

<p align="center"> <b>VIT Vellore Institute of Technology, NITTE</b>          (An Autonomous Institution affiliated to VTU, Belagavi)  <b>Third Semester B.E. (CSE) (Credit System) Degree Examinations</b>          November – December 2017  <b>14CS723 – IMAGE PROCESSING</b> </p>		
Duration: 3 Hours		Max. Marks: 10
<p align="center"><b>Note: Answer Five full questions choosing One full question from each Unit.</b></p>		
<b>Unit – I</b>		<b>Marks BT</b>
1. a) What are the two general perspectives behind pursuing of digital image processing? Explain the fundamental steps in digital image processing with a neat block diagram?	6	L <sup>1</sup>
b) Explain the data structure of representing digital images? Name and define the different distance measures used with digital images?	8	L <sup>1</sup>
c) What is histogram equalization? Taking an image of 4x4 bring out the different steps involved in histogram equalization?	8	L <sup>1</sup>
2. a) What is digital Image Processing? Briefly explain any five examples of fields that use Digital Image Processing?	6	L <sup>1</sup>
b) What is the use of Image Interpolation technique? Discuss the different image interpolation techniques used commonly.	6	L <sup>4</sup>
c) Write a short note on the following terminologies. (i) Contrast stretching (ii) Bit-plane slicing (iii) intensity-level slicing and (iv) histogram equalization	8	L <sup>5</sup>
<b>Unit – II</b>		
1. a) Define smoothing spatial filter, and design a smoothing linear filter to run on a sample image matrix of size 5x5. Produce the resultant image matrix for the two cases (i) without zero padding (ii) with zero padding.	10	L <sup>3</sup>
b) What is a low pass filter in the frequency domain? Discuss the different low pass filters available in frequency domain with proper mathematical formulations?	10	L <sup>4</sup>
a) Bring out the foundations of Sharpening filters in the spatial domain. Explain the different techniques and respective filters to achieve sharpening in the spatial domain?	10	L <sup>5</sup>
b) List down different applications that use high pass filter? With proper mathematical formulations bring out the different high pass filters, available in the frequency domain?	10	L <sup>4</sup>
<b>Unit – III</b>		
a) What is image segmentation technique? In Brief discuss how points, lines and edges are detected in a digital image?	10	L <sup>6</sup>
b) Discuss any two important region based segmentation techniques.	10	L <sup>5</sup>
<b>P.T.O.</b>		

14CS723

SEE – November – December 2017

6. a) What is the output characteristics of image segmentation? Explain different edge detection techniques producing the corresponding masks used. 10
- b) Explain two techniques using motion in segmentation? 10

#### Unit – IV

7. a) With respect to digital images write a short note on the following keywords (i) data compression, (ii) Compression ratio, (iii) Coding redundancy, (iv) spatial and temporal redundancy, (v) SNR 10
- b) What is morphological image processing? Explain dilation and erosion with an example? 10
8. a) What are lossy and lossless compression techniques? Discuss one lossy and one lossless compression technique of your choice? 10
- b) Discuss in brief any five basic morphological algorithms? 10

#### Unit – V

9. a) List the two major divisions of color image processing with an example? Explain different color models supported by color image processing? 10
- b) How smoothing and sharpening operations can be carried out in color image processing? 10
- c) Explain color transformation related color image processing giving examples. 10

**NMAM INSTITUTE OF TECHNOLOGY, NITTE**  
(An Autonomous Institution affiliated to VTU, Belgaum)  
**Seventh Semester B.E. (CSE) (Credit System) Degree Examinations**  
December - 2014

**CS713 - IMAGE PROCESSING**

Duration: 3 Hours

Max. Marks: 100

**Note: Answer Five full questions choosing One full question from each Unit.**

**Unit - I**

1. a) Explain the basic steps in Image Processing with a neat block diagram. 10
- b) With an example, explain the process of sampling and quantization. 10
2. a) Define Histogram equalization. Develop an algorithm for contrast enhancement using this technique. 10
- b) Discuss some of the basic relationships that exists between pixels in a digital image. 10

**Unit - II**

3. a) Explain image enhancement using arithmetic and logic operations. 10
- b) Describe image sharpening techniques in spatial domain based on first derivative of an image function. 10
4. a) Discuss Discrete Fourier Transform and its properties. 10
- b) Explain image smoothing algorithms used in frequency domain. 10

**Unit - III**

5. a) Discuss in brief, Homomorphic filter with block diagram. 8
- b) Explain how Hough Transform helps in extracting line segments from an image. 12
6. a) What are the properties of segmentation? Discuss the procedure of obtaining the Segmented regions using split and merge strategy. 10
- b) Discuss the basic concept of segmentation by morphological watersheds. 10

**Unit - IV**

7. a) Define image compression. Describe the image compression model. 10
- b) Explain how Huffman coding technique helps in reducing the size of an image data. Obtain the Huffman code for the following data. Also compute Entropy and efficiency. 10

Data	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>
Probability	0.4	0.08	0.1	0.04	0.1	0.3

8. a) Define Morphology. Discuss Binary dilation and erosion in detail. 10
- b) Discuss Hit-or-miss transform and region filling morphological operators. 10

**Unit - V**

9. a) Discuss the different transformations which can be performed on color image. 8
- b) Explain intensity slicing and gray level to color transformation in Pseudo color image processing. 12
10. a) Discuss RGB and HIS color models. 8
- b) Explain color image smoothing and sharpening techniques. 12

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- a) Define Histogram equalization. Develop an algorithm for contrast enhancement using this technique with a corresponding mathematical model designed for contrast enhancement. 12
- b) Discuss any two gray level transformations with their importance. 8

#### Unit – II

- a) Devise an algorithm to smooth an image using  
i) Image Averaging and  
ii) Median filtering technique. 12
- b) Develop an algorithm to compute the FFT of an image in  $O(n \log n)$  where  $n$  is the size of the image. 8
- a) Devise an algorithm to smooth an image using any two frequency domain filters. 10
- b) Describe any two image sharpening filters in spatial domain. Illustrate, considering at least an image of size  $3 \times 3$ . 10

#### Unit – III

- a) Define segmentation. Discuss how an optimal threshold can be estimated in a threshold based segmentation technique. Obtain the optimal threshold for the following  $4 \times 4$  image.

10	10	12	15	25
12	12	11	13	30
12	14	12	12	24
22	21	22	22	23
22	24	26	22	22

- b) Explain any two high pass filters in frequency domain. 12
- a) Explain how morphological watersheds are used in segmentation process. 8
- b) Devise an algorithm to obtain segmented regions using split-merge strategy. 10

#### Unit – IV

- a) Define image compression. Explain the different form of redundancies that are explored for compression purpose. 8
- b) Devise an algorithm to compress the image using Huffman coding technique. Trace your algorithm for the following data:

Symbol	Frequency
A	24
B	12
C	10
D	8
E	8

P.T.O. 12

8. a) Describe the general image compression model with a neat block diagram.  
b) Explain the procedure of JPEG coding technique.  
c) Discuss the basics of Hit-or-Miss transformation.

**Unit - V**

9. a) Discuss any three colour models. Derive an algorithm to convert RGB colour model to HSI colour model.  
b) Explain the process of sharpening of colour images.
10. a) Describe the procedure of segmentation of colour images.  
b) Write a note on Haar transform.

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**Seventh Semester B.E. (CSE) (Credit System) Degree Examinations**  
December - 2011

**CS713 - IMAGE PROCESSING**

Max. Marks: 100

Note: Answer **Five full** questions choosing **One full** question from **each Unit**.

**Unit - I**

- |       |  |    |
|-------|--|----|
| 1. a) | Write a note on UV ray imaging.  | 05 |
| b)    | How human eye gets adapted to change in brightness? How brightness adaptation is measured?   | 05 |
| c)    | Define 4-neighbor and 8-neighbor pixel in a digital image.   | 04 |
| d)    | Define and show the relation between image function, illumination and reflectance.   | 05 |
| 2. a) | Write a note on gamma correction.  | 05 |
| b)    | What is gray level? How it is related to image and its appearance?   | 05 |
| c)    | What is brightness and contrast of an image? Illustrate how contrast of an image can be enhanced using histogram equalization process? | 10 |

**Unit - II**

- |       |  |    |
|-------|--|----|
| 3. a) | Discuss the logical operations on images. Mention its applications.                            | 10 |
| b)    | What are low pass and high pass filters? Explain Butterworth low pass and high pass filtering. | 10 |
| 4. a) | What is image subtraction and image averaging? Explain its applications.                       | 08 |
| b)    | Write a note on high boost filtering and unsharp masking.                                      | 08 |
| c)    | Explain ideal high pass filter.  | 04 |

**Unit - III**

- |       |  |    |
|-------|--|----|
| 5. a) | Explain the concept of thresholding. Mention the steps that can be followed to get the global threshold T. | 10 |
| b)    | Explain how gradient is used for measuring magnitude and direction of vector.                              | 06 |
| c)    | Explain the method of detecting isolated point in an image.  | 04 |
| 6. a) | Explain how Hough transform is used for edge detection?  | 08 |
| b)    | Explain how region growing is used for segmentation?   | 05 |
| c)    | Explain the watershed concept for segmentation.  | 05 |

**Unit - IV**

- |       |   |    |
|-------|---|----|
| 7. a) | With suitable example, explain arithmetic coding method.  | 10 |
| b)    | Explain the hamming code concept.   | 06 |
| c)    | Explain the terms i) relative redundancy ii) compression ratio  | 04 |
| 8. a) | With suitable example, explain LZW compression method.  | 10 |
| b)    | Explain the dilation and erosion with suitable illustration for each. How opening and closing is related to dilation and erosion? | 10 |

**Unit - V**

- |        |   |    |
|--------|---|----|
| 9. a)  | Explain the three characteristics that are used to distinguish one color from other.            | 06 |
| b)     | What is smoothing and sharpening? Write the formula and explain.                                | 06 |
| c)     | Explain the complement transform in color images.   | 04 |
| d)     | Which are primary and secondary colors. Show the relation between them.                         | 04 |
| 10. a) | Explain HSI color model and show its relation with RGB model with the help of suitable diagram. | 08 |
| b)     | Write a note on intensity slicing and discuss any one application.                              | 08 |
| c)     | Explain the terms i) radiance ii) luminance.  | 04 |

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- b) Briefly explain the various distance metrics used to calculate the distance between two pixels in an image. 05
- c) Explain Image Digitization and Image quantization process. 05
2. a) What do you mean by contrast stretching of a digital image? How do you perform contrast stretching of a gray scale digital image? 05
- b) Briefly explain the brightness interpolation technique. 05
- c) What do you mean by white noise? Give the algorithm to generate zero mean Gaussian noise. 10

#### Unit – II

3. a) What do you mean by Edge detection of a digital image? Explain the following Gradient operators to detect edge in a digital image.  
i) Sobel ii) Robinson 10
- b) Explain the Canny Edge Detection technique. 10
4. a) What do you mean by Low pass spatial filtering? How do you achieve it? What is its drawback? 05
- b) Briefly explain the various threshold detection methods with reference to image segmentation. 05
- c) How do you achieve edge detection using zero crossings of the second derivatives technique? Explain briefly. 10

#### Unit – III

5. a) How do you perform continuous border construction using edge relaxation technique? Give the algorithm. 10
- b) With an example explain the outer boundary tracing algorithm for image segmentation. 10
6. a) Explain Hough transform to detect a line in a digital image. 10
- b) What do you mean by Region-based image segmentation technique? Explain the region split and merge technique for digital image segmentation. 10

#### Unit – IV

7. a) Briefly explain the following gray level intensity transformations.  
i) Image negatives ii) Gray level slicing 10
- b) Discuss any two low pass filters used to smooth an image in the frequency domain. 10
8. a) What do you mean by Gray-scale transformation? With the help of an example explain the histogram equalization technique for contrast enhancement. 10
- b) Discuss any two high pass filters used to find edges of an image in the frequency domain. 10

#### Unit – V

9. a) Define image compression. Describe the image compression model. 10
- b) Explain the transform coding technique used in Lossy image compression. 10
10. a) What are the differences between lossy and lossless image compression? 05
- b) Explain in brief - run length encoding and decoding scheme. 05
- c) Devise an algorithm that encodes data using Huffman compression technique. Illustrate for the following data and compute entropy and efficiency. 10

Data	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>
Probability	0.2	0.05	0.01	0.04	0.1	0.3	0.15	0.15

# **NMAM INSTITUTE OF TECHNOLOGY, NITTE**

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## **Seventh Semester B.E. (CSE) (Credit System) Degree Examinations**

**Supplementary Examinations – May - June 2011**

Duration: 3 Hours

**CS713 – DIGITAL IMAGE PROCESSING**

**Note: Answer Five full questions choosing One full question from each unit.**

### **Unit – I**

- Explain Chain and Run length coding data structures to represent the digital image. 10
- Briefly explain the various distance metrics used to calculate the distance between two pixels in an image. 05
- Explain the various geometrical transformations of a digital image. 05
- Briefly explain the various types of digital images. 05
- Briefly explain the brightness interpolation technique. 05
- What do you mean by white noise? Give the algorithm to generate zero mean Gaussian noise. 10

### **Unit – II**

- What do you mean by Edge detection of a digital image? Explain the following Gradient operators to detect edge in a digital image.  
i) Prewitt ii) Roberts 10
- Explain the Canny Edge Detection technique. 10
- What do you mean by Low pass spatial filtering? How do you achieve it? What is its drawback? 05
- Briefly explain the various threshold detection methods with reference to image segmentation. 05
- Explain the following with reference to image segmentation:  
i) Adaptive thresholding ii) Band thresholding 10

### **Unit – III**

- How do you perform continuous border construction using edge relaxation technique? Give the algorithm. 10
- With an example explain the inner boundary tracing algorithm for image segmentation. 10
- Explain Hough transform to detect a line in a digital image. 10
- With an example explain the extended boundary tracing algorithm for image segmentation. 10

### **Unit – IV**

- Briefly explain the following gray level intensity transformations.  
i) Image negatives ii) Gray level slicing 10
- Discuss any two high pass filters used to smooth an image in the frequency domain. 10
- What do you mean by Gray-scale transformation? With the help of an example explain the histogram equalization technique for contrast enhancement. 10
- Explain High Boost spatial filtering. 05
- Discuss in detail Homomorphic filtering. 05

### **Unit – V**

- Define image compression. Discuss the different forms of image redundancy. 10
- Explain the transform coding technique used in Lossy image compression. 10
- What are the differences between lossy and lossless image compression. 05
- Explain in brief run length encoding and decoding scheme. 05
- Explain how Huffman coding technique helps in reducing the size of an image data. Obtain the Huffman code for the following data. 10

Data	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>	A <sub>7</sub>
Probability	0.4	0.06	0.1	0.04	0.1	0.3	



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**Seventh Semester B.E. (CSE) (Credit System) Degree Examinations**  
**Supplementary Examinations - July 2018**

**14CST116 - MACHINE LEARNING**

Duration: 3 Hours

Max. Marks: 100

Note: Answer Five full questions choosing One full question from each Unit.

	Unit - I	Marks
1. a)	Discuss the following i) Learning Curve ii) Bias & Variance	5
b)	Let us say we are building an OCR and for each character, we store the bitmap of that character as a template that we match with the read character pixel by pixel. Explain when such a system would fail. Why are barcode readers still used?	5
c)	What is Supervised and Unsupervised Learning? Explain.	8
2. a)	Imagine you have two possibilities: You can fax a document, that is, send the image, or you can use an optical character reader (OCR) and send the text file. Discuss the advantage and disadvantages of the two approaches in a comparative manner. When would one be preferable over the other?	8
b)	Briefly explain the Reinforcement learning.	6
c)	Explain the under fitting and overfitting.	6
	Unit - II	
3. a)	What is Regression? Discuss the real world examples for Regression problems.	6
b)	Briefly explain the gradient descent for classification and its applications.	8
c)	How do univariate and multivariate regression differ?	6
4. a)	What is support vector Machine? Explain the goal and constraints in SVM classifier with proper mathematical notations.	6
b)	What is logistic regression? Explain.	8
c)	What are Artificial Neural Networks?	6
	Unit - III	
5. a)	What is a Decision Tree? How does it work? Explain with an example.	10
b)	What is deep learning? Explain with an example.	6
c)	Briefly explain Linear Discriminant Analysis.	4
6. a)	Discuss the technique of building Bayesian classifier model using a given dataset.	6
b)	Write a note on Hidden Markov Model.	7
c)	How does KNN model works? Explain with a small example.	7
	Unit - IV	
7. a)	Use the k-means algorithm and Euclidean distance to cluster the following 8 examples into 3 clusters. A1=(2,10), A2=(2,5), A3=(8,4), A4=(5,8), A5=(7,5), A6=(8,4), A7=(1,2), A8=(4,6). The distance matrix based on the Euclidean distance is given below.	

P.T.O.

14CS716

Supplementary - July 2018

	A1	A2	A3	A4	A5	A6	A7	A8
A1		$\sqrt{25}$	$\sqrt{36}$	$\sqrt{13}$	$\sqrt{50}$	$\sqrt{52}$	$\sqrt{65}$	$\sqrt{5}$
A2			$\sqrt{37}$	$\sqrt{18}$	$\sqrt{25}$	$\sqrt{17}$	$\sqrt{10}$	$\sqrt{20}$
A3				$\sqrt{25}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{53}$	$\sqrt{41}$
A4					$\sqrt{13}$	$\sqrt{17}$	$\sqrt{52}$	$\sqrt{2}$
A5						$\sqrt{2}$	$\sqrt{45}$	$\sqrt{25}$
A6							$\sqrt{29}$	$\sqrt{29}$
A7								$\sqrt{58}$
A8								

Suppose that the initial seeds (centers of each cluster) are A1, A4 and A7. Run the k-means algorithm for 1 epoch only. At the end of this epoch show:

- Find the new clusters (i.e. the examples belonging to each cluster)
  - Find the centers of the new clusters.
  - Draw a 10 by 10 space with all the 8 points and show the clusters after the first epoch and the new centroids.
  - How many more iterations are needed to converge? Draw the result for each epoch.
- How a classifier model can be evaluated?
  - What are Hypothesis testing? Briefly explain issues with Hypothesis Testing.
  - What is bagging? Explain.
- Unit - V
- What is reinforcement learning? Explain the elements of Reinforcement Learning.
  - What is Model-based learning? Explain Value Iteration and Policy Iteration algorithm for model-based learning.
- What are Temporal Difference Learning? Briefly explain the following.
    - Exploration Strategies
    - Deterministic Rewards and Actions
    - Non-deterministic Rewards and Actions

BT\* Bloom's Taxonomy, L\* Level

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Time: 3 Hours

Max. Marks: 100

Note: Answer Five full questions choosing One full question from each Unit.

**Unit – I**

- |   |    |     |
|---|----|-----|
| Define Machine Learning and explain the three types of Machine learning techniques. | 10 | L*2 |
| Differentiate Overfitting and Underfitting.   | 06 | L3  |
| Write a note on learning curve.   | 04 | L1  |
| Explain the process of training and testing in machine learning with example.       | 10 | L2  |
| Give any two applications of supervised learning and unsupervised learning.         | 06 | L3  |
| Illustrate the importance of data in machine learning.                              | 04 | L4  |

**Unit – II**

- |   |    |    |
|---|----|----|
| Discuss the structure and training of neuron in Artificial Neural Network model.  | 12 | L2 |
| Design a Multiple regression model in terms of $X(p\text{-dimension})$ , $Y(1\text{-dimension})$ , $\beta$ and $\epsilon$ . | 08 | L4 |
| Compute the parameters $\beta$ and Sum Squared Error (SSE) for the given dataset using multiple linear regression model.    |    |    |
- |   |    |   |   |    |    |    |
|---|----|---|---|----|----|----|
| X | 10 | 5 | 7 | 19 | 11 | 8  |
| Y | 15 | 9 | 3 | 25 | 7  | 13 |
- |   |    |    |
|---|----|----|
| Consider the weights for ANN model given as below; derive the functional ANN model where the input $(x_1, x_2)$ is a pair of binary values and output $y$ can be either 0 or 1. | 12 | L4 |
| I. $W=[-10, 20, 20]$ II. $W=[-30, 20, 20]$  | 08 | L5 |

**Unit – III**

- Define the entropy measure and determine the attribute selection criteria at root node of decision tree using information gain for the dataset given below.

Day	Outlook	Temp	Humidity	Wind	PlayTennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	W <	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

Write a note on Hidden Markov Model.

12 L5  
08 L2

P.T.O.

14CS316

SEE - November - December 2017

6. a) Consider the above dataset in Question 5(a) and a new instance variable values,  
 $x' = \{\text{Outlook: Sunny, Temperature: Cool, Humidity: High, Wind: Strong}\}$   
 Determine the class label to which  $x'$  belongs to using Bayesian classifier. 12 L5  
 b) Discuss the working of k-nearest neighbor model and the advantages/disadvantages of choosing a very large or small value for k. 08 L4

## Unit - IV

7. a) Consider the set of five points A(1,1,4), A2(1,2), A3(2,2), A4(5,7) and A5(3,5). Assume the initial cluster means as A1 and A2. Apply k-means clustering algorithm to compute ( $k=2$ ) clusters after two iterations. 12 L4  
 b) Explain various methods of combining learners. 08 L2
8. a) Given a distance matrix, compute clusters using hierarchical clustering algorithm.

	A	B	C	D	E	F
A	0.00	0.71	5.66	3.61	4.24	3.20
B	0.71	0.00	4.95	2.92	3.54	2.50
C	5.66	4.95	0.00	2.24	1.41	2.50
D	3.61	2.92	2.24	0.00	1.00	0.50
E	4.24	3.54	1.41	1.00	0.00	1.12
F	3.20	2.50	2.50	0.50	1.12	0.00

- b) Discuss cross validation and re-sampling methods. 12 L4  
 08 L2
- Unit - V
9. a) Discuss the different aspects of temporal difference learning. 12 L2  
 b) What is Reinforcement learning? Explain with a neat diagram. 08 L2
10. a) Explain the working of K-armed Bandit. 08 L3  
 b) Discuss any of the eight elements of reinforcement learning with proper mathematical notations if any. 12 L2

3\* Bloom's Taxonomy, L\* Level

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