

Digital Image Processing

COSC 6380/4393

Oct 24th, 2023

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Midterm Exam

- Date: Thu. Nov 2nd
- Time: 8:30 AM – 9:45 AM
 - Plan to enter class at 8:20 AM and settle in
- Location: MH 150
- Exam Duration: **75 Minutes**
 - The exam will end exactly at **9:45 AM**

Mid Term Exam

- Syllabus:
 - Introduction
 - Binary Image Processing
 - Point Operations
 - Discrete Fourier Transform
 - Spatial Filtering

Exam Submission Format

1. Exam paper with questions will be provided.
2. Each questions will have space allocated for the solutions
 1. Additional sheets will be provided if needed.
3. Write solution with pen/pencil
4. Turn-in exam paper

Exam format

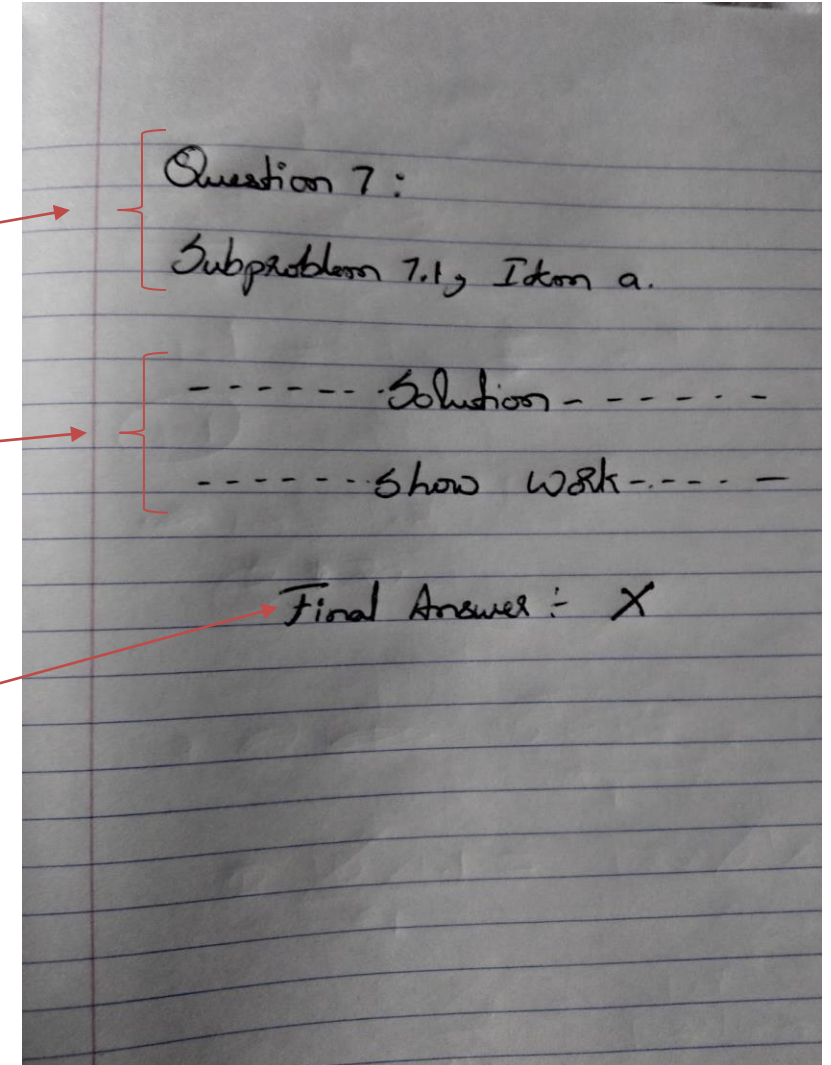
Type	Count	Points
True/False, Multiple Choice, Fill in the blank	5 to 10 questions	20 to 40
Objective Problem (involves calculations on paper)	3 to 5 questions	80 to 60

Total: 100 PTS

Objective Problem Instructions

For each objective problem

1. Clearly **identify the question number**, sub item.
2. Show your work (**Points** awarded for work)
3. Show Final answer (**Points** awarded for final answer)
 1. Label Final answer clearly
4. **Partial points possible**, in case final answer wrong



One Cheat Sheet Allowed

- **Closed book**
 - Text-book, full lecture slides, online resource, etc. **are not to be used.**
- **One A-4** size cheat sheet is allowed
 - Cheat sheet must be a **physical printed paper.**
 - **Double-sided** print is acceptable.
 - **Cheat sheets** available on computer, **phones**, tablets **not allowed.**

Calculators Allowed

1. **Only calculators (scientific, graphing, etc) are allowed.**
2. Calculators on phones, computers, tablets, etc. are **not allowed.**

Summary

Allowed	Not Allowed
One A-4 size cheat sheet (physical paper)	Textbook
Scientific calculator	Phones
Require stationary	Tablets
	computers
	Full copy of lecture slides (select slides can be included in cheat sheet)
	Collaboration with other students
	Any means to communicate with or access resources via internet.

Exam checklist

- ☐ Stationary (pen, pencil, eraser, etc.)
- ☐ Additional stationary as needed
- ☐ Scientific calculator
- ☐ Cheat sheet

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Midterm Review Questions

Image Formation

Image Formation: (Projection)

1. A person is standing M meters in front of a camera
 - h is the height of the person
 - X is the focal length of the camera
 - H is the height of the projection of the person on the imaging plane. What is H ? (Show steps)
2. A sphere/square is placed at a distance of M meters (m) in front of a camera
 - a/v is the area/volume of the object
 - X is the focal length of the camera
 - A/V is the area of the projection of the object on the imaging plane. What is A/V ? (Show steps)

Resampling

Given the location of four pixels Q_{11} , Q_{12} , Q_{21} , Q_{22} and their intensity values I_{11} , I_{12} , I_{21} , I_{22} . Assuming that Q_{11} , Q_{12} , Q_{21} , Q_{22} are the nearest pixels to P

Estimate the intensity value of pixel located at P using bilinear interpolation?

Binary Image Processing

Binary Image Logical Operations

- Given an acquired binary images I and a model binary Image M below. Generate a third binary image D representing the unmatched pixels in the acquired image compared to the model image.
- Since binary operations are quicker, you are allowed to use only binary operators (And, OR and NOT) or a combination of these on binary image M and I to accomplish this task.

0	1
1	0

 M

0	1
0	1

 I

0	0
1	1

 D

4. Morphological Operations

1. Perform a morphological operation using a window of your choice to remove the small object represented by 1 at pixel (2,4) in the image below.

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

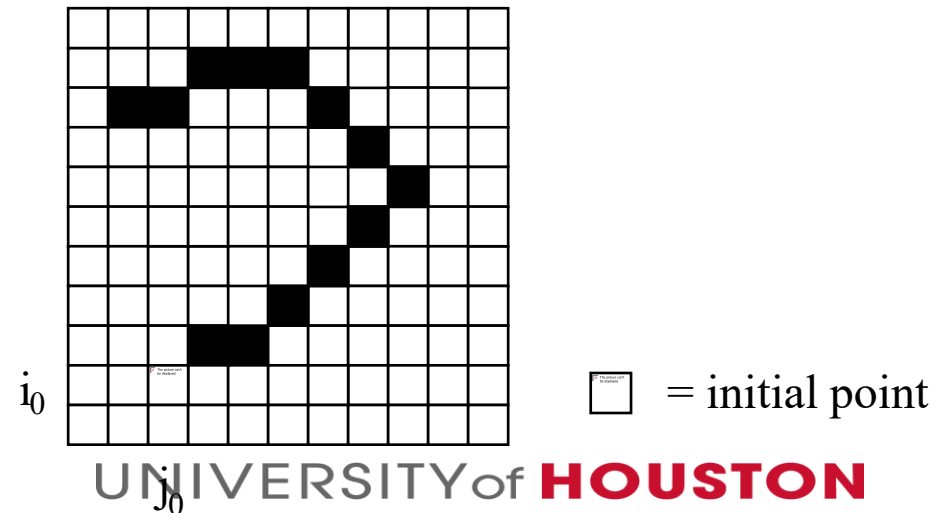
2. Operations to cover holes, remove peninsula?

5. Compression

1. Perform compression to represent sequence of pixels in the binary image below

what's
stored: '1' 7 5 8 3 1
row m 

2. Perform compression to represent the contour in the binary image using chain codes



Point Operations

Linear Point Operations

1. Perform a full contrast stretch on the image below assuming that the dynamic range of the image is 0-15
2. Perform histogram flattening, shaping

$$\mathbf{I} =$$

1	1	3	4
2	5	3	2
8	1	8	2
4	5	3	11

Discrete Fourier Transform

1. Compute the DFT of the following matrix

1	31
20	7

2. Prove that the DFT of a 2D matrix is Conjugate symmetric
 1. The magnitude of the DFT matrix is symmetric
3. Prove that the DFT of an image is periodic in nature (Periodic extension of DFT)

4. The IDFT is periodic in nature (Periodic extension of IDFT)

Spatial Filtering

Filtering

1. Apply a 3X3 spatial smoothing filter on the image I
2. Sharpen Image using a
 1. Laplacian filter (3X3 filter)
 2. Unsharp mask (3X3 filter)

$I =$

1	1	3	4
2	5	3	2
8	1	8	2
4	5	3	11