1.What is the concept of human learning? Please give two examples.

Humans acquire knowledge through experience either directly or shared by others. Learning happens when you **observe**a phenomenon and recognize a **pattern**. You try to understand this pattern by finding out if there is any **relationship**between the **entities**involved in that phenomena. All human learning is — observing something, identifying a pattern, building a theory (model) to explain this pattern, and testing this theory to check if its fits in most or all observations.

Example 1: a simple phenomenon that we observe daily — the occurrence of day and night.

Example 2: Learning to drive a motorcar

2.What different forms of human learning are there? Are there any machine learning equivalents?

Humans acquire knowledge through experience either directly or shared by others. Machines acquire knowledge through experience shared in the form of past data.

**Behaviourism** states that learning occurs based on positive responses to behaviour, and this motivates continued behaviour. This requires an action before learning can begin.

Ex: let's say a child accidentally activates a light by pushing a button. If the light is motivating, the child will push the button again. Motivation in this instance is extrinsic, or it comes from outside the learner.

**Cognitivism**deals with thought processes rather than rewarded behaviours. The key to cognitivism can be thought of with the question, ''Why?'' Here, there is an intrinsic, or coming from the inside, motivation to learn.

**Constructivism** is the most advanced theory on learning. It states that learning comes from our desire to construct our own worlds based on what we know already. Motivation is both intrinsic and extrinsic.

***Human Learning Theory Equivalent***

**Supervised learning** is similar to [concept learning](https://en.wikipedia.org/wiki/Concept_learning) where a person is required to classify new objects into existing categories, by matching the features of the new objects to examples in the categories.

**Unsupervised learning** is similar to the Artificial neural networks follow the neuronal principle of Hebbian learning, where the algorithm centres on inputs with similar properties, just like how neurons that activate simultaneously strengthen the synaptic link between each other.

**Reinforcement Learning** is similar to the reward system of [operant conditioning](https://en.wikipedia.org/wiki/Operant_conditioning) how cats learn to escape a puzzle box more quickly after a repeated number of trials.

Skinner similarly created a chamber for rats and pigeons, where one lever delivered a reward while another administered a shock. He found that when the animals started to identify what each lever did, pressing of the reward lever was reinforced and frequency of the behaviour increased. Conversely, punishment resulted in decrease of the shock lever being pressed.

3. What is machine learning, and how does it work? What are the key responsibilities of machine learning?

Machine learning is the practice of applying algorithmic models to data, in an iterative manner, so that your computer discovers hidden patterns or trends that you can use to make predictions. It’s also called algorithmic learning. Machine learning is a core sub-area of Artificial Intelligence (AI). ML applications learn from experience (or to be accurate, data) like humans do without direct programming. When exposed to new data, these applications learn, grow, change, and develop by themselves.

In an ML project you gather data in a training set, and you feed the training set to a learning algorithm.

If the algorithm is model-based it tunes some parameters to fit the model to the training set (i.e., to make good predictions on the training set itself), and then hopefully it will be able to make good predictions on new cases as well. If the algorithm is instance-based, it just learns the examples by heart and uses a similarity measure to generalize to new instances. The system will not perform well if your training set is too small, or if the data is not representative, noisy, or polluted with irrelevant features (garbage in, garbage out). Lastly, your model needs to be

neither too simple (in which case it will underfit) nor too complex (in which case it will overfit). once you have trained a model, you want to evaluate it and fine-tune it if necessary.

4. Define the terms "penalty" and "reward" in the context of reinforcement learning.

Reinforcement learning is all about gamifying the learning process. This type of machine learning algorithm also referred to as agent uses a reward-penalty method to teach an AI system. If it makes the right move, it gets rewarded. If it makes a mistake, it receives a penalty.

5. Explain the term "learning as a search"?

A machine learning algorithm strives to learn a general function out of a given limited training examples. In general, we can think of concept learning as a search problem. The learner searches through a space of hypotheses, to find the best one. The best one would be the one that fits the training examples the best. And while searching and trying different hypotheses, we would hope for the learner to eventually converge to the correct hypothesis. This convergence is the same idea as Learning.

6. What are the various goals of machine learning? What is the relationship between these and human learning?

The goal of machine learning, closely coupled with the goal of AI, is to achieve a thorough understanding about the nature of learning process (both human learning and other forms of learning), about the computational aspects of learning behaviours, and to implant the learning capability in computer systems.

To be more specific, there are three aspects of the goals of ML.

(1) To make the computers smarter, more intelligent. The more direct objective in this aspect is to develop systems (programs) for specific practical learning tasks in application domains. (2) To develop computational models of human learning process and perform computer simulations. The study in this aspect is also called cognitive modelling.

(3) To explore new learning methods and develop general learning algorithms independent of applications.

The understanding of human learning and its computational aspect is a worthy scientific goal. We human beings have long been fascinated by our capabilities of intelligent behaviours and have been trying to understand the nature of intelligence. It is clear that central to our intelligence is our ability to learn. Thus, a thorough understanding of human learning process is crucial to understand human intelligence. ML will gain us the insight into the underlying principles of human learning and that may lead to the discovery of more effective education techniques. It will also contribute to the design of machine learning systems. Finally, it is desirable to explore alternative learning mechanisms in the space of all possible learning methods. There is no reason to believe that the way human being learns is the only possible mechanism of learning. It is worth exploring other methods of learning which may be more efficient, effective than human learning.

7. Illustrate the various elements of machine learning using a real-life illustration.

Real-world examples of image recognition:

a) Label an x-ray as cancerous or not

b) Assign a name to a photographed face (aka “tagging” on social media)

c) Recognise handwriting by segmenting a single letter into smaller images

Machine learning is also frequently used for facial recognition within an image. Using a database of people, the system can identify commonalities and match them to faces. This is often used in law enforcement.

8. Provide an example of the abstraction method.

Abstraction is defined as dealing with ideas instead of events. In the context of Ml, that means worrying more about what the right algorithm is and less about how to implement it. Another way of looking at it, for those technically inclined, is as an API call (abstracted) vs. a self-implemented function or series of functions.

Example Classify patterns by discrete labels.

9. What is the concept of generalization? What function does it play in the machine learning process?

**Generalization** refers to your model's ability to adapt properly to new, previously unseen data, drawn from the same distribution as the one used to create the model.

10. What is classification, exactly? What are the main distinctions between classification and regression?

 Classification is about predicting a label and regression is about predicting a quantity.The key distinction between Classification vs Regression algorithms is Regression algorithms are used to determine continuous values such as price, income, age, etc. and Classification algorithms are used to forecast or classify the distinct values such as Real or False, Male or Female, Spam or Not Spam, etc.

11. What is regression, and how does it work? Give an example of a real-world problem that was solved using regression.

Regression refers to the estimation of a continuous dependent variable or response from a list of input variables, or features.

Businesses often use linear regression to understand the relationship between advertising spending and revenue. revenue = β0 + β1(ad spending)

The coefficient β0 would represent total expected revenue when ad spending is zero.

The coefficient β1 would represent the average change in  total revenue when ad spending is increased by one unit (e.g. one dollar).

If β1 is negative, it would mean that more ad spending is associated with less revenue.

If β1 is close to zero, it would mean that ad spending has little effect on revenue.

And if β1 is positive, it would mean more ad spending is associated with more revenue.

Depending on the value of β1, a company may decide to either decrease or increase their ad spending.

12. Describe the clustering mechanism in detail.

Clustering is the task of dividing the unlabeled data or data points into different clusters such that similar data points fall in the same cluster than those which differ from the others. In simple words, the aim of the clustering process is to segregate groups with similar traits and assign them into clusters.

13. Make brief observations on two of the following topics:

i. Machine learning algorithms are used.

ii. Studying under supervision

Supervised learning is a machine learning approach that’s defined by its use of labeled datasets. These datasets are designed to train or “supervise” algorithms into classifying data or predicting outcomes accurately. Using labeled inputs and outputs, the model can measure its accuracy and learn over time. Supervised learning can be separated into two types of problems: classification and regression.

iii. Studying without supervision

Unsupervised learning uses machine learning algorithms to analyze and cluster unlabeled data sets. These algorithms discover hidden patterns in data without the need for human intervention (hence, they are “unsupervised”).

Unsupervised learning models are used for three main tasks: clustering, association and dimensionality reduction.

iv. Reinforcement learning is a form of learning based on positive reinforcement.