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MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

**SIXTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - APRIL / MAY 2017**

**SUBJECT: COMPUTER VISION (ECE - 4038)**

**TIME: 3 HOURS** **MAX. MARKS: 50**

**Instructions to candidates**
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. State the expression for Gaussian kernel $G_\sigma(x, y)$. Differentiate between Gaussian smoothing and a uniform smoothing filter. In the implementation of Gaussian or uniform smoothing filter, discuss the challenges that arise at the boundary pixels (margins of an image). Describe two possible solutions to overcome these challenges.

1B. Define histogram of an image. Given an 8-bit grayscale image, suppose the lower bit (LSB) representing the grayscale intensity is set to 1 for all the pixels in this image. Describe the corresponding change in the histogram of this image.

1C. State the intrinsic and extrinsic parameters of the camera.

(5+3+2)

2A. Given an image of size 256 x 256 consisting of textures only, describe an algorithm in detail to synthesize textures, so the output image is of larger size (i.e. greater than 257 x 257).

2B. Describe in detail the algorithm to compute scale invariant interest points using LoG.

2C. Define the gray scale co-occurrence matrix used in texture representation. Compute the grayscale co-occurrence matrix $C_{(1,0)}$ and $C_{(1,1)}$ for the image shown in Figure 2C.

(5+3+2)

3A. Define shot in a video. Describe four different methods for shot boundary detection using interframe distance.

3B. Define agglomerative clustering. Discuss the similarities between watershed segmentation and agglomerative clustering.

3C. State the mathematical expression for computing the first order and second order gradient of an image *f(x,y)*. Explain the need for smoothing an image before computing its gradient.

(5+3+2)

4A. Given the observed data $(x_i,y_i)$, $i = 1,..N$, we wish to use the least square approach of fitting the line $y=ax+b$. State the error function that is minimized to obtain the parameters of the line. Consequently, derive the expression for the unknowns *a, b* in terms of $(x_i,y_i)$. State one shortcoming of this approach.

4B. Given two image pair of a scene, describe the process of computing the rectified images. Discuss the advantages of using the rectified image pair in the 3D reconstruction of the scene.

4C. Explain M-estimator in detail. Compare RANSAC with M-estimator.

(5+3+2)

5A. Given a training dataset $(x_1,y_1),....(x_N,y_N)$ consisting of $N$ points $(x_1,....x_N)$. Each point is assigned a class label which is denoted by 1 or -1. Let $y_i$ represents the class label. Show that in support vector machine for linearly separable data, the decision boundary is determined by minimizing $norm(w)^2$, subject to $y_i(wx_i + b) \geq 1$, where $w, b$ are the parameters of the hyperplane. Compare support vector machine with a classifier where the class conditional densities are modeled with the histogram.

5B. Describe the algorithm for a $(k,0)$ nearest neighbor classification. List at least one challenge in building this classifier.

5C. Describe hard negative mining and bootstrapping used in classification.

(5+3+2)

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**Figure 2C**