

**Question 1 - What does PWM mean and what does it do/used for?**

1. Pulse Width Modulation, to control motors/power LEDS
2. Pulse Width Modulation, to control Digital and Analog Signal Swap
3. Pulse Wide Machine, to control motors/power LEDS
4. Pulse Wide Machine, to control Digital and Analog Signal Swap

**Question 2 - Pull-Up Resistors are Internally enabled or disabled - which setup will allow High Impedance Input?**

1. DDRx - 0 // PORTx - 0
2. DDRx - 0 // PORTx - 1
3. DDRx - 1 // PORTx - 0
4. DDRx - 1 // PORTx - 1

**Question 3 - According to Shannon's theory of information entropy, what does a lower entropy signify in a message?**

1. Higher uncertainty and unpredictability
2. Greater redundancy and repetition
3. Less uncertainty and greater predictability
4. Increased complexity and ambiguity

**Question 4 - Which statement best describes the role of pruning in decision tree algorithms?**

1. Pruning guarantees a perfect fit by subdividing until the model exactly matches the training data.
2. Pruning is particularly effective for specific datasets but is not generally reliable.
3. Pruning is unnecessary for small training instances as they are inherently noisy.
4. Pruning creates smaller and less complex trees, reducing overfitting and ensuring better generalization.

**Question 5 - What are VIAS, and why can we abuse them on a PCB board?**

1. VIAs are virtual interfaces for asynchronous communication, and they can be used to optimize signal propagation delays.
2. VIAs are versatile integrated amplifiers, and they can be abused to boost signal strength on a PCB.
3. VIAs are vertical interconnect access points, and they can be employed to create connections between different layers of a PCB, enabling routing of signals.
4. VIAs are visual inspection areas, and they can be manipulated to enhance the visual appeal of a PCB design.

**LONG QUESTION: What is an H-Bridge and how does it work?**

**LONG QUESTION: What is the difference between AC and DC, why is it important?**

**[ANSWERS On FOLLOWING PAGES]**

## ANSWER PAGE

Q1

**Pulse Width Modulation, allows the ability to control motors/power LEDs** - It's a technique used to control motors and power LEDs by adjusting the average power delivered to them. Essentially, PWM rapidly switches a signal on and off, varying the width of the pulses. By controlling the width of these pulses, we can effectively control the amount of power delivered to the device. This method is also commonly used for tasks like voltage regulation, where the average voltage applied to a device is adjusted by varying the width of the pulses. Additionally, PWM is employed in communication systems for modulation, where it alters the characteristics of a signal to carry information.

Q2

**DDR<sub>x</sub> - 0 // PORT<sub>x</sub> - 0 - Provides High Impedance Input** - the second 0/1 allows for input with pull-up enabled, the third 1/0 allows for output to be at LOW, the fourth allows output to be at HIGH.

Q3

**Less uncertainty and greater predictability** - Shannon's theory of information entropy states that entropy measures the uncertainty or unpredictability of a message. Lower entropy indicates less uncertainty and greater predictability in the message. This means that the message contains less randomness or ambiguity, making it easier to predict or understand.

Q4

**Pruning creates smaller and less complex trees, reducing overfitting and ensuring better generalization** - Pruning plays a pivotal role in decision tree algorithms by curating simpler and more generalized models, thereby mitigating the risk of overfitting. By selectively removing unnecessary branches and nodes from the decision tree structure, pruning streamlines the model's complexity. This reduction in complexity ensures that the model focuses on the most pertinent features and relationships within the data, rather than memorizing noise specific to the training dataset. Consequently, pruned decision trees are better equipped to generalize to unseen data, as they are less prone to capturing irrelevant patterns or fluctuations present in the training set. Ultimately, pruning serves as a crucial mechanism for enhancing the predictive accuracy and robustness of decision tree models by fostering a balance between model complexity and generalization capability.

Q5

**Vias are vertical interconnect access points, and they can be employed to create connections between different layers of a PCB, enabling routing of signals** - Vertical Interconnect Access Points (VIAs) are crucial elements in printed circuit board (PCB) design, enabling connections between different layers of the board. These small plated holes drilled through the PCB's insulating layers serve as conductive pathways, allowing electrical signals or power to pass vertically through the board's stack-up. VIAs establish connections between traces on different layers, facilitating the routing of signals or power between various components or sections of the circuit. This functionality is particularly important in multi-layer PCBs, where space is limited, and complex circuitry needs to be accommodated efficiently. VIAs enable the creation of dense and intricate circuits by providing a means to interconnect layers, thereby contributing to the overall functionality and compactness of electronic devices.

### What is a H-Bridge and how does it work? (ANSWER)

#### 1. Functionality:

- An H-Bridge is an electronic circuit used to control the direction and speed of motors or other loads.
- It consists of four switches arranged in an "H" configuration, allowing current to flow in either direction through the load.

#### 2. Operation:

- By selectively turning on and off the switches, the H-Bridge can control the direction of current flow through the load, thus controlling the motor's rotation direction.
- Speed control is achieved through pulse-width modulation (PWM), which varies the effective voltage applied to the motor by adjusting the duty cycle of the PWM signal.

#### 3. Applications and Considerations:

- H-Bridge circuits find applications in robotics, electric vehicles, DC motor control, and power inverters.
- While offering bidirectional control and efficient motor operation, H-Bridges require careful attention to prevent shoot-through currents and necessitate proper heat dissipation to avoid damage to components.

## What is the Difference between AC and DC, why is it important? (ANSWER)

### 1. Power Compatibility and Supply:

- Understanding that Arduino microcontrollers operate on direct current (DC) power sourced from batteries, USB ports, or DC power supplies.
- Highlighting the importance of ensuring compatibility with Arduino's power requirements to prevent damage to the microcontroller.
- Acknowledging the need for voltage regulators or transformers to convert alternating current (AC) to DC when interfacing with AC-powered components or sensors.

### 2. Signal Processing and Control:

- Emphasizing the significance of comprehending DC principles for tasks such as sensor readings, digital signal manipulation, and control of external devices like LEDs and motors.
- Noting that while Arduino cannot directly process AC signals, familiarity with AC principles is crucial for interfacing with AC-powered devices using appropriate circuitry.

### 3. Safety Considerations:

- Highlighting the importance of implementing safety measures when working with electrical systems, especially AC power.
- Emphasizing the need for caution and proper insulation, grounding, and circuit protection to mitigate the risk of electrical accidents, particularly when dealing with high-voltage AC circuits.



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