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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

**SIXTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION**
**JUNE 2019**
**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 uniform smoothing filter. Discuss the problem that arises at the boundary pixels in the implementation of Gaussian or uniform smoothing filter. Describe two possible solutions to overcome these problems.

1B. With the help of a suitable example, explain the non-maximum suppression and hysteresis thresholding algorithm. Explain the scenario where you would use these two algorithms.

(5+5)

2A. State the mathematical expression for computing the first order and second order image gradient. Explain the need for smoothing an image before computing its gradient. Describe the algorithm to sharpen an image using second order gradient.

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

2C. Differentiate between point and area sources. Give example of each. Differentiate between specular and diffuse reflections.

(4+3+3)

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

3B. Explain at least one benefit of using homogenous coordinate representation. Describe the intrinsic and extrinsic parameters of the camera. Given two image pair of a scene, describe the process of computing the rectified images.

(5+5)

4A. Define superpixels. State one algorithm to estimate/compute superpixels. Given the observed data $(x_i, y_i)$, $i=1,2,....,N$, and use least square approach of fitting the line represented by $y = mx+c$. State the error function that is minimized to obtain the parameters of the line. Consequently, derive the expression for the unknowns $m,c$ in terms of $(x_i, y_i)$. Show that this approach fails if all the x-coordinates are equal.

4B. Explain in detail M-estimator. Compare RANSAC with M-estimators and describe two limitations of M-estimator.

(7+3)

5A. Assume that $L(i->j)$ is the loss incurred when an object of class $i$ is classified as having class $j$. For a two-class classifier with class 1 and class 2, show that the select class 1 if

*p(1|x) L(1->2) > p(2 | x) L(2 ->1)* ;

where *p(k|x)* is the posterior probability of class *k* given feature vector *x*. Describe the multi class Bayes classifier that minimizes total risk.

5B. Given a training dataset $(x_1, y_1) \ldots\ldots (x_N, y_N)$ consisting of *N* point $(x_1, \ldots. x_N)$. 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 modelled with histogram.

(5+5)