



Digital Image Processing

UE18CS333 – Elective III

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Digital Image Processing

Course Overview

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Digital Image Processing

What will we study in this course?

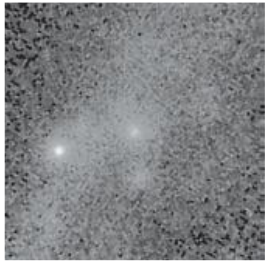


- Techniques to **work with images** to make them amenable for **feature extraction**
- Algorithms to *process* digital images
 - Improve the contrast in an image
 - Adjust brightness (dark to bright, bright to dark,...)
 - Find edge maps and segment regions of interest
 - Work with black and white images for object detection, optical character recognition, etc.
 - Nuances of color spaces and working with color images
- Extract features from images (for tasks such as classification, recognition, etc.)
- Machine learning techniques for image classification, etc., tasks
- Deep learning architectures for images for object recognition, etc., tasks

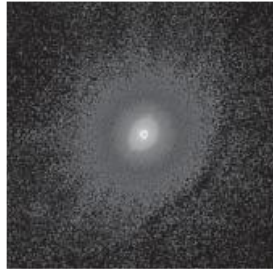
Digital Image Processing

Unit 1: Elements of visual perception and analyzing the histogram and applying gray level transformations

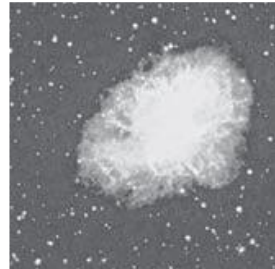
- How do we see an image?
- A peek into different imaging systems



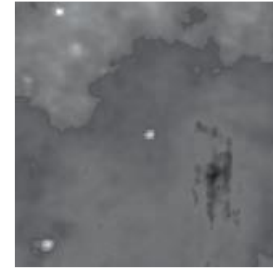
Gamma



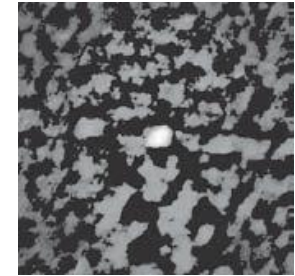
X-ray



Optical

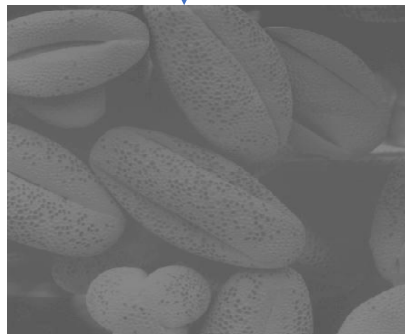


Infrared

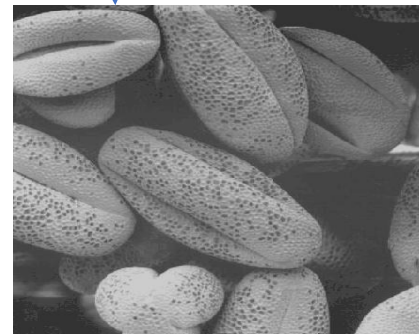


Radio

- Given an image, how do we assess what processing will enhance this and apply that?
- How do we go from this



this... ?

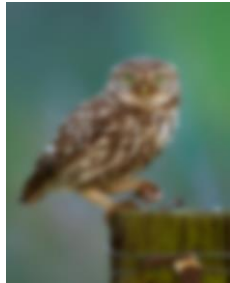


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Unit 2: Image enhancement

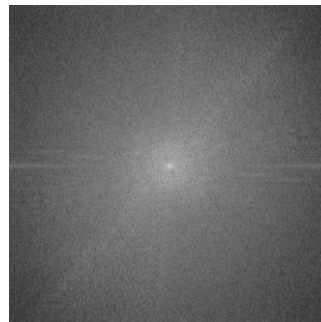
- Spatial domain enhancement techniques

How do we smooth, sharpen and denoise an image?



- Frequency domain enhancement techniques

- How do we interpret an image in the Fourier domain?

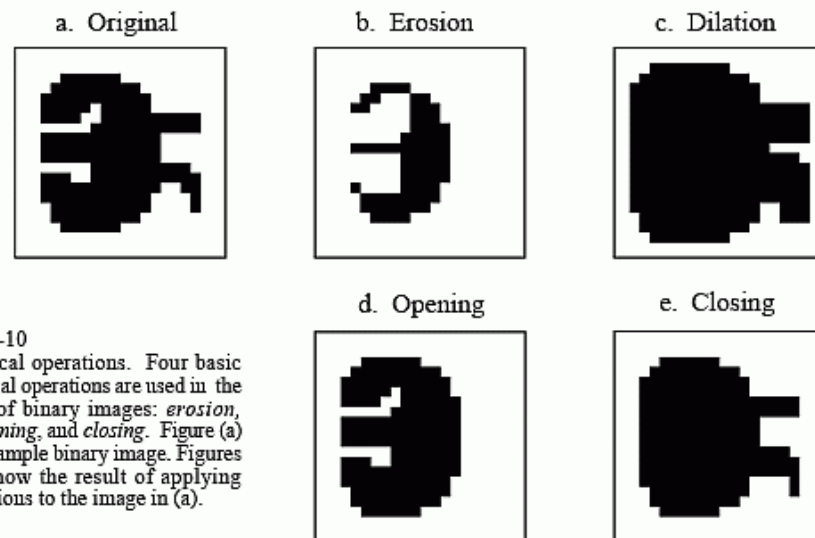
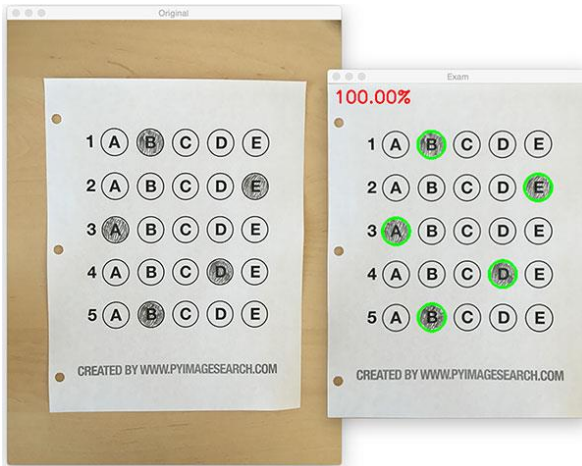


- How do we process images (design filters) in the transform domain?

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Unit 3: Morphological image processing and segmentation preliminaries

- Working on black and white images
- Number plate detection, optical character recognition, counting of objects, automated evaluation of OMR sheets... using:



- Segmentation preliminaries
- Detecting objects of interest in the foreground and
- Separating them from each other and the background



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Unit 4: Color fundamentals and basics of compression

- Understanding different color spaces and converting from one to another

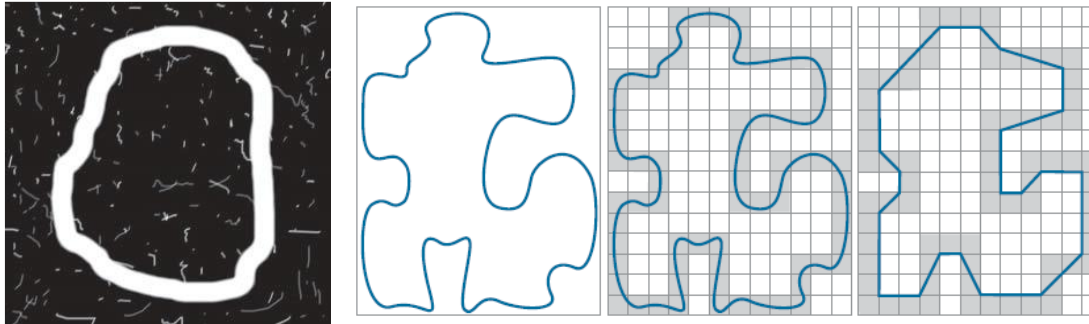


- How does image compression work?
- How does arithmetic coding work with images? What is the jpeg format?

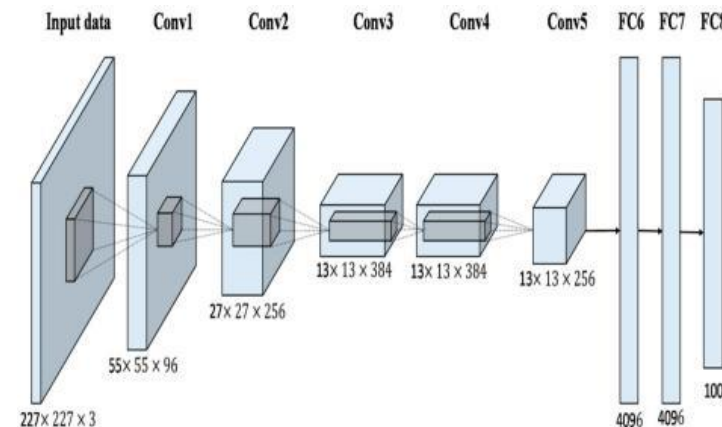


- How do we ensure the information is intact but eliminate redundancy?

- Understand different ways of describing an image (or its contents) for cognitive tasks
- Describing an object boundary, computing the area or perimeter of regions, statistical moments, textures, etc.



- How does deep learning 'extract' features?
- How do CNN's and other architectures work for cognitive tasks?



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Pre-requisites



- Linear algebra
- Machine Intelligence
- A curiosity to see inside the ‘black box’ and get a peek into the ‘how’ behind Picasa or Photoshop
- Plenty of enthusiasm to learn
- [Is there a textbook that covers most of this course?](#)
- Yes, the primary reference would be the classic text for digital image processing “Digital Image Processing” (fourth edition) by Rafael C. Gonzalez and Richard C. Woods
- We will refer to relevant literature as needed (particularly, for Unit 5 on deep learning)
- [What is the tool we will learn with this course?](#)
- We will run quick tests and build prototypes using Matlab; you are welcome to explore OpenCV or Python if you are more comfortable with these for the miniproject that is a part of the course

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Evaluation policy (tentative)



- ISA 1 (Units 1,2,3): 24 marks
- ISA 2 (Units 4, 5): 16 marks
- Assignments, seminar, quizzes: 10 marks
- ESA: 40 marks
- Mini-project: 10 marks

Please note:

- The evaluation components and weight allotted to each component are tentative; the course will conform to the guidelines/ framework prescribed by the University/ Department
- Further, due to the current situation with the pandemic, in-class components (such as seminar) will depend on the strength of the class, modality of conduction of lectures, attendance of classes (online vs. offline or dual mode), etc., to ensure those attending online are not at any disadvantage.

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References and image courtesy



- Digital image processing (fourth edition) by Rafael C. Gonzalez and Richard C. Woods, Pearson, 2018.
- [Image denoising using nonlinear filters]
http://www.iaeng.org/publication/IMECS2019/IMECS2019_pp377-380.pdf
- [Automated OMR evaluation]
<https://www.pyimagesearch.com/2016/10/03/bubble-sheet-multiple-choice-scanner-and-test-grader-using-omr-python-and-opencv/>
- [AlexNet architecture]
<https://www.mdpi.com/2072-4292/9/8/848/htm>



THANK YOU
