



Final Exam

2024 Spring
Name:
Andrew id:

Multiple Choice Question (Single Answer):

Select the statement that accurately describes the electromagnetic force, one of the fundamental forces in physics. This question requires you to choose one correct answer from the provided options below.

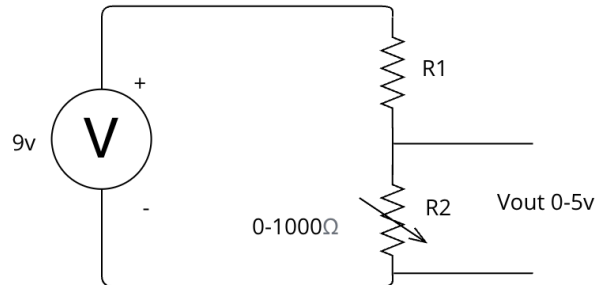
1. Which of the following statements best describes the electromagnetic force?

- A. It involves the interaction between charged particles and is significantly stronger than gravitation, holding atoms and molecules together.
- B. It is responsible for holding the nucleus of an atom together.
- C. It is the weakest of the fundamental forces and mainly involves the interaction between quarks and neutrinos.
- D. It is mainly responsible for the gravitational interactions that hold planets and galaxies together.

2. Why is the exploration and development of new user interface technologies considered crucial beyond mere technological advancements, especially in the context of historical successes and future implications?

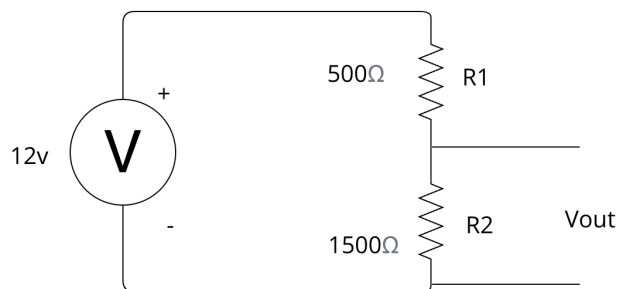
- A. They are developed purely for their entertainment value and technical drive.
- B. They are primarily designed to address issues such as privacy and attention demands.
- C. They help overcome the stagnation brought about by the widespread adoption of traditional graphical user interfaces by exploring the omnipresence of computing possibilities.
- D. They are mainly used for testing the performance of new hardware.

3.If a variable resistance sensor R2 ranges from 0 to 1000 Ohms and you want the output voltage Vout to be between 0 and 5 volts, what value should you choose for R1?



- A. 1000 Ohms
- B. 1500 Ohms
- C. 2000 Ohms
- D. 2500 Ohms

4.Given the circuit below, if R1 is 500 Ohms and R2 is 1500 Ohms, with Vin at 12 volts, what is Vout?



- A. 3 v
- B. 6 v
- C. 9 v
- D. 12 v

5.When building decision trees, how do we determine which features are most effective for creating splits in the data?

- A. Choose features randomly to ensure the model remains unbiased.
- B. Use features that are mostly noise since they add complexity and detail to the model.

- C. Select features that have high information content to effectively narrow down decision-making.
- D. Always use features that are easy to understand, regardless of their predictive power.

Short Answer Question(Open-ended):

In this section, you will encounter open-ended short answer questions that aim to evaluate your understanding and critical thinking on specific topics discussed in the readings and lectures. These questions require a detailed response, reflecting your insights, interpretations, and proposals based on the provided materials and your own knowledge.

6. Discuss the concept of "utility" as it relates to decision-making in mixed-initiative user interfaces and AI-infused systems. Explain how utility values are used to determine the best course of action, considering both the probability of a user's intent and the consequences of system actions.

7. Reflect on the concept of "Situationally Appropriate Interaction" as it relates to user interface design. Consider the evolving needs of users and the technological advancements discussed in the readings. Explain how understanding the user's context and state can enhance interface design, and propose potential applications or improvements that could be integrated into current systems. This is an open-ended question, and you are encouraged to draw from both the provided readings and your own insights.

Answer

Q1: A

The electromagnetic force is one of the fundamental forces of nature, characterized by its interaction between charged particles. It is vastly more powerful than gravitational force, approximately 3×10^{37} times stronger, and plays a crucial role in holding atoms and molecules together. This force allows for the vast array of physical phenomena that occur at atomic and molecular scales, distinguishing it from other fundamental forces like the strong and weak nuclear forces and gravitation, which hold the nucleus together and govern larger scale interactions like those seen in astronomy, respectively.

Q2: C

The importance of developing new user interface technologies lies in overcoming the stagnation caused by the widespread adoption of traditional graphical user interfaces. Weiser's group pioneered ubiquitous computing, pushing boundaries by integrating computing into everyday life, which not only advances technology but also addresses broader issues like privacy and user engagement. This exploration marks a shift towards a more user-centered approach, where technology is seamlessly integrated into daily contexts.

Q3: B

In this circuit, because R_1 and R_2 are connected in series, the voltage V_{out} across R_2 is determined by the ratio of R_2 to the total resistance ($R_1 + R_2$). To ensure that V_{out} reaches a maximum of 5 volts when R_2 is at its maximum value of 1000 Ohms, R_1 should be chosen so that the voltage through R_2 is 5 volts.

Q4: C

This circuit functions as a voltage divider, where R_1 and R_2 are in series and V_{out} is taken across R_2 . The value of V_{out} is determined by the proportion of the total voltage (12 volts) that falls across R_2 , which is calculated based on the ratio of R_2 to the total resistance ($R_1 + R_2$). This reflects that a larger proportion of the total resistance by R_2 results in a higher V_{out} .

Q5: C

In the construction of decision trees, the effectiveness of a feature for splitting the data is determined by its information content. Features with high information content are more predictive of the label and thus can significantly narrow down the decision-making process, leading to more accurate and efficient models. Features that are mostly noise do not effectively contribute to decision-making as they do not significantly reduce uncertainty about the label.

Q6: Sample Answer

In mixed-initiative user interfaces and AI-infused systems, the concept of "utility" is essential for decision-making. It quantifies the benefit or cost of system actions based on the accuracy of the system's inference about the user's intent. The utility function ($u(A, G)$) represents the benefit of taking action (A) when the user actually has goal (G), whereas ($u(A, \neg G)$) measures the potential detriment of taking action (A) when the user does not have goal (G). Similarly, ($u(\neg A, G)$) and ($u(\neg A, \neg G)$) represent the utilities when no action is taken, depending on whether the goal exists or not.

The system calculates the expected utility (EU) to decide on actions. This is done by combining the probability of a user's goals with the respective utilities:

$$[EU(A | E) = P(G | E) \times u(A, G) + P(\neg G | E) \times u(A, \neg G)]$$

Here, ($P(G | E)$) is the probability that the user has goal (G) given the evidence (E), and ($P(\neg G | E)$) is the probability of the user not having the goal.

The system acts when the expected utility of taking action is higher than not acting, ensuring that actions are beneficial more often than not. The framework of utility values requires careful tuning and empirical data to set thresholds for action, ensuring that AI behavior is beneficial and aligns with user expectations. This approach allows AI systems to act in more sophisticated, context-aware ways and aligns with human-centric design principles by prioritizing actions that maximize positive outcomes and minimize negative impacts.

Q7: Sample Answer

The concept of "Situationally Appropriate Interaction" underscores the importance of context-awareness in user interface design. As users interact with technology in varying environments and under different circumstances, it becomes crucial that the systems they use can adapt accordingly. By understanding the user's current situation, such as whether they are in a meeting, driving, or at home, interfaces can tailor their responses to fit the context, thus enhancing usability and effectiveness.

One practical application of this concept could be in smartphone usage. Modern smartphones could use sensors and data to detect the user's environment—such as being in a quiet library or a noisy cafe—and adjust notification settings automatically to suit the ambiance. For example, in a library, the phone could switch to silent mode and only display critical notifications, whereas in a personal setting like home, it might allow more audible alerts.

Furthermore, situationally appropriate interactions could significantly improve safety in automotive systems. For instance, if a car detects that it is in heavy traffic, it could limit complex interactions with the infotainment system to reduce driver distraction. Conversely, when the vehicle recognizes that it is safely parked, it could unlock more features for the driver to interact with, such as setting up navigation routes or browsing media libraries.

Overall, embedding context-aware capabilities into interfaces can lead to more intuitive and adaptive technologies that align with the dynamic needs of users. This approach not only improves user experience but also enhances safety and efficiency by reducing inappropriate interactions that could demand attention at critical times. By continuing to develop and integrate these adaptive features, designers can create more empathetic and responsive systems that respect and enhance human capabilities and limitations.