

1. Which one of the following **IS NOT** a quality to a microcontroller?

- a. Contains memory for programs and data
- b. Includes a Central Processing Unit
- c. Includes I/O Capabilities
- d. Support dynamic loading of programs**

d. Microcontrollers are usually “One Time Programmable” (OTP), and the programs are not meant to be rewritten continuously.

2. In what situation would a voltage divider come in handy?

- a. trim down a higher voltage to a lower desired voltage**
- b. filters to selectively let through high frequencies and block (attenuate) low frequencies
- c. store charges
- d. Turn on/off the flow when a large current that can't be dealt with directly flows through

a. Because a voltage divider employs two resistors in series, V_{out} will be smaller than V_{in} , with V_{out} dependent on the values of R_1 and R_2 . $V_{out} = V_{in} * R_2 / (R_1 + R_2)$.

3. What property about a potentiometer makes it a handy tool in controlling voltage?

- a. $R_1 + R_2$ remains constant regardless of wiper position. Which means, V_{out} has a linear relationship with position.**
- b. It changes resistance in response to changes in the environment.
- c. They allow for current to only flow in one direction.
- d. All of the above

a. $R_1 + R_2$ remains constant in a potentiometer—this is why they make good input devices for knobs and sliders.

4. What is something that the linear regression model is **incapable** of doing?

- a. Create relationship between features and predicted value

b. Note changes in predictions caused by unreported and unobserved features

- c. Take a set of observed features to create an estimate of a resulting value
- d. None of the above, a linear regression model is capable of everything mentioned.

B. changes in predicted values are assumed to be caused by changes in features—this does not include unreported or unobserved features.

5. What are some of the benefits of using a decision tree algorithm?

- a. DT Algorithm will subdivide all the way down to single training instances to fit data.
- b. Decision trees are particularly prone to overfitting.
- c. Can be trained recursively
- d. All of the above.**

D. Decision trees use a simple nested conditional structure to get to an end result. Thus, by splitting with features having the largest “information gain”, we can utilize a train on a decision tree algorithm by recursively training on each part of the rest of the tree.

6. In a few sentences, explain the steps to machine learning. How are features used to become predictions, and what are some of the algorithms that can be used? Be sure to also mention some of the applications to machine learning.

Machine learning can be split into two main steps: training, and prediction.

In the training phase, features must be provided to the model. Features usually come in the form of numbers, and discrete numbers of a small or large set of data. Through methods such as linear regression, a prediction, or an estimate in the form of a resulting value, can be provided. Linear regression is a mathematical model that can be used to find a linear relationship between features and predictions. This way, when other feature inputs are presented to the model, the model can use this linear relationship to map the input to a prediction. Furthermore, by using algorithms such as decision trees, people can train ML models to be able to come to their final categorization.

Some of the applications to ML models like this include: predicting house prices, predicting the source of mechanical failures, and many more.

*7. What are some of the concerns with installing sensors in homes? Please list out some of the **obstacles and concerns** that people have with having sensors installed. How can we address these concerns?*

Some of the obstacles and concerns with installing sensors in homes are incorrect installation of sensors and privacy concerns. Oftentimes, these sensors that exist in homes have many different parts that communicate with each other, however, when one part of the system is incorrectly installed, the other parts fail to work. Directional sensors need to be pointed and angled correctly, and there is a learning curve for those installing sensors that are not tech-literate—especially older people. In addition, there are also a variety of privacy concerns. These devices often use cameras and microphones to detect activity, however, many users may see this as an invasive means of data collection—the devices are not transparent about how exactly this information is being used, and also uncomfortable with the fact that there is a device tracking their living habits inside a home-environment—a deeply personal and private space.

Some of the methods that can be employed to tackle these concerns are educating users on data collection, storage, and transmission. By making these topics more transparent to users, users can start to see that the current technologies are not as invasive and powerful as one may believe—by seeing how the applications of these technologies can benefit their own experiences, the technology gap can be gradually bridged. In addition, it is also important to avoid highly directional sensors, as people's living spaces vary, and it may be difficult to correctly angle sensors.