INDIAN STATISTICAL INSTITUTE
THIRD SEMESTER EXAMINATION, 2015/17 SESSION
PAPER - 13: INFORMATION STORAGE, RETRIEVAL AND DBMS
(MASTER IN LIBRARY INFORMATION SCIENCE)
22nd November 2017 (10:00-13:00) (3 Hours)

This Question paper consists of 2 pages. **Attempt Questions and/or Sub-Questions sufficient enough to score 100 marks.** Please print all your answers in the Answer Booklet provided. Scientific Calculator is allowed.

QUESTION 1.

Write briefly about

    i)   Devices to store data   **[4 marks]**

    ii) What is thresholding?   **[4 marks]**

    iii) Role of RDBMS and E-R Diagrams in text information retrieval   **[4 marks]**

    iv) K-Means Clustering   **[6 marks]**

QUESTION 2.

A. Figure 1 is a four-bit greyscale image, $f(x,y)$, of size 7 x 7 pixels, depicting greyscale values of a picture in a document. These greyscale values range between 0 and 15 (4-bit image).

3	5	9	8	9	6	6
11	9	7	13	5	6	7
10	9	7	12	9	8	7
6	8	12	9	4	8	6
2	3	5	12	9	11	12
3	6	9	6	10	12	16
6	8	12	9	11	9	7

Figure 1

Convert the data shown in Figure 1 into binary form by choosing a median value as the threshold value   **[6 marks]**

B.. Compute $\sum_{x,y} f(x, y)$, and plot a histogram for the above 7 X 7 multi-valued image   **[6 marks]**

QUESTION 3.

Let β and $(1-\beta)$ be probability values observed after first level of bisection of a map depicting spatially spread phenomenon. (ii) By considering β and $(1-\beta)$ respectively as 0.62 and 0.38, compute α_q and $f\alpha_q$ for the q values ranging between -3 to +3, and construct the $f\alpha$ spectra and find out what is information dimension.   **[10 marks]**

QUESTION 4.

Write the formula with clear explanation of all notations and parameters involved in K-Mixture model. Explain its use in document summarization.   **[8 marks]**

QUESTION 5.

Compute the spatial autocorrelation via Moran's Index, by showing all the involved steps, for a spatial field of your choice. Explain the interpretation of the index from the perspective of Information Science..   **[10 marks]**

QUESTION 6.

What is Mahalanobis Distance? Compute it for the data, created of your choice, containing two variables (x and y) belonging to two groups (A and B). Write your conclusions about the relevance of Mahalanobis Distance in the context of information retrieval.   **[12 marks]**

QUESTION 7.

A. Write briefly about musicological parameters. Explain Hit-Or-Miss Transformation (HMT), and Blur Hit-Or-Miss Transformation (BHMT) and their use in Music Information Retrieval (MIR)

[8 marks]

QUESTION 8.

Application of Rectangular Granulometries in quantitatively characterizing the geometrically complex Delimiter space of the first page of any document published in a standard technical journal. **[8 marks]**

QUESTION 9.

A. Write an algorithm to convert point-data into polygonal form. By considering at least three points $\left(X^1, X^2, X^3\right)$ spread over discrete space, where $\left(X^1 \cap X^2 \cap X^3\right) = \phi$, explain on how to generate three zones of influence via Skeletonization by Influence Zone (SKIZ), and Weighted Skeletonization by Influence Zone (WSKIZ) transformations.

[7 marks]

B. Computation of Morphological Interpolations between the (a) sets X and Y, where $\left(X \cap Y\right) \neq \phi$, and (b) the two spatial functions f^1 and f^2, where $f^1 \wedge f^2 \neq f^1$ and $f^1 \wedge f^2 \neq f^2$. Explain on how morphological interpolations could be applied to generate the missing data. **[8 marks]**

QUESTION 10.

Let f^i and f^j be two spatial fields. The two spatial fields of size 3×3 are shown in Figure 2a and 2b.

95	193	222		102	198	236
81	115	94		190	73	254
221	235	242		205	100	195
	(a)				(b)	

Figure 2. The two spatial fields (a) f^i, and (b) f^j

Considering the above details, address the following questions: **[12 marks]**

(a) Write an equation to compute morphological median for f^i and f^j.

(b) Compute $\left(f^i \wedge f^j\right)$ and $\left(f^i \vee f^j\right)$

(c) Compute $A\left(f^i\right)$, $A\left(f^j\right)$ $A\left(f^i \wedge f^j\right)$, and $A\left(f^i \vee f^j\right)$

(d) Dilate $\left(f^i \wedge f^j\right)$ with 0B, B, and 2B (consider B as symmetric square 3×3 primitive size)

(e) Erode $\left(f^i \vee f^j\right)$ with 0B, B, and 2B (consider B as symmetric square 3×3 primitive size)

(f) Take infima of (i) $\left(f^i \wedge f^j\right) \oplus 0B$ and $\left(f^i \vee f^j\right) \ominus 0B$, (ii) $\left(f^i \wedge f^j\right) \oplus B$ and $\left(f^i \vee f^j\right) \ominus B$, and (iii) $\left(f^i \wedge f^j\right) \oplus 2B$ and $\left(f^i \vee f^j\right) \ominus 2B$

(g) Take suprema of three output results obtained in (f).

QUESTION 11.

Write full set of equations to classify the three disjointed spatial zones namely $\left(X^1, X^2, X^3\right)$ of a spatial system S to compute variable-specific force of interaction between all possible combinations of the zones using the modified gravity model, where additional parameters are asymmetric distances, location significance indices. Provide interaction matrices in support of the equations. **[8 marks]**

QUESTION 12.

Write a simple morphology-based algorithm to compute the ranks for pair of images. Give an example of your choice to explain illustratively with support of equations. **[8 marks]**

END OF PAPER