

Representative Sample Questions for the Final Exam

The final exam will consist of several questions that are similar to the questions below. These are topics that we covered (at least to some extent) in class, but you may find it useful to do additional research beyond the lecture notes to be prepared to answer these questions.

1. Very Short answer
 - We have used mean shift in both segmentation and tracking in the last half of the semester. What does the “mean shift” piece actually do?
 - Describe the Harris corner detector, in terms of properties of the image derivatives near a potential point. Your answer should include the word “eigenvalue” or “trace”.
 - What does the acronym BRDF stand for?
 - What does the acronym SIFT stand for?
 - What does the acronym RANSAC stand for?
 - What does the acronym PCA stand for, (spelling counts)?
 - As we’ve used these terms in this class, what is the difference between a quadratic program and a linear program?
 - Give one example of an algorithm that we discussed that used quadratic programming.
 - What is the “Bhattacharyya coefficient” (or bhattacharyya distance), and how was it used in the bag-of-words model to recognize objects.
 - Define the “gnomic projection” of a sphere onto a plane.
2. Define an “auto-regressive process” (or, auto-regressive moving average), and explain, in detail, how it was used in the dynamic textures work featured in lecture 14.
3. Explain how you could use the Hough Transform to search for vertically oriented parabolas (those of the form $y = ax^2 + bx + c$ in an image. Be sure to explain any trade-offs that you are making between accuracy and memory or processing time.
4. The first step in a vision algorithm for, say, driving a car, is often to detect features that one can use to recognize a location or an object that you may have passed on a previous trip. List at least four important properties for this type of feature detector.
5. Describe the 128 different elements of the SIFT feature *descriptor*.
6. Describe the “intelligent scissors” algorithm: both the pre-processing that is done on the image, and what happens when the user clicks on a start point.
7. We talked about the “signed distance function”, relative to the boundary of a shape.
 - Draw/describe the signed distance function for a square (which should be zero on the edges of the square, and positive inside the square).
 - What is the magnitude of the gradient of a signed distance function?
 - What does the direction of the gradient tell you?
8. Draw a small sketch explaining the BRDF. What is the BRDF equation for a Lambertian surface?

9. For the problem of tracking people walking across the Wash. U webcam, propose a model of tracking, including how you would initialize a track, what features you would use, and how you would update those features. In particular, explain why you chose the feature (e.g. template, color histogram, set of SIFT features), and what state you are using (position? position and speed? something else?) method you are using to update your state (mean-shift? particle filters?). There is more than one reasonable answer, but not all combinations of the above features are reasonable.