CPSC 425: Sample Midterm Exam

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NOTE: The actual midterm will be slightly longer. Total time available for the exam will be 60 minutes.

Multiple choice questions: Note that some questions have more than one correct answer (where indicated). Circle the letters corresponding to your answers.

Question 1 (2 marks)

What must be true for a set of 3D lines so that they all share the same horizon line when projected into an image?

A. The lines are all parallel in 3D.

B. The lines all lie on the same 3D plane.

C. The lines are both parallel and on the same 3D plane.

Question 2 (2 marks)

What type of image distortion is caused by lens vignetting?

A. The slight curvature of straight lines away from the center of the image.

B. The shift in colour caused by the varying refraction of light at different wavelengths.

C. The darkening of an image towards its edges.

C. The difficulty in bringing all parts of an image into focus at the same time.

Question 3 (2 marks)

Why are two thresholds used rather than one when linking edge points in the Canny edge detector?

A. The use of two thresholds is used to prevent gaps that would otherwise appear in the linked edge points.

B. The selection of edge points is more accurate as a result of requiring that both thresholds be used.

C. Different thresholds are needed to select edge points when linking edges forward or backward from the starting location.

D. The X and Y directional derivatives each require a threshold for linking to new edge points.

Question 4 (4 marks)

We can detect an object in an image by performing normalized cross-correlation of a template with the image and selecting the best match. In order to detect the object at a range of different sizes, one approach would be to correlate templates of increasing size with the image. However, a more efficient approach is to build a Gaussian pyramid and convolve a fixed-size template with each level of the pyramid. Why is this more efficient? (Select ALL of the answers that apply).

A. The higher levels of the pyramid have fewer pixels, which reduces the cost of cross-correlation compared to using larger templates on the original image.

B. The cost of creating new levels of the pyramid is less than the cost of creating larger versions of the template.

C. It takes fewer operations to correlate templates with fixed sizes than ones with increasing sizes.

D. The higher levels of the pyramid avoid aliasing.

Question 5 (4 marks)

Under what image transformations does the Harris corner detector select stable features? Features are considered stable if the same locations on an object are typically selected in the transformed image. (Select ALL answers that apply).

A. Image scaling.

B. Image translation.

C. Image rotation.

D. Image blur.

Question 6 (4 marks)

What are the advantages of using a hash table to store the votes of a Hough transform rather than an array? (Select ALL answers that apply).

A. It is more efficient to enter each vote into a hash table.

B. There are more votes in each bin when the fitted object is present.

C. There is no need to initialize the empty bins in a hash table.

D. It is not necessary to predict the maximum range of each parameter in order to determine the array size.

Short answer questions: Answer each question concisely and clearly. Points will be deducted for overly long or unclear answers.

Question 7 (5 marks)

It is common to use normalization of image patches when they are being matched for stereo correspondence, and we saw in class that this often improves the results. For the Efros and Leung texture synthesis method (as used in the second homework) would it further improve the results to also do normalization of patches in the matching step? Explain your answer with just one or two sentences.

Question 8 (5 marks)

The K-means algorithm will converge to different solutions depending on which points are selected at random as the initial cluster centers. If we ran the algorithm 10 separate times with different random selections and wanted to select the best solution, how would we determine which solution is the best? Give your answer using one or two sentences.

Question 9 (5 marks)

Give a 3 by 3 pixel linear filter that shifts an image 1 pixel upwards and also reduces the image brightness by 30%.

Question 10 (7 marks)

Assume that we are fitting a circle to a set of points using RANSAC. If we assume that 50% of the points are outliers, then how many random samples of 3 points are needed to detect the circle with 95% probability? (You don't need to compute an actual number, but just show how it would be computed if you had a scientific calculator available).