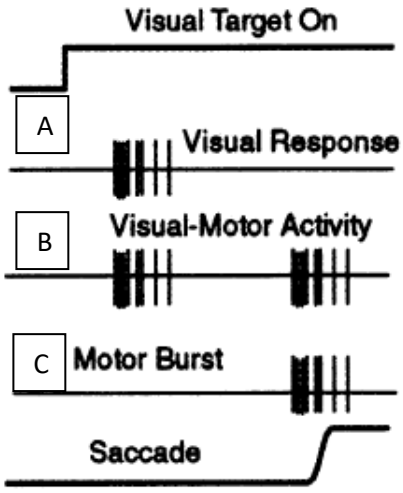
FINAL EXAM: T580, June 8th 2020

-Please show your work. I am more interested in how you are thinking rather than the final answer. Don't just write the answer. Explain, Explain, Explain.

- Please READ the questions carefully.

- There are ***four*** questions. One on each page

- Read the questions carefully. The test is a 2 hour 00-minute test. **Please leave enough time to post the test by 3.00 pm.**



1. The traces are schematic responses of different cell-types (A, B, C) in a single brain region. Answer the following questions:

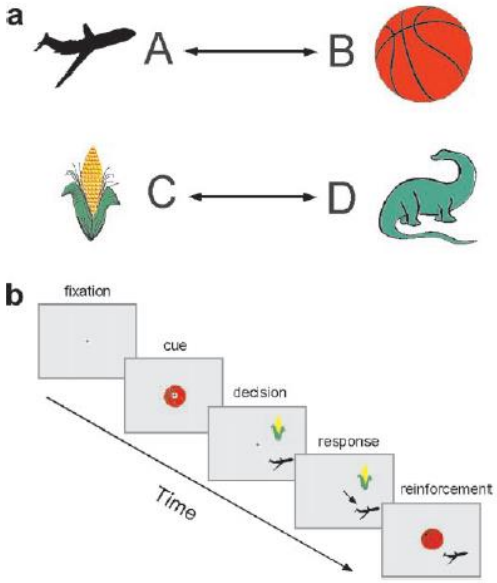
A. Which brain region is represented in these recordings? Explain the rationale for your answer. (2)

B. What are the inputs and outputs from this brain region? (3)

C. How might the cell-types A, B, C be connected to each other? What experiment (one) would you do to confirm your hypothesis? (3)

D. What are the defining characteristics of the cell-type C? That is what properties of saccades are encoded in those cells. (2)

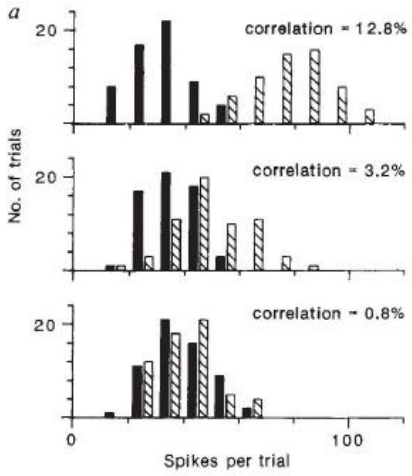
2. This is a paired association test. Answer the following questions:



A. What does this test examine? Describe the logic behind the experiment. (2)

B. Neurons in which region of the brain are learning the association. **Diagram** the change in response of neurons in this region as the monkey learns the association. (3)

C. Describe the circuit model underlying this association. (5)



3. The figure on the left shows the result of an experiment performed to assess the role of single neurons in motion perception in primates. Solid bar = responses in null direction. Hashed bar = responses in preferred direction. Correlation refers to correlation between movement of random dots. Answer the following questions:

A. What region in the brain would you record from to find neurons that drive motion perception? (1)

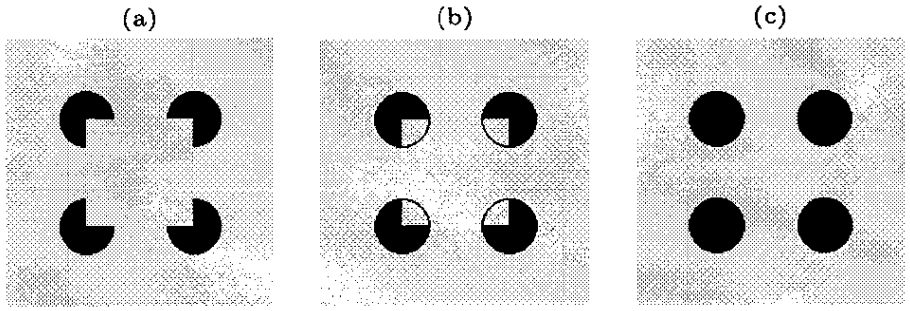
B. Describe the experimental procedure being employed here? That is how do researchers assess whether a given neuron is important for motion perception? (3)

C. If the monkey is indeed making perceptual decisions based on this single neuron, what would its behavioral response look like? What analysis would you do to compare neural response to behavioral response? (3)

D. If the behavioral response is better than what you would predict from this neuron, what is the most likely reason? (1)

E. What experiment would you do to show that this region in the brain is important for behavior response to motion? (2)

4. The figure is (a) represents a popular illusion. We observe a square where there is none, i.e, an illusory square. Answer the following question:



A. Design an experiment using the three visual stimuli and single neuron recording to test whether a given neuron responds to illusory edges. **Diagram** the neural response to these stimuli consistent with the conclusion that the neuron does respond to illusory edges. Why do we need the stimuli in (b) and (c)? (3)

B. It turns out neurons in V1 and V2 both respond to illusory square in (a). Neurons in V2 respond (70 ms after stimulus onset in V2 versus 100 ms in V1) earlier than neurons in V1 to the same illusory edges. What does the fact that neurons in V1 respond later tell you about the mechanism underlying the responses to illusory square? (2)

C. Describe the neural circuit underlying the response of V1 neuron to illusory square. Specifically, which circuits are involved and what are their roles? (3)

D. One would expect each image processing area in the brain to be respond to some aspect of the illusory square. Diagram the receptive field of neurons in 3 different cortical regions associated with image processing. (2)