CN530: Neural and Computational Models of Vision
Study Guide

This document contains a list of terminology, concepts, and sample essay questions on topics that form the core of the course. For items that are merely *listed*, an understanding sufficient to generate a brief definition will constitute adequate performance on the in-class exams. Please prepare yourself for the following situation: Often students try to write "everything" about a topic on an exam, on the assumption that the more they write, the more likely "what the professor is looking for" will be contained in their answer. Try to learn the most succinct definitions or explanations possible of the perceptual phenomena, physiological terms, and modeling concepts listed in this document, so that you can give rapid, concise answers when asked to do so for "short identification" items. You may find it helpful to practice *actually writing* definitions or explanations of the terms. (You will have ample opportunity in essay questions or take-home examinations to give more elaborate answers that show off the *depth* of your knowledge!)

Some issues requiring short essay length answers are listed in a separate heading ("Essays") at the end. The format of questions on the in-class examination will include both short identifications and essay questions, with the former predominating. The precise wording of questions may include phrases that vary slightly from those given in this document, and it is conceivable that some word or concept not listed in this document will figure in an answer. Nonetheless, at least 90% of the content of the exams will be directly relatable to items in this document.

KEY TERMS AND CONCEPTS:
You should be able to give short definitions of the terms listed in the following three headings (phenomena and special stimuli, physiology, and modeling concepts). Some terms may require more than a sentence, in order to explain nuances of usage or assumptions that are implicated in usage of the term, but you should in any case be on the lookout for references in the readings or lectures to these terms.

Note: Items preceded by a bullet (•) pertain to the weeks after the midterm examination, so will not be covered on that test.

Phenomena and special stimuli:

apparent motion
beta motion
brightness assimilation
brightness constancy
brightness contrast
Craik-O'Brien-Cornsweet Effect
Ehrenstein illusion
emergent grouping or segmentation
Gelb effect
Mach bands
neon color spreading (conditions for generating the phenomenon)
phi motion
Ternus effect
Yarbus stabilized image (hemifields and moving disk)
Units of percept and all related ambiguities

Physiology:

end-stopping (end-stopped cells)
LGN (and its laminas)
magnocellular – parvocellular
orientation column
orientation hypercolumn
receptive field (including spatio-temporal aspects)
simple, complex, hypercomplex cells
V1, V2, MT
von der Heydt and Peterhans data
Reverse-corrlation in single cell recording
Van Essen et al data
Subunits of MT receptive field
Single cell recording data regarding aperture problem, early response, late response

Modeling concepts:

aperture problem
automatic gain control by shunting inhibition
BCS/FCS interaction (inhibition of diffusion)

CC Loop
contrast sensitivity function
distance-dependent network (vs. non-distance dependent network)
Difference of Gaussians (DOG)
D-max for “short-range” motion
end cuts (what they are; how they are generated)
end-stopping (end-stopped cells)
FACADE
feedback signal function's effects in competitive networks
featural noise suppression
G-wave (a.k.a. traveling Gaussian wave)
Gelb effect's relation to assumptions in brightness constancy models
LAMINART
linearity of response in spatial “channels”
long-range motion
textons
normalization (of total network energy; and under what conditions?)
OC Filter
peak shift
“receptive field” definitions or usage in physiology and neural networks
(Cf contextual modulation of cell responses)
“reflectance” -- differences between photometric usage and Grossberg's usage
reflectance processing
Reichardt detector
Retinex theory
short range motion
shunting
structural/functional scale
traveling Gaussian wave (a.k.a. G-wave)
uncertainty (orientation, position, boundary)
zero-crossings

Short Essay Topics:

BCS/FCS *explanation* of neon spreading (as opposed to the *phenomenon)*

difficulties with the concept of “receptive field” (relation of physiological usage to connectivity concepts in neural network modeling)

evidence for multiple spatial scales in early vision; meaning of “multiple spatial scales”

feedback signal function effects (slower/faster/linear/sigmoid)

pattern and energy factorization (also, UMAP explanation of brightness contrast and constancy)

reasons for the need for "filling-in" of any kind

Retinex-style brightness algorithm vs. diffusive filling-in (especially transitivity with multiple boundaries or spatial scales)

"seeing" vs "recognizing" (arguments for the distinction and for the "invisibility of boundary contours")

contrasting theories of "parallel pathways"

shift property

look up table vs dynamical system styles of representation

"zero-crossings" (Marr) vs. shunting network processing of "edges"

Selecting basis features for recording from V1, V2, V4 (Van Essen et al data), early response, delayed response

Subtelties in interpreting sparese-noise reverese correlation maps, regarding non-linearities, long and short reverse correlation delays with respect to late and early cell responses

FINAL DISCLAIMER: This document is provided as an indicator of important material in the course. The terms and sample questions are not *necessarily i*n complete correspondence with what will be on exams. Material may be on exams that is not indicated in this document -- if it occurs in lectures or required readings!

OTHER STUDY GUIDES: Preceding generations of CNS students have generated one or more unofficial study guides for CN 530. To the extent that you feel access to such a guide might be helpful, you are welcome to inquire among your peers "at your own risk."