

Final Exam

Gadget, sensor, and activity recognition in HCI | Spring 2024

Multiple Questions

1. If your variable resistance sensor R_2 ranges from 0 to 1000 Ohms, and you'd like your output voltage V_{out} to be between 0 and 4 volts, what value should you choose for R_1 if the input voltage V_{in} is 12 volts?

- a. 500 Ohms
- b. 1000 Ohms
- c. 1500 Ohms
- d. 2000 Ohms

Answer: D

The answer can be derived from the voltage divider formula: $V_{out} = V_{in} \times (R_2 / (R_1 + R_2))$

2. Which of the following is an **INCORRECT** description of a capacitor?

- a. A capacitor is a device that can “hold a charge” with two conducting plates separated by an insulating material.
- b. A capacitor can selectively let through high frequencies and block (attenuate) low frequencies.
- c. A capacitor is a device used in electronic circuits to amplify electrical signals.
- d. A capacitor stores and releases charge like a small battery.

Answer: C

A capacitor does not amplify electric signals, but rather store and release electrical energy.

3. According to Horvitz's principles for mixed-initiative UI, which of the following is **NOT** a factor for the effective integration of automated services with direct manipulation interfaces?

- a. Compelling users to conform to the system's rigid interaction pattern and mechanism.

- b. Employing dialog to resolve key uncertainties.
- c. Developing significant value-added automation.
- d. Considering the status of user's attention in the timing of services.

Answer: A

Instead of having the user to conform to the mechanism predefined by the system, Horvitz argues that the system should make natural and efficient references to the "shared" short-term experiences with users and have the ability to be better at working with the user through continuous learning and observation.

- 4. When facing challenges related to connecting components on a PCB design, which of the following is NOT recommended?**
- a. Distributing traces across multiple layers.
 - b. Change the layout of the components to minimize the need for connections.
 - c. Implement vias to establish connections between different layers of the PCB.
 - d. Reduce the number of layers in the PCB to simplify the routing process.

Answer: D

Deducing the number of layers in the PCB may limit the available routing space and increase the complexity of routing.

- 5. Which of the following is NOT a best practice for debugging hardware?**
- a. Use a multimeter to measure current load.
 - b. Take a step-wise approach and test a simple and easily verifiable thing at a time.
 - c. Accumulate hardware modifications and conduct a one-off comprehensive debugging test for efficiency.
 - d. Turn LED on/off at various points to make something about your code execution observable.

Answer: C

It can make it difficult to pinpoint the cause of any issues that arise.

Long Questions

1. In this class, we focused on building devices primed with multisensory interactions and moved away from graphical user interface. Apart from being fun, list **THREE** motivations for why we build gadgets.

Potential Answers:

(Any three motivations from the following)

While graphical user interfaces have fundamentally changed the usefulness of computers and computation, like many highly successful things, they eventually become an impediment to progress with significant stagnation.

Reaching ubiquitous computing where computers are, or can be, everywhere and in everything.

There is something about a concrete physical representation which allows us to think differently as compared to the more abstract and visual by manipulating with our well developed spatial/tactile/kinesthetic abilities.

Improve user interface through contextual awareness. Most current interfaces are static in the sense that they don't act differently in different human situations.

Any other motivations that make sense from a historical, technological, experiential, or design perspective.

- 2. Decision tree is one of the major “classic” classification algorithms. Explain what a decision tree is and then reason why it is prone to the problem of overfitting.**

Potential Answers:

(As long as the answer covers the basic definition of a decision tree and can make an argument about why it is easily prone to overfitting due to its splitting nature)

A decision tree splits data into smaller parts based on the feature that provides the most helpful information. It begins by finding the feature that leads to the largest reduction in uncertainty or "entropy." This feature becomes the starting point for the tree. After data is split into 2 parts, it recursively trains on each part for the rest of the tree.

It may lead to overfitting when the decision trees split the data way down to single training instances that do not generalize well on new data.