Given name:_____ **Family name:**_____

Student number:_____ **Signature:**_____

UNIVERSITY OF CALIFORNIA, San Diego
Department of Cognitive Science

COGS 101A (Sensation and Perception)
Instructor: Virginia de Sa

Midterm 1-Version 2 (There are 2 subtlely different versions)
October 19,2004

Duration: 80 minutes

No aids allowed. Everyone must work individually; all questions should be directed to the Professor or TAs. There are two subtlely different versions of this test.

This examination paper consists of **8** pages and **21** questions. Please bring any discrepancy to the attention of an invigilator. The number in brackets at the start of each question is the number of points the question is worth.

Answer all questions.

Please show your logic. Partial credit will be given for reasonable attempts — put down what you can. Full sentences are not required but clear logical presentation is. Read all questions before starting. Do the easiest questions first. Good luck!

For instructor's use:

	Score
1 (3)	
2 (4)	
3 (6)	
4 (3)	
5 (3)	
Subtotal	

	Score
6 (4)	
7 (2)	
8 (3)	
9 (1)	
10 (2)	
Subtotal	

	Score
11 (2)	
12 (3)	
13 (4)	
14 (3)	
15 (4)	
Subtotal	

	Score
16 (6)	
17 (2)	
18 (5)	
19 (4)	
20 (4)	
21 (2)	
Subtotal	

Total (70)	

1. [3] Enter these terms (or abbreviations) in the correct slots (Method of Adjustment (MoA) , Method of Limits (MoL), Method of Constant Stimuli (MoCS))

   The difference between the MoA and the MoL is that in the MoA the stimuli are adjusted in a continuous manner. Of all three methods, MoCS is the most time consuming but most accurate method.

2. [4] In the following pairs of structures in the eye, circle the one that is physically FARTHER from the external light source.

   (a) Cornea or lens?

   (b) Pigment Epithelium or Photoreceptors?

   (c) Photoreceptors or Bipolar cells ?

   (d) Vitreous Humor or Aqueous Humor?

3. (a) [2] What is the blind spot (give enough detail to explain why it is called the blind spot)?
   The blindspot is where the retinal ganglion cell axons gather and exit the eye. Because the axons exit there, there are no photoreceptors there and thus this spot is blind

   (b) [1] What is the purpose of the pigment epithelium?
   The pigment epithelium supplies enzymes to help in pigment regeneration. It also nourishes the photoreceptors

   (c) [1] What is the near point?
   the closest distance that you can focus

   (d) [2] What is presbyopia (give symptom **and** cause)?
   Presbyobia (old eye) is when the near point moves farther away. It is caused by the lens getting stiffer and the ciliary muscles weaker

4. [3] Circle the correct options

   Myopia is the inability to see **(far objects clearly/near objects clearly/colors)**. In myopia parallel rays of light are brought to a focus **(in front of/(virtually) behind/on)** the retina. Myopia is fixed with a **(convex/concave)** lens.

5. [3] Circle the correct options

   The right **(visual field/eye)** projects to the **(right/left)** thalamus (LGN) which projects to the **(right/left)** visual cortex.

6. (a) [2] Why does the fovea appear as a dip in the retina? Explain the physical cause **AND** explain the reason.

   The fovea appears as a dip in the retina because the cells normally overlying the photoceptors are pushed aside. This is to give the light an unimpeded path to the photoreceptors where we have our most detailed vision

   (b) [1] Why are there no rods in the center of the fovea?

   to make room for more cones which we need for color vision

   (c) [1] Why are there no blue cones in the center of the fovea?

   because blue light scatters more than the separation between cones in the center of the fovea, we don't need them there

7. [2] What is the Purkinje shift **and why** does it happen?

   The Purkinje shift is the change in spectral sensitivity (towards shorter wavelengths) as you go from cone vision to rod vision. It happens because the cones and rods have different spectral sensitivities

8. (a) [1] What do dark adaptation curves measure (use the term pigment, do not use the term "dark adaptation")?

   They measure the photopigment regeneration

   (b) [2] What is the approximate time for full adaptation of the rods 20 to 30 minutes and cones 5 to 10 minutes ?

9. [1] Circle the correct option

   The neurotransmitter released by the photoreceptors acts as an **(inhibitory/excitatory)** transmitter on the on-center bipolar cells.

10. [2] Give **two** reasons why ganglion cells that get input from rods are likely to be more sensitive to light than those that receive input from cones.

    1) The rods are more sensitive to light 2) The rods have more convergence on to their ganglion cells

11. [2] As seen in the "Moving Dot" part of Lab 1, which can you detect better in your peripheral visual field - color or motion ? **Why?**

    You can detect motion better in your peripheral field, because rods are good at this. You need your cones to see color and there are very few of them in the far periphery, so you don't see color well there

12. (a) [1] Define the receptive field of a visual neuron:
    The area of the retina that can affect the activity of a visual neurons

    (b) [1] Define (and contrast) the terms ipsilateral and contralateral.
    ipsilateral means on the same side. contralateral means on the other side

    (c) [1] Define the term retinotopic.
    retinotopic means that the visual area is laid out like the retina. Neighboring neurons have neigboring receptive fields.

13. [4] Put an M or P beside the following properties to say whether they are more true of Magno ganglion cells or Parvo ganglion cells

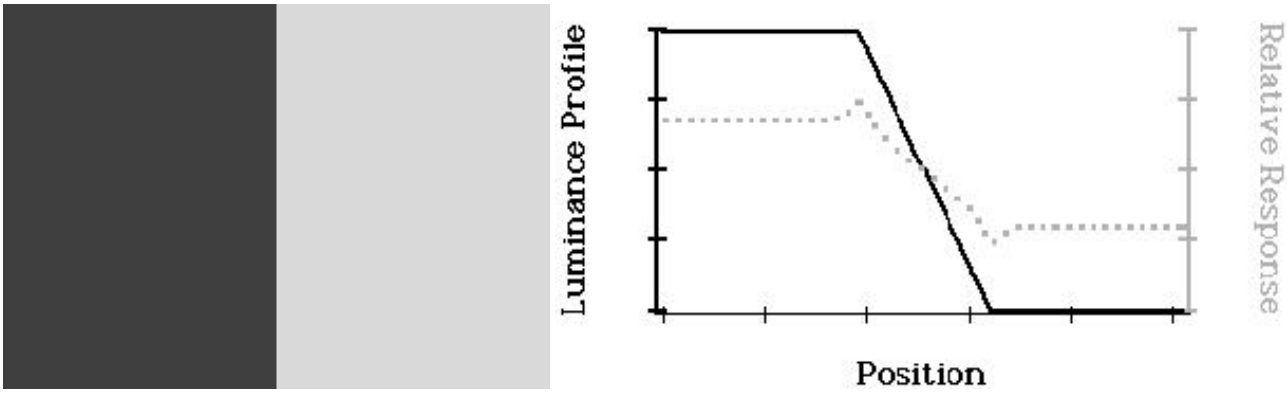
    (a) large soma M

    (b) receive input from cones in and around the fovea P

    (c) give a transient response to sustained stimuli M

    (d) form the major input to the dorsal stream M

14. [3] Explain the Mach band effect in terms of center surround receptive fields(as in lecture) OR lateral inhibition (as in the text). If you choose the center surround option, you do not have to talk about how the center surround receptive field property is wired. Just start from that assumption. If you choose the lateral inhibition option, explain as in the text. **For either option explain the effect for both on-center and off-center receptive fields. You may draw on or under the figure.**



The Mach band effect is where the lighter color beside a darker color looks even lighter right at the border, and the darker color even darker right at the border

To explain the effect: Consider an on-center/off-surround (on/off) ganglion cell that has its receptive field(RF) fully in the dark area (neuron A) compared to one that has its center in the dark area but its surround in the light area (neuron B). Neuron B will be more inhibited by light in its surround and it will be less activated than Neuron A. The brain will interpret this as darker.

Now consider an on/off ganglion cell that has its RF fully in the light (neuron C) compared to one that has its center in the light area but its surround in the dark (neuron D). Neuron C will be less inhibited as it has dark in its surround and will thus be more active than neuron D. The brain will interpret this as lighter.

Now consider off-center/on-surround (off-on) ganglion cells in the same positions. All the arguments will hold in reverse (an off/on neuron at position A will be less active than an on/off neuron at position B). The key here is that the brain interprets activity from the off-on neurons as darker. Therefore again the dark edge near the lighter part will appear darker. The same argument holds for off-on neurons on the lighter side.

15. (a) [1] What is the name that refers to the type of retinal ganglion cell (and LGN) receptive fields: center-surround.

    (b) [1] How do the receptive fields of the simple cells in V1 differ?
    They are elongated and prefer oriented bars

    (c) [2] Draw a simple diagram and explain how simple cell receptive fields might be instantiated from LGN receptive fields
    By taking input from 3 (or so) LGN neurons with aligned center-surround receptive fields, we can get an elongated receptive field that likes an oriented bar.

16. [6] Describe the structure of V1 using the terms (or similar ones) (retinotopic, vertical column, as you move horizontally, orientation, ocular dominance, receptive field center,hypercolumn)

    V1 is organized in a retinotopic manner, which means that nearby neurons have nearby receptive fields. Within a vertical column, the neurons have very similar preferred stimuli (and the same receptive field). As you move horizontally across the cortex, response preference changes slowly (as does receptive field center location). Orientation preference changes smoothly. There are ocular dominance stripes which reflect which eye is dominant in that column. We can talk about a hypercolumn which contains all orientation columns and right and left eye ocular dominance columns for one receptive field location.

17. [2] Draw the contrast sensitivity function, label the axes and give a 1 sentence explanation of what it means.

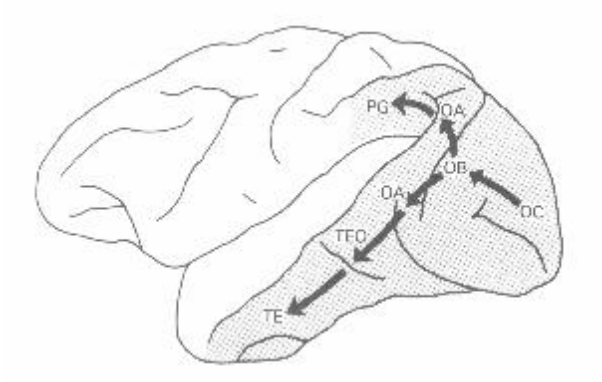
see Figure 3.23 in the text. It means that we are most sensitive to medium spatial frequencies

18. (a) [2] Circle the correct options. Relative to V1, the neurons in V2 (the second visual cortical area) should be **(less/more)** sensitive to spatial precision and prefer more **(complex/simple)** stimuli.

    (b) [3] Given what you know so far, what would you guess would be optimal stimuli for V2 (2nd visual cortical area). Give your reasoning. (Note there is no one correct answer, I'm looking for good reasoning)

We have seen that LGN receptive fields can be combined together to give simple cell receptive fields. And simple cell receptive fields can be combined to give complex cell receptive fields. Perhaps V2 receptive fields should be composed of several complex receptive fields. They might respond to moving or stationary shapes (such as triangles, corners or squares). Note they are not likely as complex as faces (because that comes later in IT) but more complex than oriented bars.

19. [4] In the figure below, label the two pathways with their "functional names" and also with their "anatomical names" (There are two options for the 2nd (after the lobes of the brain or their relative positions in the brain. You may use either but be consistent in your pick for both pathways)



The top pathway is the where/how, dorsal and parietal pathway. The bottom pathway is the what, ventral and temporal pathway.

20. (a) [1] What is the microstimulation technique?

This is where you stimulate a local area of neurons and observe the change in the monkey's behavior.

(b) [1] How is it useful?

It is useful to establish a connection between physiology and behavior. If you can stimulate and change behavior you have a good link

(c) [2] How is the lesion technique similar and different?

The lesion technique also seeks to establish a connection between physiology and behavior. It is different because you inactivate (rather than stimulate) an area. It is also cruder and usually permanent

21. [2] Define AND give an example of inattentional blindness.

Inattentional blindness is when you don't notice (are blind) to a stimulus even when you are looking right at it, if you are not paying attention to it. In class we saw an example where we were told to count passes on a basketball court and we didn't notice that a girl with an umbrella walked right through the court.

End of examination
Total pages: 8
Total marks: 70