Final Review

ENGN 6528

Exam Instructions cont.

- Student access to the Turnitin practice site can be found here:

  https://www.anu.edu.au/students/academic-skills/academic-integrity/turnitin

- Use Microsoft Lens for scanning images

Exam Instructions cont.

The following are requirements for formatting of your submitted exam:

- Do not submit an assignment cover sheet
- The question number should be clearly written at the top of each page
- Each question should begin on a new page
- Multi-part questions (e.g. question 1 parts a and b) may be addressed on the same page but should be clearly labelled (e.g. 1a, 1b)
- You must type your ANU student identification number at the top of the first page of your submission
- You can include scanned images in your exam answer report.

You must upload your completed answers **in a single document file** within the allotted time using a compatible file type for Turnitin (Preference: MS Word .doc or .docx format) **It is the student's responsibility to check that the file has uploaded correctly in Turnitin. No late exams will be accepted.**

Exam question types

The exam includes questions on

- Basic concepts & analysis
- Basic calculation
- Basic algorithm design & analysis

Basic concepts [quiz-Q1]

Q1: (10 marks) [basic concepts]

Answer the following questions concisely. Each of the questions must be answered in no more than 5 lines of text. Longer answers will be penalized.

(1) Consider the HSV colour space. What does H, S and V stand for ?
Based on the HSV colour representation, what is the main difference between a "red" colour and a "pink" colour ?

(2) What does SIFT stand for ?

Basic calculation [quiz-Q3]

Q3: (15 marks) [basic calculations]

Consider the 5×5 image below. The pixel grey values are indicated by the values in the cells.

3	2	1	2	4
2	1	3	200	3
6	7	8	7	9
8	100	6	6	7
7	9	6	8	8

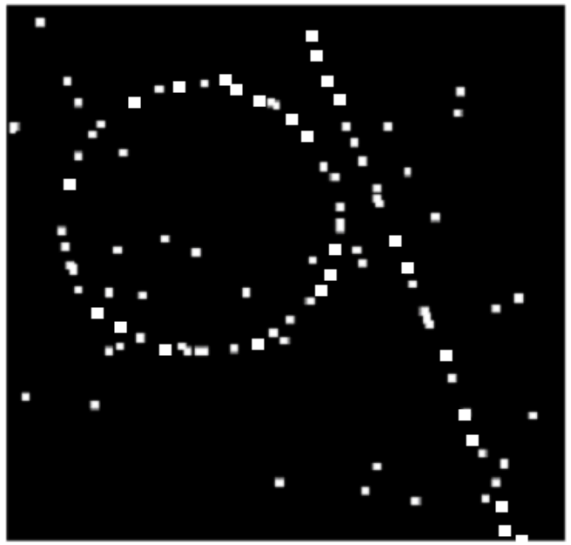
Apply a 3×3 median filter to the image. Note that to avoid problems at the edges of the image you only need to calculate the filtered values for the central 3×3 region.

Apply the vertical edge filter used by the Sobel edge detector to the image above. Again, you only need to calculate the results for the central 3×3 region.

Basic algorithm design & analysis (quiz-Q5)

Q5: (15 marks) [basic design problem]

Given below is an input binary image. You are asked to design an algorithm that can extract the circle in it. You need to estimate all the parameters of the circle.



(i) Please outline your algorithm briefly.

Basic algorithm design & analysis (quiz-Q5)

Q5: (15 marks) [basic design problem]

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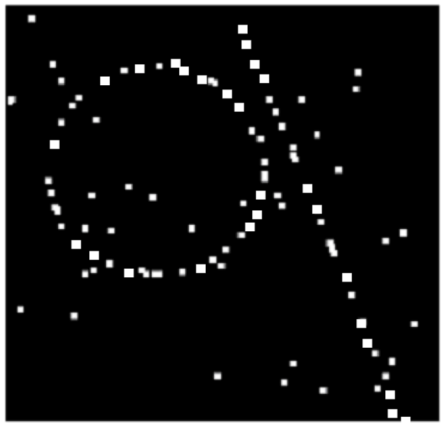
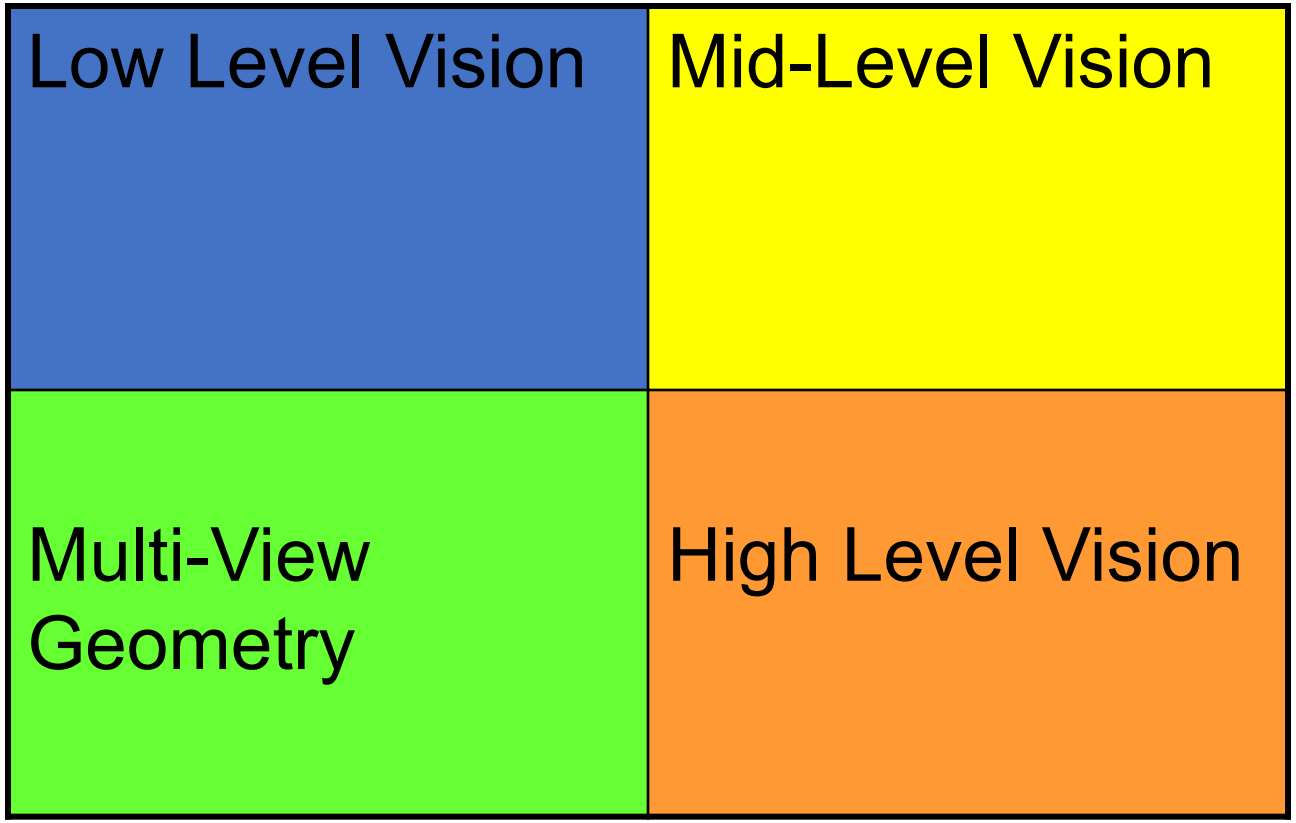


(i) Please outline your algorithm briefly.

(ii) Briefly explain how the circle is extracted by your algorithm, and how the line is ignored by your algorithm.

Review

Four modules



Low Level Vision

- Image processing (fundamentals about images, Lec02)
  - Effect of spatial resolution of the image
  - Effect of image intensity quantization levels (for gray-scale image)
  - Color space, e.g. RGB, HSV
- Histogram based image editing (Lec03)
  - Histogram modification
  - Histogram enhancement, e.g. Histogram equalization, Power-law transformations
- Geometric image transformation, e.g. rotation, scale
  - Image warping, e.g. forward and backward warping

- Image filtering, (Lec 05)
  - eg. Median filtering, Mean filtering, Gaussian filtering,
  - Knowing how to do image filtering using convolution and correlation
  - Understanding different types of filters for edge extraction, computation of image gradient
- Line fitting and corner detector (Lec 06)
  - Understanding Least-square line fitting
  - Understanding RANSAC for line fitting
  - Hough Transform – understanding how it works

Mid-level Vision

- SIFT (Lec06)
- Image segmentation: K-means, mean-shift, MRFs (Lec07)
- PCA and Eigen faces, Viola-Jones Face detection, HoG, SVM and Bag of words for image retrieval (Lec08)

3D Vision (Weeks 7 - 9)

- Pinhole camera model, projection matrix, meaning of K, R, t
- Relative rotation and translation between two coordinate systems
- Camera resection and homography estimation using DLT
- Two-view Epipolar geometry
  - Epipole, epipolar line and fundamental matrix
- SFM pipeline and its applications

3D Vision (Weeks 7 - 9)

- Stereo vision
  - Basic geometry transformation between disparity and depth
  - Pixel correspondences in stereo vision
- Optical flow estimation

Deep learning (Weeks 10 -12)

- Logistic regression
  - Binary and multi-class classification
- Fundamentals of neural networks
  - Activation functions, MLP, backpropagation
- Convolutional neural networks
  - Alexnet, VGG, Resnets, Receptive fields, pooling
- Deep learning for object detection, semantic segmentation and instance segmentation
  - Fast(er) RCNN, FCN, UNet

Deep learning (Weeks 10 -12)

- Generative models
  - Theory and applications
  - VAE, GAN and auto regressive models
- Training neural networks
  - Signal propagation, activation functions, weight initialization, batch normalization
  - Optimization methods
  - Regularization

Q & A