DEPARTMENT OF COMPUTER SCIENCE
Cochin University of Science and Technology
M.Sc. (Five Year Integrated) in Computer Science (AI & DS)
Fourth Semester
21-805-0403: Digital Signal Processing
Second Series Examination, July 2023

Time: 2 hours | *Answer All Questions* | Maximum Marks: 20

1. A 5×5 2D signal is given by

$$\begin{bmatrix} 1 & 2 & 5 & 4 & 3 \\ 4 & 3 & 2 & 0 & 0 \\ 6 & 2 & 4 & 1 & 0 \\ 4 & 3 & 6 & 2 & 1 \\ 2 & 5 & 6 & 1 & 3 \end{bmatrix}$$

   Filter the above signal using a 5×5 mean filter. Assume replicate padding of the input signal. [4]

2. What are band-reject filters? Illustrate any two band-reject filters. [4]

3. A blur filter is given by:

$$h(m,n) = \begin{bmatrix} 1 & 1 & 2 & 1 \\ 2 & 1 & 1 & 2 \\ 1 & 3 & 2 & 1 \\ 2 & 1 & 2 & 1 \end{bmatrix}$$

   Find the deblur filter in the frequency domain using Wiener filter approach with $S_\eta = 300$ and $S_f = 150$. [4]

4. A 4×4 2D signal is given by:

$$\begin{bmatrix} 8 & 6 & 7 & 2 \\ 12 & 14 & 18 & 12 \\ 25 & 18 & 6 & 5 \\ 8 & 12 & 4 & 9 \end{bmatrix}$$

   Filter the above signal using (a)MIN filter and (b)MAX filter using the following filter mask:

   Assume replicate padding of the input signal. [4

5. Filter the following 2D signal using a 3×3 neighborhood Laplacian mask.

$$\begin{bmatrix} 1 & 2 & 3 & 2 \\ 4 & 2 & 5 & 1 \\ 1 & 2 & 6 & 3 \\ 2 & 4 & 6 & 7 \end{bmatrix}$$

Department of Computer Science, Cochin University of Science & Technology
M. Sc. Computer Science (Artificial Intelligence and Data Science)
Second Internal Examination, July 2023. Total: 20 Marks

21-805-0404: AGILE SOFTWARE ENGINEERING

Section I: Answer the following (5 marks)

1. Which among the following is NOT a known benefit of adopting CMMI ?
a) Predictability b) Repeatability c) Testability d) Better Quality

2. Which of these is a work breakup hierarchy in Agile scrum methodology?
a) Epic, Task, User Story b) User story, Epic, Task
c) Task, Epic, User Story d) Epic, User Story, Task

3. In MoSCoW project management, which among the following is True?
a) Must have is not more than 60% b) Should have is typically around 60%
c) Could have is usually below 40% d) Wont have is typically around 20%

4. Which among the following is True about Scrum and XP?
a) Sprint in XP is usually a month long, while Scrum typically has 1-2 week sprints.
b) Working Software is important in scrum, while XP is not focused on quality.
c) Scrum focus on management and productivity, while XP focus on testing and Software quality.
d) Scrum is developer focused and XP is focused on customer need.

5. Which among the following is true representation of a burn down chart?
a) Effort estimate vs Agile Sprint count b) Work remaining vs Agile Sprint count
c) Work remaining vs Effort estimate d) Work completed vs Effort estimate

Section II: Answer the following (Total 15 Marks)

6. Distinguish between agile roles: project manager, scrum master and product owner? (3 marks)

7. How do you compute velocity of an agile project ? (3 marks)

8. Given a git code repository in cloud, provide commands to download the code, create a branch, add one patch to the branch and upload the modifications to the same repository? (4 marks)

9. An apartment complex is building an online directory consisting of information such as: name of house owner, profession of owner, address, members in each house, relationship of member to owner, phone number of each member. Every house owner can login and view details of other members by searching with any of these information. Provide 5 user stories capturing this requirement. Define the technologies required to build such an application in cloud by drawing its software architecture. (5 marks)

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Cochin University of Science and Technology

Department of Computer Science

Fourth Semester M.Sc. (Five-Year Integrated) in Computer Science (Artificial Intelligence & Data Science)

End Semester Examination - July 2023

21-805-0401: Foundations of Data Science

Duration : 3 Hrs | Maximum Marks : 50

Answer all questions. From each question fully answer either (a) or (b)

1. (a) Assume m points generated at random in d-dimensions where each coordinate is a zero mean, unit variance Gaussian. Prove that for sufficiently large d, with high probability the distances between all pairs of points will be essentially the same. **(10 marks)**

OR

(b) Discuss in detail any two applications of Singular Value Decomposition (SVD). **(10 marks)**

2. (a) Define giant component in a random graph. Describe the four topologically distinct regimes in the evolution of random network. **(10 marks)**

OR

(b) Real networks are not truly random. Compare random networks with real networks on the following terms: Degree Distribution, Connectedness, Average Path Length, and Clustering Coefficient. **(10 marks)**

3. (a) Define Markov Chain. Draw the state transition diagram for the Markov chain with three states, $S = \{1, 2, 3\}$, whose transition matrix, P is given below. If we know $P(X1 = 1) = P(X1 = 2) = \frac{1}{4}$, find $P(X1 = 3, X2 = 2, X3 = 1)$. **(10 marks)**

$$P = \begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$

OR

(b) Consider a Drunkard's walk, where a man walks along a four-block stretch of Park Avenue. If he is at corner 1, 2, or 3, then he walks to the left or right with equal probability. He continues until he reaches corner 4, which is a bar, or corner 0,

which is his home. If he reaches either home or the bar, he stays there. Represent this process as a Markov chain using a transition matrix. What is the expected number of steps before the chain is absorbed, given that the chain starts from state (corner) 2 ? **(10 marks)**

4. (a) Perform perceptron algorithm on the given Data (X,Y) in the table below to find a linear separator. Assume initial weights $w = [0, 0]$, bias $w_0 = 0$. **(10 marks)**

Example Number	X_1	X_2	Y
1	-1	2	-1
2	-2	-2	+1
3	1	-1	+1
4	-3	1	-1

OR

(b) What are kernel tricks? Explain how Support Vector Machine can be kernelized for the classification of non-linearly separable data. Demonstrate using the kernel $K(x, z) = (x^T z)^2$ where $x, z \in \mathbb{R}^k$ **(10 marks)**

5. (a) With a worked-out example, explain Misra and Gries's Frequent algorithm to find all items in a sequence whose frequency exceeds a $1/k$ fraction of a data stream of length n. **(10 marks)**

OR

(b) Explain how the Locality-Sensitive Hashing algorithm can be used to find candidates of duplicate pair for checking document similarity. Use Jaccard similarity measure. **(10 marks)**

DEPARTMENT OF COMPUTER SCIENCE

Cochin University of Science and Technology

M.Sc. (Five Year Integrated) in Computer Science (AI & DS)

Fourth Semester

End Semester Examination, July-August 2023

21-805-0403: Digital Signal Processing

Time: 3 hours | Maximum Marks: 50

Module I

1. (a) Discuss in detail the sampling and quantization process. [5]

   (b) What are linear systems? Give examples. Explain the two important properties of a linear system. [5]

OR

2. (a) What do you mean by linear shift-invariant system? Explain its properties. [5]

   (b) Define the terms (i) Impulse Sequence and (ii) Exponential sequence. [5]

Module II

3. (a) Compute the convolution of the following pairs of signals: [5]
   $x(n) = \{1, 2, 3, 1\}$ and $h(n) = \{1, 2, 1, -1\}$

   (b) Compute the 2D DFT of the following 2D signal.

12	4	2	6
5	10	12	24
6	8	10	12
14	12	8	10

[5]

OR

4. (a) Define 2D Z-transform and its inverse. Comment on the relationship of the Fourier transform to Z-transform. [5]

   (b) Compute the DFT of the four-point sequence $x(n) = \{0, 1, 2, 3\}$. [5]

Module III

5. (a) Compute G_x and G_y gradients of the following 2D signal performing the convolution with Sobel filter. Use border values to pad the signal.

P.T.O.

0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10
0	0	10	10	10

[5]

[5]

(b) Define Butterworth lowpass and highpass filters.

OR

6. (a) Apply a 3×3 median filter on the below 2D signal with replicate padding.

6	3	1	1	3
3	6	2	3	4
2	3	3	4	2
4	3	5	4	1
2	5	5	6	6

[5]

[5]

(b) Discuss about any two periodic noise reduction filters in detail.

Module IV

7. (a) How deconvolution can be performed using Wiener filter? Explain with an example. [5]

(b) Explain how the Laplacian filter can be performed in the frequency domain. [5]

OR

8. (a) How direct inverse filter works? Explain with the help of an example. [5]

(b) With the help of neat sketches explain any two notch reject filters. [5]

Module V

9. (a) What are band-reject filters? Illustrate the buttorworth band-reject filter. [5]

(b) What are the applications of band-pass filters? Explain with examples. [5]

OR

10. (a) Discuss about any two notch-reject filters in detail. [5]

(b) Describe how gradient magnitude and orientation angle can be computed for a 2D signal. [5]

Department of Computer Science, Cochin University of Science & Technology

M. Sc. Computer Science (Artificial Intelligence and Data Science)

Semester IV Final Examination, July 2023

21-805-0404: Agile Software Engineering

Max: 50 marks Time : 3 Hours

(Answer either Part A or Part B of each question. Each Part carries 10 marks)

Module I

I A 1) Distinguish between four types of maintenance activities to be performed in a software product.

2) A construction business is having a finance application consisting of information such as: name of employee along with his project name, manager, home address, phone, email. For each Project, there is an associated cost which is sum of all manpower cost, material cost and consulting cost. Draw the Entity Relationship diagram for this application.

(5+5 marks)

OR

I B 1) A home automation system has a mobile app which can control lights, fan, air condition and power plugs in multiple rooms. Additionally, it can be used to monitor CCTV footage in live and recorded fashion. Draw the wireframe of this mobile application that is being used multiple customers and controlled by an administrator. Also, provide UML diagram for the application.

(10 marks)

Module II

II A 1) Explain the following: a) Boundary Value Analysis b) Equivalence partitioning

2) Draw the software architecture of the application in the question I B 1.

(5+5 marks)

OR

II B 1) Explain the roles: a) Product owner b) Scrum Master

2) Provide feature listing as epics and user stories for the application in the question I B 1.

(5+5 marks)

PTO

Module III

III A 1) What are the 12 principles in Agile Methodology of development? (10 marks)

OR

III B 1) Explain the activities in the following two sprint ceremonies in detail. a) Daily scrum call and b) Sprint Retro. (10 marks)

Module IV

IV A 1) Distinguish between Agile SCRUM and XP methodologies. Where would be each methodology be more suited? (10 marks)

OR

IV B 1) Explain MoSCoW model of software development. How are tasks prioritized in this model? (10 marks)

Module V

V A 1) What are story points? How do you calculate velocity of a project? Create a burndown chart and explain these concepts (10 marks)

OR

V B 1) What are the documents prepared by QA for agile methodology? What is the updates needed from a QA in a daily scrum call and how does it help in estimation of progress? (10 marks)

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Department of Computer Science
Cochin University Of Science And Technology
IV th semester M.Sc (Five Year integrated) in Computer Science(AI&DS)
End Semester Examination-July-2023

21-805-0405 Optimization Techniques

Time:3hr Maximum marks:50

(ANSWER ONE FULL QUESTION FROM EACH PART)

PART 1

1. A paper mill produces two grades of paper, X and Y. Because of raw material restrictions, it cannot produce more than 400 tonnes of grade X and300 tonnes of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a tonne of products X and Y respectively with corresponding profits of 200 and 500 per tonne. Formulate this as a LPP to maximize profit and find the optimum product mix. 2 mark
2. Use simplex method to solve the LPP.
   Min Z = x2 – 3x3 + 2x5
   Subject to,
   3x2 – x3 + 2x5 <=7
   – 2x2 + 4x3 <=12
   – 4x2 + 3x3 + 8x5 <=10
   x2, x3, x5 >=0
   8 mark

OR

3. Solve the following LPP.
   Minimize Z = 4x1 + x2
   subject to ,
   3x1 + x2 = 3
   4x1 + 3x2 >=6
   x1 + 2x2 <=3
   x1, x2 >=0
   10 mark

PART II

4. How can we solve an assignment problem using Hungarian method? Write down steps.Using the following cost matrix and determine (i) Optimal job Assignment and (ii) The cost of Assignments. 10 mark

		Jobs				
		1	2	3	4	5
Mechanics	*A*	10	3	3	2	8
	B	9	7	8	2	7
	C	7	5	6	2	4
	D	3	5	8	2	4
	E	9	10	9	6	10

OR

5. Find the sequence that minimizes the total elapsed time (in hours) required to complete the following tasks on two machines. 6 mark

Task	A	B	C	D	E	F	G	H	I
Machine I	2	5	4	9	6	8	7	5	4
Machine II	6	8	7	4	3	9	3	8	11

6. Explain the following terms briefly with examples: 4 mark
   (i) North West Corner Rule
   (ii) Least Cost Method

PART III

7. A project schedule has the following characteristics.

Activity	1–2	1–3	2–4	3–4	3–5	4–9	5–6	5–7
Time(days)	4	1	1	1	6	5	4	8
Activity	6–8	7–8	8–10	9–10				
Time(days)	1	2	5	7				

From the above information, you are required to:
   (i) Construct a network diagram.
   (ii) Compute the earliest event time and latest event time.
   (iii) Determine the critical path and total project duration. 10 mark
   (iv) Compute total, free float for each activity.

OR

8. Solve the following integer programming problem using Gomory'sCutting plane method, Max Z=5x 1 ÷7x 2 , subject to conditions -2x 1 +3x 2 <= 6,6x 1 + x 2 <= 30 and x 1 , x 2 >= 0 and integer. 10 mark

PARTIV

9. Explain about the basic operators and basic technologies in genetic algorithm. 10 mark

OR

10. Evaluate any two of following algorithm in detail. 10 mark
    a)Artificial Immune Algorithm-
    b)Clonal selection algorithm
    c)Negative selection algorithm
    d)Immune network algorithms
    e)Dendritic cell algorithms.

PART V

11. Explain particle optimization algorithm in detail with example. 10 mark

OR

12. Evaluate any two of following algorithm in detail. 10 mark
    a) Artificial Bee Colony Algorithm-
    b) Cuckoo search based algorithm
    c) Hybrid Algorithms
    d) Shuffled Frog Leaping Algorithm -
    e) GrenadeExplosion Algorithm

DEPARTMENT OF COMPUTER SCIENCE

Cochin University of Science and Technology

M.Sc. (Five Year Integrated) in Computer Science (AI & DS)

Fourth Semester

Make-up Examination, August 2023

21-805-0403: Digital Signal Processing

Time: 3 hours

Maximum Marks: 50

Module I

1. (a) Derive the mathematical expression for the linear convolution process. [5]
   (b) Define the terms (i) Periodic Sequence and (ii) Exponential sequence. [5]

OR

2. (a) Define Kronecker and Dirac delta functions. What are its applications? [5]
   (b) Define a Signal. Explain its basic properties with the help of an example. [5]

Module II

3. (a) Compute the convolution of the following pairs of signals:
   $x(n) = \{2, 6, 2, 1, 7\}$ and $h(n) = \{3, 2, -1, -1\}$ [5]
   (b) Prove that the four-point DFT matrix is a unitary matrix.

OR

4. (a) Compute the 2D DFT of the following 2D signal.

8	4	2	6
8	5	2	4
6	5	1	2
9	1	1	8

[5]

   (b) What are the properties of a Discrete Fourier Transform? [5]

Module III

5. (a) Compute G_x and G_y gradients of the following 2D signal performing the convolution with Prewitt filter. Use border values to pad the signal.

5	7	1	5
5	7	2	5
6	4	2	7
7	5	3	7

[5]

P.T.O.

(b) Define Gaussian low-pass and high-pass filters. What are its merits over ideal low-pass and high-pass filters? [5]

OR

6. (a) Apply a 3×3 mean filter on the below 2D signal with replicate padding.

4	5	6	8
2	7	7	8
2	8	8	7
4	8	7	6

[5]

(b) Differentiate between time-domain and frequency-domain filtering process. [5]

Module IV

7. (a) How deconvolution can be performed using Direct Inverse filter? What are its limitations? [5]

(b) Describe the working of Gaussian band pass filter with the help of an example. [5]

OR

8. (a) How Wiener filter works? Explain with the help of an example. [5]

(b) Describe the working of Butterworth notch reject filter. What are its applications? [5]

Module V

9. (a) Describe how gradient magnitude and orientation angle can be computed for a 2D signal. [5]

(b) How Butterworth band-pass filter works? Explain with an example. [5]

OR

10. (a) Explain the importance of magnitude and phase angle spectrum of a fourier signal. How it can be computed? [5]

(b) How Gaussian band-reject filter works? Explain with an example. [5]