Computational Vision
Psy 5036, Fall 2004

Study Guide

To prepare for the final, you need to read both the lecture notes and the relevant readings.

Definitions of key concepts. You will be asked to write a short paragraph on each concept discussing its definition and relationship to vision. On the exam, you will answer 8 from a selection of 12. 3 points each for a total of 24 points.

"cooperative" computation of scene properties (see Lecture 23)

shape-from-shading
correspondence problem
Generalized bas-relief transform
aperture problem
Distributed representation
Inverse optics
lightness normalization (or anchoring) problem
Perceptual "explaining away"
gradient descent
slant/tilt
subjective contours
Bayes net
intersection of constraints
gradient space (p,q)

motion parallax
specular reflection
motion field vs. optic flow
homogeneous coordinates
structure-from-motion

Lightness/reflectance
lambertian
random dot stereogram
accidental view and generic view
motion gradient constraint
contrast normalization
pictorial cues

Long essay questions. On the exam, you will be asked to answer 2 questions. 12 points each for a total of 24 points for this section.

1. Sketch the connections between V1, V2, V4, MT, MST. Then pick one of these visual cortical areas and describe its properties and discuss its possible function(s).

2. Describe what is meant by distributed vs, modular object representations in cortex. Give an example of experimental evidence supporting the case for distributed representation and another for modular representation. Discuss the theoretical advantages of a distributed representation for an object or object class.

3. Explain how the motion gradient constraint could be represented in terms of spatio-temporal neural receptive fields.

4. Discuss an algorithm for the computation of lightness. What are the limitations of spatial filter-type models for lightness?

5. Can all the parameters of the eye or camera's movement in a rigid environment be recovered from the

motion field? Explain. Describe one method for recovering the translational component of camera motion from optic flow to determine direction of heading.

6. Describe the Bayesian decision theory approach to visual perception. Discuss its relation to the psychology and neurophysiology of perception.

7. Discuss the computational problems of visual object recognition. Explain the difference between "structural description" and "exemplar" theories.

8. Discuss the computational problems of visual object localization in scene layout. Describe some of the ambiguities vision must resolve in order to determine relative spatial relationships between objects.

9. Summarize the key points from one of the following papers on your reading list:

a) von der Heydt (2003)
b) Liu et al. (1995)
c) Hillis et al. (2002)
d) Weiss et al. (2002)
e) Tenenbaum (1999)
f) Poggio and Shelton (1999)