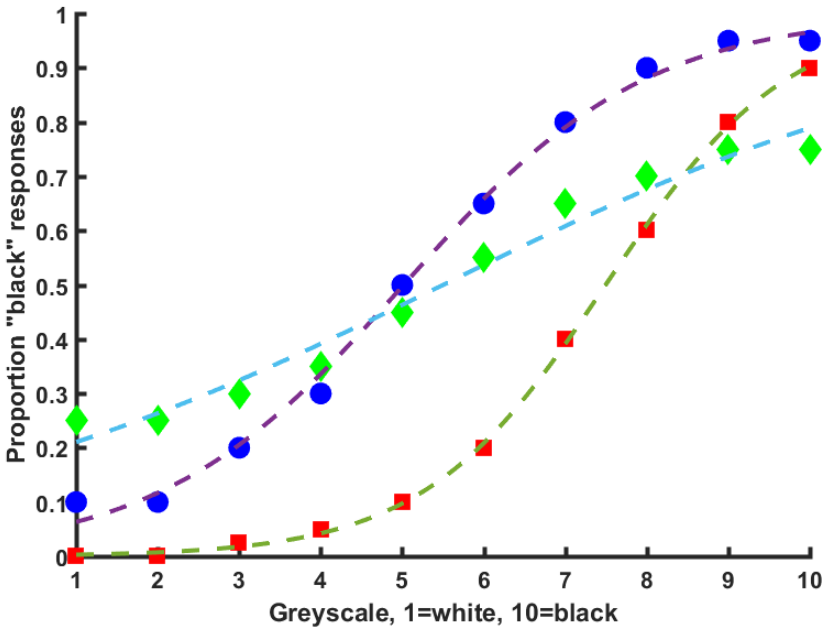
CS786 Quiz 2

100 points

Q1. **(25 points)** 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. (3 points)

(b) Again, without explicitly calculating, can you say which condition has the least perceptual sensitivity? (3 points)

(c) Can you identify which set of data correspond to which experimental condition? What leads you to this conclusion? (10 points)

(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? (9 points)

Q2. **(25 points)** 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. (25 points)

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. **(25 points)** (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)

Q4. **(12 points)** Fill in the blanks for the following passage (marks indicated within blank).

The *(1 point)* consists of three layers of cells. The top layer cells are photoreceptor rod and cone cells. The difference between these is that *(2 points)*. Visual transduction is the process by which *(2 points)*. Visual transduction begins in the photoreceptor cells because of compounds present in discs on their outer segment called *(1 point)*. For example, rod cells contain a compound called *(1 point)*, each molecule of which exists in a bent *cis*- configuration until it absorbs a photon. Once it does, (3 *points*), leading to the signal being received in downstream ganglion cells. The center-surround difference in response profiles for *(1 point)* cells permits information about simple shapes and patterns to be encoded as early as in *(1 point)*.

Q5. **(13 points)** Auditory transduction is the process by which *(1 point)*. This is performed in the inner ear by the cochlea. The basic computational problem the cochlea solves is *(1 point)*. This requires encoding the *(2 points)* of incoming sound signals. Along the entire cross-section of the cochlear duct, the *(1 point)* membrane sits atop the *(1 mark)*. This latter structure is in loose contact with the membrane above via *(1 point)* and with the brain via *(1 point)* below. The magnitude of incoming sound waves is encoded by *(2 points)*. The frequency of incoming sound waves is encoded by *(2 points)*.