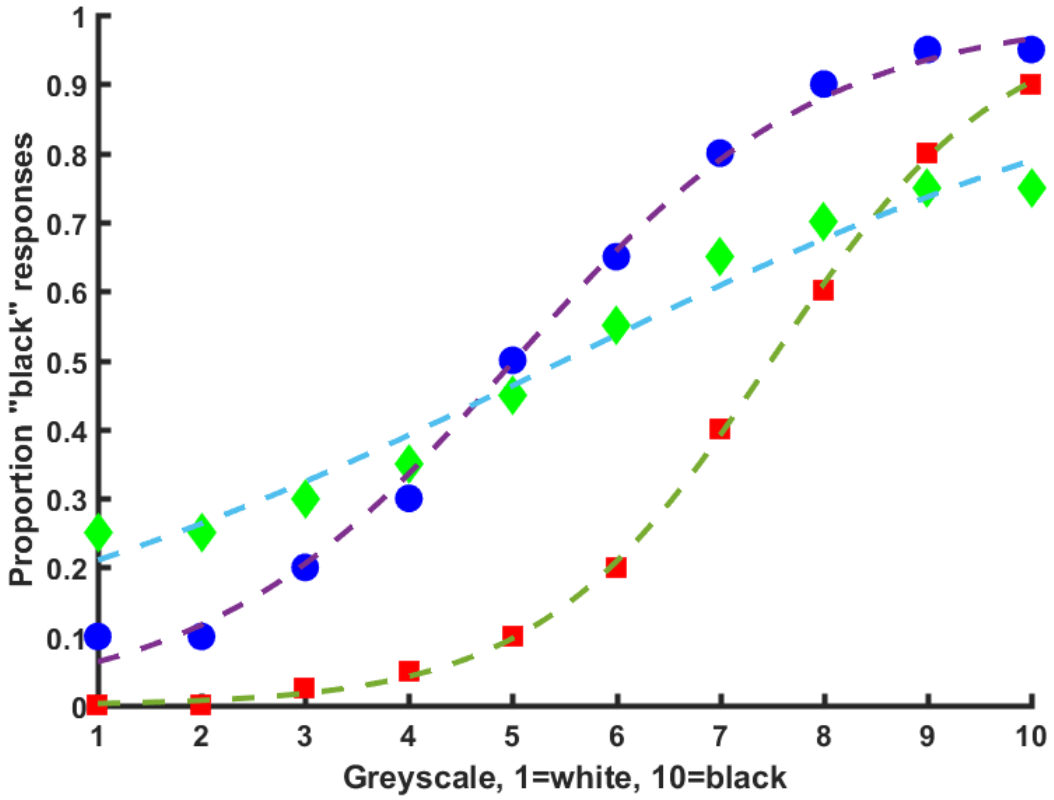
CS 786 Quiz 2

Q1. Imagine an observer performing a 2AFC task where they're presented with a shade of grey and they have to press one button to categorise the colour as white, or another button to categorise the colour as black. Intuitively, they're more likely to classify a grey stimulus as black the closer it is to black, and less likely the colour it is to white. We run this experiment in three conditions, one with stimuli presented on a white background, one with stimuli presented on a black background, and one with stimuli presented on a gray background but obscured by a blur filter. The results are plotted as circles, squares and diamonds on the graph below.



(a) Without explicitly calculating numbers using signal detection theory, can you say which of the conditions causes the greatest bias in the observer? Explain.

(b) Again, without explicitly calculating, can you say which condition has the least perceptual sensitivity?

(c) Can you identify which set of data correspond to which experimental condition? What leads you to this conclusion?

(d) The dashed lines represent best fit logit link function *F(data; slope, threshold)* to each of the three datasets, using a two-parameter logit that fits the slope and the threshold. The fits are not really great, as you can see visually. How might we improve the fit? What would the improved mathematical function that we fit look like?

Q2. A well-meaning CSE professor asked his students to complete an experiment for course credit, which involved figuring out which direction some dots in a display were moving. He suspects some students of being less than conscientious about doing the experiment and responding randomly to the probes. The experiment involved having to say left when the dots were moving to the left, and right when the dots were moving to the right. Three students' response rates are listed in the table below. Use signal detection theory to decide which of the students actually did the experiment, and which just pretended to do it.

Student 1	Actually left	Actually right
Responds left	0.8	0.3
Responds right	0.2	0.7

Student 2	Actually left	Actually right
Responds left	0.5	0.6
Responds right	0.5	0.4

Student 3	Actually left	Actually right
Responds left	0.1	0.9
Responds right	0.9	0.1

Q3. (a) Describe the basic elements of the feature integration account of visual object recognition. (10 points)

(b) What empirical data does it most prominently explain? (5 points)

(c) What category of phenomena does it find hard to explain? (5 points)

(d) There are lots of data that the theory finds hard to explain. But can you construct, in your head, a finding that would contradict the feature integration account fundamentally? Explain how. (5 marks)

Q4. (a) Whenever the opposing captain has the call, the match referees keep tossing a coin that they claim is absolutely not biased, but it keeps landing heads. Assuming the ICC are perfect Bayesians, and won't consider any appeals unless the probability of the coin being biased is at least 95%, how many heads does Virat Kohli need to see in a row before he can fairly lodge an appeal? (10 points)

(b) Virat appeals to the ICC after seeing three heads in a row. The host country accuses Virat of bias. Can you help the ICC quantify Virat's prior belief about the bias of the referees that made him appeal? (10 points)

(c) Briefly describe how the ICC's Bayesian methodology might be of use to scientists who study visual perception. (5 points)

Q5. Consider a neuron in visual MT that is sensitive to motion in a particular direction.

(a) Under what conditions must we record the spiking rates of this neuron in order to determine its dynamic range? (5 points)

The neuron fires strongly in response to motion in its preferred direction, and with less vigor in response to similar directions. One possible parameterization of this phenomenon is by drawing the response rate from a normal distribution centered around the preferred motion direction, with a variance determined by the width of the neuron population's tuning curve.

(b) If this variance is high for all neurons in a population, would an electrode stuck in visual MT pick up less or more activity on average than for neurons with low variance? Why? (5 points)

(c) Can you think of a practical reason each why the variance in visual MT neuron responses should be (i) not too high and (ii) not too low? (8 points)

(d) The Law & Gold paper demonstrates a specific mechanism by which perceptual learning might come about. What is it, and what role does reinforcement learning play in it? Can you think of other possible mechanisms by which perceptual learning might occur? (7 points)