

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ)

FIRST SEMISTER 2023-2024

Pattern Recognition (BITS F446)

Comprehensive Examination (Open Book)

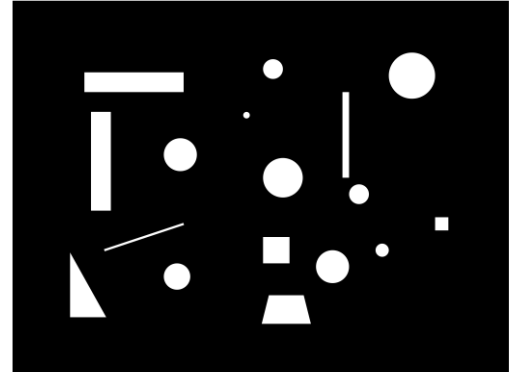
Maximum Marks: 20 (10%)

Maximum time: 60 minutes

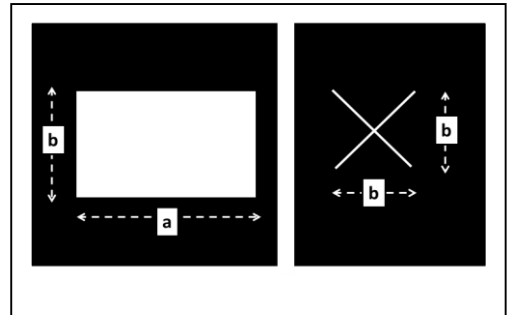
Date: 18/12/2023

- Each symbol has its usual meaning
- Answer to the point
- Use fresh A4 page

Q1. Propose an algorithm involving strictly morphological operations to separate the discs. The diameters of discs are varying as shown in the figure. Your final image should contain only discs of original diameter and at original location. [8M]



Q2. Propose an algorithm to transform a rectangle into \times pattern as shown in the image. The dimensions are as shown in the image. *Strictly morphological operations.* (Note: You are not permitted to take \times as a strel) [8M]



Q3. What is the suitable topological descriptor for identifying



from



? [4M]

-----All the best-----

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ)

FIRST SEMESTER 2023-2024

Pattern Recognition (BITS F446)

Comprehensive Examination (Closed Book)

Maximum Marks: 60 (30%)

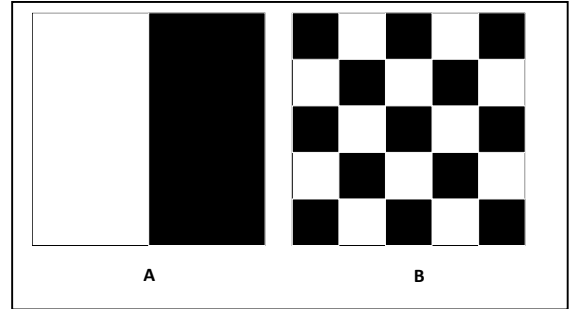
Maximum time: 120 minutes

Date: 18/12/2023

- Each symbol has its usual meaning
- Answer to the point

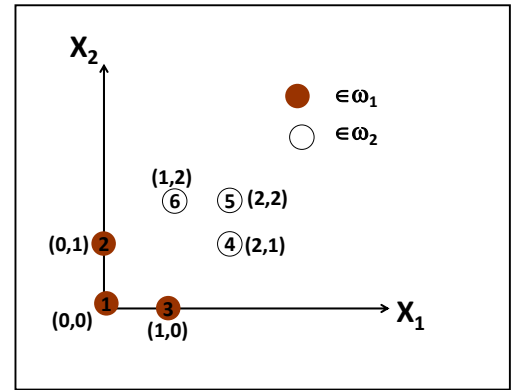
Q1. The images A and B as shown in the figure are binary in nature (white pixel=1 & black pixel=0) having size 250×250 pixels. Answer the following questions:

(Ignore the image boundary pixels. Marks will be awarded only with proper labeling of the axes showing the values)



- i) What are the histograms of the images A and B?
- ii) What are the histograms of first order x-derivative of the images A & B?
- iii) What are the histograms of the Laplacian (90° rotationally invariant) of the images A & B? [2+5+5=12M]

Q2. Apply neural networks (perceptron) algorithm to the two pattern classes ω_1 & ω_2 with the training points as shown in the figure. Use fixed increment correction rule with $c = 1$ and $W(1)=(0,0,0)^T$ to estimate the values of $W(2)$ to $W(8)$. Show all the W 's in a table. Write all the steps involved. The point number is shown inside the circles in the figure. The coordinate readings are shown in bracket () in the figure. [14M]



Q3. Find the discrete Fourier transform (DFT) of binary image of dimension 1×6 as shown below and finally write $F(u)$ for $u = 0, 1, 2, 3, 4$ & 5 [10 M]

0	0	1	1	0	0
---	---	---	---	---	---

Q4. Four different handwritten characters need to be detected based on topological descriptor. Based on topological properties, formulate the Euler number which can be used for the detection of these characters. Test the formula by showing that the framed Euler number is unique for these characters. *You are permitted to take only the linear combination of the topological features with a co-factor equal to +1 (+one) or -1 (-one). You are permitted to take ONLY topological parameters: connected component, convex deficiency and/or holes.* [12 M]



Q5. Draw the signature of a rectangle whose sides are length=12 and width=8 units. Normalize it with respect to the starting point. Full marks will be awarded only with proper labeling of the axes showing the numerical values. [6M]

Q6. Matlab related questions:

[2+1+2+1=6M]

Fill in the blanks

(A) Code for adding a scalar (=90) to cameraman.tif.

```
a=imread('cameraman.tif');
```

```
[m,n] = _____(a); %%<-----what is in the blank here-----
```

```
for i=1:m
```

```
for j=1:n
```

```
b(i,j)=a(i,j)+90;
```

```
end
```

```
end
```

```
%for displaying the output image 'b'
```

```
_____ (b); %%<-----what is in the blank here-----
```

(B) Part of the code for thresholding 'cameraman.tif'

```
threshold_value=116;
```

```
for i=1:m
```

```
for j=1:n
```

```
if _____ %%-----what is in the blank here-----
```

```
b(i,j)=255;
```

```
_____ %%-----what is in the blank here-----
```

```
b(i,j)=0;
```

```
end
```

```
end
```

```
end
```

_____ **All the best** _____