

**CSE/ECE 344/544: Computer Vision**  
**Assignment-2**

Max Marks: 100

Due Date: 11:59PM, Feb 16, 2017

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**Instructions**

- Please complete all questions.
  - Keep collaborations at high level discussions. Copying/Plagiarism will be dealt with strictly.
  - Start early, solve the problems yourself. Some of these questions may be asked in Quiz/Exams.
  - Submission: Backpack.
  - Late submission penalty: 50% credit per day.
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1. (15 points) Write a function for performing 2D filtering that takes an  $M \times N$  grayscale image and a  $k \times k$  filter kernel as an input and outputs the convolved/filtered image. Please implement the filtering from scratch. You are not permitted to use any built-in functions for filtering or convolution. Use the two images `road1.png` and `road2.png` for performing the following filtering operations:
  - (a) (5 points) image blurring using an  $11 \times 11$  filter with  $\sigma = \{1, 3, 7\}$ . Display the images in your report.
  - (b) (5 points) gradient computing using a Sobel operator with kernel sizes  $\{3 \times 3, 7 \times 7, 11 \times 11\}$ . Display the individual components of the gradients as well as their magnitude image.
  - (c) (5 points) image sharpening using one of the blurred images you obtained above. Choose parameters based on what appears to be the most visually appealing to you. Display the sharpened image and comment on which parameters did you use for image sharpening.
2. (40 points) Suppose you are a Computer Vision Intern working for Google's autonomous car project. You are required to detect lanes from the sample road images given in [1](#). Your supervisor wants you to implement your algorithm according to following instructions and explore every method described.
  - (a) (10 points) Use image processing techniques to *highlight* the Lanes in the images. Include the pre-processed images in your report. Explain the method you used in brief. *Hint*: You may use contrast enhancement, sharpening, or any other image processing technique for highlighting the lanes (edges).
  - (b) (10 points) Use the canny edge detector to generate the edge image such that there is minimum clutter. Explain the choice of your parameters and how they affect the edge image. Display the edge images in your report.

- (c) (20 points) Use Hough Transform (HT) for lane detection on the edge image. Explain your choice of parameters. Make sure that you are only identifying one line corresponding to a lane. Report the final images where each HT based lane is overlaid on the RGB image.

**Note:** Your algorithm should work for both images using the same parameter settings. Report the parameters used in your report.



Figure 1: Sample Road Images. Left: road1.png Right: road2.png

3. (45 points) Suppose you are a Research Engineer working for Amazon in Computer Vision Department of their upcoming project [Amazon-Go](#). You are given a task to design an image segmentation based algorithm to identify which product customer is choosing. The image is given in the [2](#). Your task is to,
- (a) (20 points) With the help of the mean-shift based segmentation tool, [EDISON](#), segment the image in a way that each product has as minimum number of segments as possible. You will need to read the tool's documentation to change the parameters to obtain a segmentation that is reasonable. After segmenting the image save the final segmented image from the toolbox. This image will be required to implement the next part.
- (b) (25 points) Create a simple application which allows the user to select a product from the store using rectangular bounding box. You will be using the color features (e.g. RGB mean and variances, color histogram etc.) to classify the product of user selection. Implement Nearest Neighbor classification algorithm for classification. Watch [this video](#) to get an idea on how your application should work. Use the given image to take input from user and segmented image saved from the toolbox to extract color features.

**The name of the products from Left to Right are :**

1. Top shelf : Fanta - Orange flavor, Fanta - Grape flavor, Vault - Energy Drink, Minute Maid - Lemonade.
2. Middle shelf : Coca-Cola - Vanilla flavor, Coca-Cola - Strawberry flavor, Barq's - Root beer.
3. Bottom shelf : Coca-Cola - Classic, Sprite.



Figure 2: Drinks Section