1. [L21] Imagine that you have just arrived at a friend’s home for a party and are petting their excited dog when your friend issues a command to their home assistant. What sources of noise must be removed in order to process your friend’s voice command?

2. [L21] In class, we talked about how a person’s personal experience with dogs might bias their estimate of the size of an average dog. Give another example of how a person’s personal experiences might bias their probabilistic estimates.

3. [L21] Pat and Jan are playing a game with cards. A standard deck of cards contains thirteen ranks of cards (A, 2, 3, ... 10, J, Q, K) in four suits (spades, hearts, clubs, and diamonds). Pat pulls a card from the deck and tells Jan either the rank of the card (as a number from 1 to 13) or the suit of the card (as a number from 1 to 4). Jan must then guess whether the number represents the rank or the suit. For the following questions, use explain how to use maximum likelihood estimation to obtain the answer, and quantify when necessary.
   A. What should Jan guess when Pat says 5?
   B. What should Jan guess when Pat says 4?
   C. Finally, Pat tells Jan that Pat chooses to give the card’s rank 90% of the time. Given this additional knowledge, what should Jan guess when Pat says 2?

4. [L22] Explain the difference between a point cloud and an image.

5. [L22] What visual clues are missing in visual puzzles that enable our brains to see the puzzle as representing different types of entities (such as faces or a vase)?

6. [L22] Compute the convolution of the two Sobel edge detection filters (shown to the right—these are the same as those discussed in lecture)—for the green pixel in the small image below. Show your work.

   \[
   \begin{array}{cccc}
   1 & 1 & 0 & 2 \\
   2 & 2 & 0 & 2 \\
   2 & 2 & 1 & 0 \\
   2 & 2 & 1 & 0 \\
   \end{array}
   \]

   \[
   \begin{array}{ccc}
   -1 & -2 & -1 \\
   0 & 0 & 0 \\
   1 & 2 & 1 \\
   \end{array}
   \]

   \[
   \begin{array}{ccc}
   -1 & 0 & 1 \\
   -2 & 0 & 2 \\
   -1 & 0 & 1 \\
   \end{array}
   \]

   - vertical edge filter
   - horizontal edge filter
7. [L23] Explain how augmented reality could be used to replace dissection in biology labs (dissection is the process of cutting a body apart to see the various organs). Would you want a surgeon whose only experience had been with augmented reality to operate on you in an emergency?

8. [L23] How can motion capture be used to help professional athletes improve their performance?

9. [L23] What advantages does a virtual reality cave offer over a virtual reality headset in terms of immersion?

10. [L24] Human drivers are not trained on simulators, so why is it necessary for the ML models in autonomous vehicles to make use of simulated data? Can you think of a profession in which people controlling vehicles are trained on simulators?

11. [L24] Let’s say that the stopping distance for a particular vehicle traveling at 10 meters/second on a dry gravel road is 9 meters. If the vehicle accelerates to 20 meters/second on the same road, what is its new stopping distance? What about 30 meters/second?

12. [L24] Why is choosing the right balance between safety and performance difficult in autonomous driving?

[ We may have a term-matching problem of the form that you saw in the guide for Exam 1 and on Exam 2, in which you match terminology from the class with the definitions. ]