

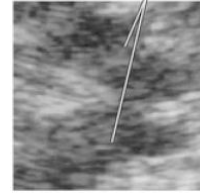
Medical Image Analysis (EE61008)

Practice Test - Mid Term (Spring 2014-15)

Date: 10 Feb 2015, 1:30 - 2:30 PM, N232 Dept. of Electrical Engineering

Duration: 1 hour.

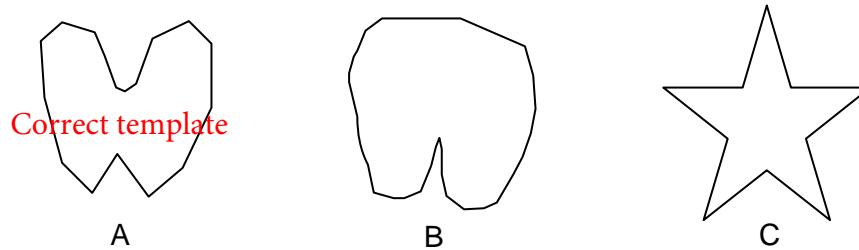
Full Marks: 40, Marks are indicated in ().



Question 1. Identify the following in Fig. 1.

- (a) Organ? (1) **Brain** **Transverse**
- (b) Plane of imaging? (Transverse, Sagittal, Coronal) (1)
- (c) Modality? (1) **Ultrasound**
- (d) Structure / anatomical location of interest? (1) **Mid-brain** Fig. 1.

Question 2. Choose the appropriate template which closely matches the anatomical location of interest in Fig. 1? (2) Justify your choice, also mentioning any affine transformation you would need to apply on the template. (4) **90 deg counter clock wise rotation**



Question 3. Design a scale-space search operator to segment the vessel in the f matrix. mentioning the scales and dimension of the kernel. (4) Compute the complete uint8 representative kernel of size 5×5 with appropriately chosen other parameters. (6)

Laplacian of Gaussian (LoG) operator of 5×5 with $\sigma = 1$.

Ref: Gonzalez & Woods, Digital Image Processing,

Question 4. Compute the edge weights at the underlined pixel location in a random walks solver for the 8-connected graph representation of an ultrasound image where similarity across pixels in a scan-line is 100 times less likely to be compared to similarity of pixels along a scan-line. Pixels across diagonal are 25 times more likely to be similar compared to similarity across scan-lines. The scan-lines are vertical. (10)

**$\beta_H = \beta_V / 100$
 $\beta_D = 25 \beta_H$**

$$f = \begin{bmatrix} 67 & 72 & 1 & 0 & 10 & 11 \\ 5 & 32 & 1 & 1 & 9 & 57 \\ 15 & 23 & 0 & 2 & 11 & 20 \\ 10 & 10 & 1 & 0 & 1 & 23 \\ 10 & 3 & 1 & 1 & 2 & 22 \\ 10 & 10 & 1 & 1 & 2 & 29 \end{bmatrix}$$

$$g = \begin{bmatrix} 67 & 72 & 1 & 0 & 10 & 11 \\ 5 & 32 & 1 & 1 & 9 & 57 \\ 15 & 23 & 0 & \underline{2} & 11 & 20 \\ 10 & 10 & 1 & 0 & 1 & 23 \\ 10 & 3 & 1 & 1 & 2 & 22 \\ 10 & 10 & 1 & 1 & 2 & 29 \end{bmatrix}$$

Question 5. Compute the TP, FP, TN, FN, Precision, Recall, Sensitivity, Specificity, F-Score, Accuracy for the following RGB color image segmentation problem of optical microscopic histology I and its ground truth M . Perform segmentation with nearest neighbor search using the following class seeds $1 = \{(1,1,3)\}$ and $0 = \{(10,3,9)\}$ (10)

Classified =

**1 1 1 0
1 1 0 1
1 0 0 0
1 1 0 0**

$$I = \begin{bmatrix} (1,1,2) & (1,1,1) & (0,0,1) & (10,2,4) \\ (0,1,2) & (1,3,4) & (10,1,2) & (1,3,1) \\ (0,0,0) & (9,9,9) & (9,8,9) & (10,2,10) \\ (1,1,1) & (1,2,1) & (9,10,11) & (10,11,10) \end{bmatrix} \quad M = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \end{bmatrix}$$