|E,M)$			
$+e$	$+m$	$+s$	1.0
$+e$	$+m$	$-s$	0.0
$+e$	$-m$	$+s$	0.8
$+e$	$-m$	$-s$	0.2
$-e$	$+m$	$+s$	0.3
$-e$	$+m$	$-s$	0.7
$-e$	$-m$	$+s$	0.1
$-e$	$-m$	$-s$	0.9



$P(M)$	
$+m$	0.1
$-m$	0.9

$P(B\|M)$		
$+m$	$+b$	1.0
$+m$	$-b$	0.0
$-m$	$+b$	0.1
$-m$	$-b$	0.9

(i) $P(-e, -s, -m, -b)$
(ii) $P(+b)$
(iii) $P(+m \mid +b)$

Question 2. [Marks: 14]

a) Suppose there are risks involved when taking any action based on your decision. [3+3]
   i) Devise a decision rule that minimizes the overall risk for a two-class problem.
   ii) Will your classifier ensure minimum error rate? Justify your answer.

b) Consider the task of minimum error Bayesian classification of benign and malignant tumors based on their gray values. The average gray values of benign and malignant tumor are 15 and 12, respectively. Assuming that their gray values of both malignant and benign tumors follow a Gaussian distribution with a standard deviation equal to 2, find the decision boundary when (i) *P(Benign) = P(Malignant)* (ii) *P(Benign) = 2*P(Malignant)*. [4+4]

Question 3. [Marks: 14]

a) What characteristics should an ideal feature extractor hold during extracting a feature vector representing a sample object? Briefly explain each of them. [6]

b) Find the edit distance between the word "google" and its misspelled version "doodle". What is the sequence of edit operations to achieve them? [8]

Question 4. [Marks: 14]

The dataset shown in Table 1 reports the price and weight of three products. Show the step-by-step calculation to derive the feature vector by applying principal component analysis (PCA). [10+4]

Table 1

Product	Price	Weight
1	4	70
2	53	65
3	32	10

1139.129 → λ_1

512.537 → λ_2

Also, show that in PCA the eigenvector with the highest eigenvalue is the principle component of the data set.

Question 5. [Marks: 14]

a) Express the decision boundary of SVM classifier in terms of the Lagrange multipliers, α_i and show that this satisfies the KKT conditions. [6]

b) Consider the following distance matrix [6+2]

$$D = \begin{pmatrix} 0 & & & & \\ 2 & 0 & & & \\ 6 & 3 & 0 & & \\ 10 & 9 & 7 & 0 & \\ 9 & 8 & 5 & 4 & 0 \end{pmatrix}$$

Cluster the records using **complete link hierarchical clustering** and show final results in dendrogram. Also, what is the basic difference between **partitional** and **hierarchical clustering?**

Question 6. [Marks: 14]

a) Show that the distance from the hyperplane $g(x)=w^t x+w_0=0$ to the point x_a is $|g(x_a)|/\|w\|$ by minimizing $\|x-x_a\|^2$ subject to the constraint $g(x)=0$. [6]

b) Suppose the following data set is given, where 10 sample instances are given along with their true class label: *p* for positive class and *n* for negative class. If the scores are to be considered for classification into two classes, then draw the ROC curve for four different thresholds: 0.75, 0.60, 0.53 and 0.52. [8]

Inst#	Class	Score
1	p	.9
2	p	.8
3	n	.7
4	p	.6
5	p	.55
6	p	.54
7	n	.53
8	n	.52
9	p	.51
10	n	.505

Question 7. [Marks: 14]

a) Write the differences between bagging and boosting methods of ensemble learning. Define weak and strong classifiers. How does AdaBoost algorithm assign weights to different classifiers so that combined classification error is minimized? [2+2+2]

b) Consider the case of a binary classification starting with a training data of 8 tuples as shown in Table 2 with the Lagrange multipliers λ_i for each training tuple. [1+3+4]

Table 2

A_1	A_2	y	λ_I
0.38	0.47	+	65.52
0.49	0.61	-	65.52
0.92	0.41	-	0
0.74	0.89	-	0
0.18	0.58	+	0
0.41	0.35	+	0
0.93	0.81	-	0
0.21	0.10	+	0

i. What are the support vectors?

ii. Find the value of the weight and bias parameters. Also, Construct the maximum margin hyperplane using these values.

iii. Find the resulting SVM's classification of the test instance x = (0.5, .0.5).

Date of Examination: 20.3.2023

Ahsanullah University of Science and Technology

Department: Computer Science and Engineering
Program: Bachelor of Science in Computer Science and Engineering
Semester Final Examination: Spring 2022
Year: 4th Semester: 2nd
Course Number: CSE4203
Course Title: Computer Graphics

Samit

Time: 03 (Three) hours **Full Marks: 70**

Instruction: *There are seven questions carrying a total of 14 marks each. Answer any five questions. Marks allotted are indicated in the margin.*

Question 1. [Marks: 14]

a) Explain the level-of-detail rendering. [3]

b) What is a vanishing point? Give an example scenario of multiple vanishing points. [3]

c) Consider a sphere centered at (0, 4, 0) with a radius of 5. A viewing ray is generated with an origin (4, 4, 2) and end-point (4, 10, 2). Determine the ray-sphere intersection point(s) if there exists any using the concept of orthographic ray tracing. [8]

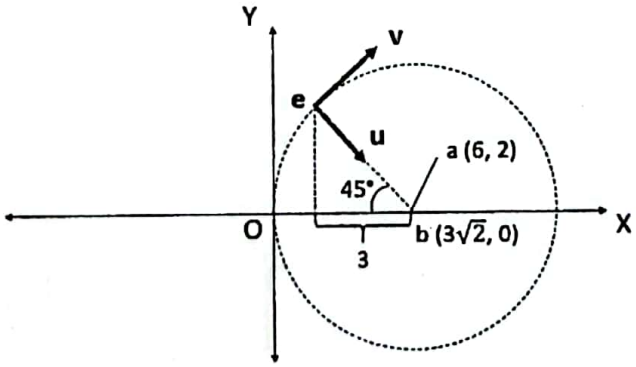
A = 36 D = 720
B = −72
C = 31

Question 2. [Marks: 14]

a) State the differences between raster and vector images. [4]

b) Explain the problems associated with it if homogeneous coordinates were not used in matrix transformation. [2]

c) Here (in the figure), origin O and basis {x,y} construct a 2D canonical coordinate system. Within this, line ab is our model (Pxy). Now, we want to view it from a new 2D camera with eye e and basis {u,v}; which is rotated by −45 degrees around b. Determine the position of a and b w.r.t camera coordinate. [8]
Assume that, u is the viewing direction and b is the center of the circle.



Question 3. [Marks: 14]

a) Consider a rectangle with vertices A(1, 1), B(6, 1), C(6, 5) and D(1, 5). Apply appropriate transformation to the rectangle to obtain a parallelogram in such a way that point C and D move 4 units to its right from the original position and point A and B remain unchanged. [8]

b) Write down the algorithm to create a half circle given the radius and the center using Bresenham's Circle drawing algorithm. [6]

Question 4. [Marks: 14]

(a) Consider a line with a start and end point of (0, 0) and (-1, -2) respectively. Apply the necessary transformation to increase the size of the line by 100% and find the final vertices after the transformation. Also, determine the coordinates of each pixel along the transformed line segment using the midpoint line drawing algorithm. [10]

Necessary adjustments of the original algorithm for different octants are provided below:

(1) plot(x, y)	(2) swap(x, y); plot(y, x)	(3) x=−x; swap(x, y); plot(−y, x)	(4) x=−x; plot(−x, y)
(5) x=−x; y=−y; plot(−x, −y)	(6) x=−x; y=−y; swap(x, y); plot(−y, −x)	(7) y=−y; swap(x, y); plot(y, −x)	(8) y=−y; plot(x, −y)

(b) Derive 2D perspective projection matrix. [4]

Question 5. [Marks: 14]

(a) Consider a triangle with vertices A(1, 1), B(5, 1), and C(3, 3) and color values of red(1, 0, 0), green(0, 0.9, 0), and blue(0, 0, 0.8) at each vertex of the triangle. Find the color of the point P(3, 2) inside the triangle using the concept of barycentric interpolation. [7]

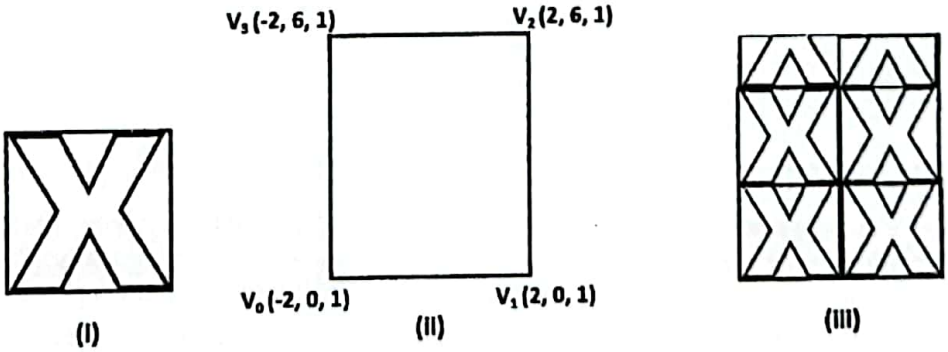
(b) Consider a square OACB with vertices O(3, 2), A(3, 6), C(7, 6) and B(7, 2). Reflect the square along a line x = -1 using 2D transformation. Determine the composite transformation matrix and find the final vertices. [7]

Question 6. [Marks: 14]

(a) Suppose we have a cubic Bézier curve defined by the control points $P_0 = (0, 0)$, $P_1 = (2, 5)$, $P_2 = (5, 5)$, and $P_3 = (8, 0)$. Find the mid-point and end-point of the cubic curve. [7]

(b) State the limitations of the Lambertian shading model. [3]

(c) In the following figure, (i) is a texture, (ii) is a rectangular face $V_0V_1V_2V_3$ to be mapped with the texture, and (iii) is the output after texture mapping. List the texture coordinates for corresponding xyz-coordinates to perform texture lookup. (assume any data if necessary) [4]



Question 7. [Marks: 14]

(a) Transform a 3D line AB from an orthographic view volume to the viewport of size 256 x 128. Consider the vertices of the line are A(-2, -4, -1), B(1, 5, -5) and the orthographic view volume has the following setup: [7]

$$l = -6, r = 6, b = -7, t = 7, n = -2, f = -8$$

(b) Consider there are two objects overlapping each other, where C_1 is the color of the foreground object and C_2 is the color of the background object. Construct an alpha compositing formula if the foreground object has 30% transparency and the background object is fully opaque. [4]

(c) Explain how to determine whether a polygon is facing towards or away from the camera. [3]

Date of Examination: 23/03/2023

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department: Computer Science and Engineering
Program: Bachelor of Science in Computer Science and Engineering
Semester Final Examination: Spring 2022
Year: 4th Semester: 2nd
Course Number: CSE 4237
Course Name: Soft Computing
Time: 3 (Three) hours **Full Marks: 70**

Instruction: *There are seven (7) questions. Answer any five (5) questions. Marks allotted are indicated in the right margin.*

Question 1. [Marks: 14]

a) List the differences between RNN and LSTM. Explain the basic structure of a LSTM network. [6]

b) Consider the simple hidden Markov model (HMM) in Figure-1. This model is composed of 2 states, **HIGH** and **LOW**. You can for example consider that HIGH characterizes coding DNA while LOW characterizes non-coding DNA. Analyze the model and find out the right regions of DNA for the following sequence using the Viterbi algorithm. [8]

A C T G A

State every step of the simulation.

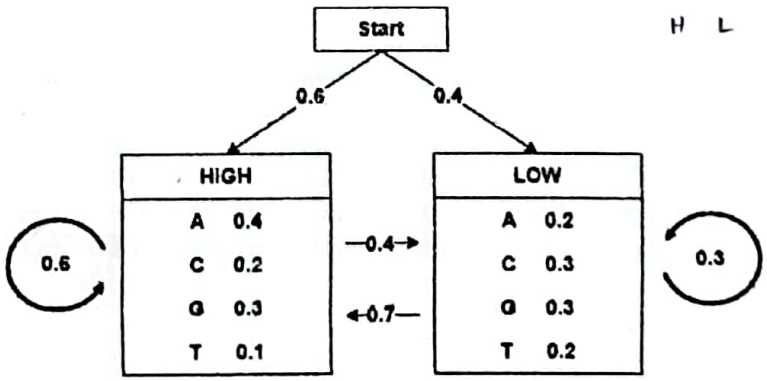


Figure – 1

Question 2. [Marks: 14]

a) I) Describe the idea of cosine similarity. [6]

II) How word embeddings can help with analogy reasoning? – Explain with suitable example.

b) I) Write down the steps to train a skip-gram model and analyze the model with a proper example. [8]

II) Note down the problems of Softmax classification and explain how to resolve them.

Question 3. [Marks: 14]

a) I) List the problems with Bag of Words (BoW) model and then explain how to fix them. [6]

II) What is the importance of inverse document frequency in the concept of TF-IDF?

b) Consider, you are working on an NLP project and using TF-IDF as the features of your model. The corpus you have been provided is given below. [8]

Although football is a global sport, Europe is famous for playing this sport. Asians, Africans, and Americans also play this game. However, European football is more deluxe. Besides, Brazil and Argentina are arguably the most supported teams in the world. **Their styles of aesthetic and inventive play are completely different from fast-pacing European football.** This sport is known by different names. For instance, it is commonly known as "soccer" in the United States.

Now capitalize each word token and analyzing the text find the TF-IDF features for the bold-faced sentence.

Question 4. [Marks: 14]

a) Define the vanishing gradient problem. How can the vanishing gradient problem of sigmoid or tanh activation function can be overcome? [6]

b) I) What role does bias play in a logistic regression? [8]

II) "A Neural Network is a combination of several logistic regressions."– Do you agree with the statement? Justify your answer with proper evidence.

Question 5. [Marks: 14]

a) How normalization can be achieved in Convolutional Neural Network? What is the rule of thumb to use a CNN architecture? [6]

b) Calculate the number of parameters for the following architecture for the input shape of (478,464). [8]

input→Conv(3,2)→Minpool(4)→ReLU→Conv(5,3)→Maxpool(3)

output←FC(5)←tanh←FC(128)←Dropout(0.2)←ReLU←FCwB(256)

Here, Conv(x,y) denotes a convolutional layer that has the kernel size of x and stride size of y,
Minpool(x) denotes a Minpooling layer that has both window size and stride size of x,
Maxpool(x) denotes a Maxpooling layer that has both window size and stride size of x,
FCwB(x) denotes a Fully Connected Layer of x neurons with Bias,
Dropout (y) denotes a Dropout Layer that drops input at a rate of y, and
FC(x) denotes a Fully Connected Layer of x neurons without Bias.

Question 6. [Marks: 14]

a) List the advantages of a fuzzy system. How a Neuro-Fuzzy system can be built? [6]

b) Two fuzzy numbers A and B are given below. Add the numbers using the extension principle. [8]

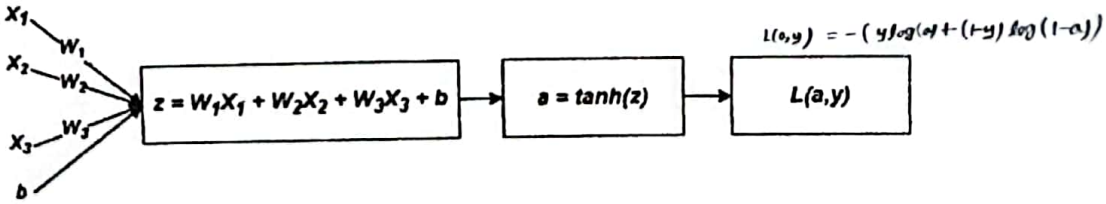
$$A = 0.2/1 + 0.5/2 + 0.7/3 + 1/4 + 0.7/5 + 0.5/6 + 0.2/7$$

$$B = 0.3/3 + 0.5/4 + 0.8/5 + 1/6 + 0.8/7 + 0.5/8 + 0.3/9$$

Question 7. [Marks: 14]

a) What is the importance of gradient descent in neural network? Write down the algorithm of Adam optimizer. [6]

b) Perform backward propagation on the following logistic regression algorithm to modify the parameters in order to minimize the loss. [8]



Here, y is the actual label of the training data, and
L(a,y) denotes the cross entropy loss between a and y.

Date of Examination: 29 March 2023

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Spring 2022

Year: 4th **Semester: 2nd**

Course Number: CSE 4227

Course Name: Digital Image Processing

Time: 3 (Three) hours **Full Marks: 70**

Instruction: *There are seven (7) questions.* ***Question#1 is mandatory to answer.*** *Answer any* ***other four (4)*** *questions out of six (6) from question#2 to question#7.*
Marks allotted are indicated in the right margin.

Question 1. [Marks: 18]

a) i. Explain with an example how a spatial filter affect an image. [2] [9]

ii. Suppose we have a 3x3 image as [(2, 5, 8), (5, 1, 3), (4, 7, 2)]. Now if we apply an average filter on this image of size 3x3 and zero padding is considered, what would be the filtered output image? [4]

iii. Explain why the output of applying a median filter preserves more edge sharpness in compared to that of applying an average filter. [3]

b) Consider the simple 3x3, 8 bit image as [(3,4,7),(3,4,7),(3,4,7)]. Suppose you want to compress the image using a loss less Lempel-Ziv-Welch (LZW) fixed length coding algorithm. [9]

i. Generate your new codebook using 9 bits and illustrate your step by step LZW encoding process for the above image. [5]

ii. What kind of redundancy of image data it reduces in your encoding process? Explain. [2]

iii. Any compression achieved by employing LZW in your above encoding process? Proof it. [2]

Answer any *FOUR (4)* questions from the following:

Question 2. [Marks: 13]

a) The locations of two points (r1, s1) and (r2, s2) control the shape of transformation function in Piecewise Linear Transformation. Now illustrate the relation between (r1,s1) and (r2,s2) for [5]

i. Linear Identity function. [1]

ii. Thresholding function. [2]

iii. Contrast Stretching function. [2]

b) Consider a 4x4 image with 5-bit gray values [(11,10,12,7),(6,8,7,7),(5,6,11,11), (9,9,7,7)]: [8]

i. Calculate the histogram of image. [1]

ii. Compute and sketch the normalized histogram of the image. [2]

iii. Compute and sketch the equalize histogram of the image. [4]

iv. Sketch the transformation curve. [1]

Question 3. [Marks: 13]

a) i. Mention two techniques those made the digital representation of analog world possible. [3] [5]

ii. "The more intensity level used, the finer level of detail discernible in an image"- explain why? [2]

b) Consider the image below with V = {0, 1, 2, 4} and answer the followings: [8]

p	1	4	3	4 r
	2	3	4	7
	0	5	1	6
	3	4	7	1 q

i. What are the properties of Distance Function for Distance Metrics if there are 3 pixels p, q and r? [2]

ii. Calculate the distances: $D_4(p,q)$, $D_4(p,r)$, $D_8(p,q)$ and $D_e(p,q)$. [2] 6, 3, 3, $\sqrt{18}$

iii. Define the terms $N_4(p)$, $N_D(p)$ and $N_8(p)$ of above image. [1.5]

iv. Does 4-path exist between p and q? Explain your answer. [1]

v. Does m-path exist between p and q? Explain your answer. [1.5]

Question 4. [Marks: 13]

a) Describe two different morphological basic operations along with mathematical equations. Explain the effects of them and give examples of their applications. [5]

b) Consider the following image F and structuring element B: [8]

0	0	0	0	0	1
0	0	1	1	1	0
0	1	1	1	1	0
0	1	1	1	0	0
1	0	0	0	0	0

F

1
1
1

B

Compute the followings:

i. Reflection of B
ii. F dilated by B
iii. F^c eroded by B
iv. (F dilated by B) – F
v. Opening of F by B (and also write the process with mathematical equation)
vi. Closing of F by B (and also write the process with mathematical equation)

Question 5. [Marks: 13]

a) i. Why image compression is needed? [1] [5]

ii. How many and what types of data redundancies are there in an image? [2]

iii. A 512 X 512 8-bit image with 5.3 bits/pixel entropy is to be Huffman Coding. What is the maximum compression that can be expected? [2]

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b) Consider the simple 3x3, 8 bit image [(18,16,16),(11,11,14),(11,14,16)]. Suppose you want to compress the image using Huffman code algorithm. [8]

i. Illustrate your Huffman encoding process for the above image. [3]

ii. Compute the entropy of the above image. [2] 1.89

iii. What kind of redundancy of image data it reduces in your encoding process? Is it a loss less compression technique? [1]

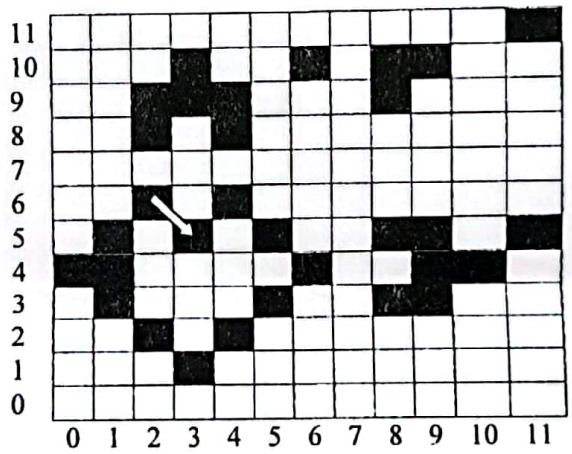
iv. Any compression achieved by employing Huffman coding in your above encoding process? Proof it. [2] 3.30

Question 6. [Marks: 13]

a) How many steps are in Canny Edge detection algorithm and what are the steps? Explain any one step of them. What are the false positive and the false negative edge pixels? How canny reduces these errors? [5]

b) i. Suppose we have a 3x3 image with values as [(3, 7, 6), (2, 5, 8), (3, 4, 7)]. Using Sobel operator on the image illustrate the gradient magnitude image. Also, find the edge direction of central pixel. [4] 29, 14.74° [8]

ii. Consider the following image where each black square denotes a point and the numbers are the coordinates.



Find the Chain Code of the above image that is invariant in starting point and rotation. An arrow marks the reference pixel and the direction. Use 8-neighbor relationship. [4]

Question 7. [Marks: 13]

a) Describe the RGB color model with schematic of RGB color cube. [5]

b) i. Why RGB color model is called ***'Additive'*** where as CMYK is called ***'Subtractive'***? [4] [8]

ii. What is the basic differences between RGB image and Indexed color image? Which representation is preferred in case of storage and transmission? [4]