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Question 1

Linear regression is a technique whose dependent variable is continuous, and the independent variable is continuous or discrete. Linear regression sets up a relationship between the dependent(Y) and one or independent variables (X) by finding the line of best fit. The relationship between the dependent, and independent variables is linear.

Logistic regression has binary dependent variables (yes or no, 1 or 0, positive or negative). Logistic regression is mostly used for binary classifications.

	Linear Regression	Logistic Regression
Dependent variable	Linear regression is used when the dependent variable is continuous. Example GPA of students.	Logistic regression is used when the dependent variable is discrete — example yes/no, diabetes/ no diabetes.
Outcome	In linear regression, the result can take on any value. In other words, the result in linear regression is continuous.	In logistic regression, the outcome has limited possible values. The result is a probability value and falls between 0 and 1 inclusive.
Error minimizing technique	Linear regression uses least square error method to find	Logistic regression uses maximum likelihood

	the weights that minimize the error and arrive at the best possible fit.	estimation to minimize the errors and arrive at the best possible fit.
Residuals distribution	In linear regression, residuals are assumed to be normally distributed.	In logistic regression, residuals are independent, but not distributed normally.

Question 2

(a). What is reinforcement learning?

Reinforcement learning is about (an agent) taking action through trial and error to maximize reward in a particular situation. In simple terms, reinforcing learning is learning by experience. It allows an agent to take actions in its environment and get rewarded or penalized based on the correctness of the action chosen. It uses concepts such as agent, action, reward, environment.

1. A**gent**: an agent takes action. For example, the super Mario moving in a video game.
2. **Action**: it's the set of all possible moves the agent can make.
3. **Discount factor**: the **discount factor** is multiplied by future rewards as discovered by the agent to dampen these rewards' effect on the agent's choice of action.
4. **Environment** is the world through which the agent lives.
5. **State:** A **state** is an immediate situation in which the agent finds itself.

(b). The differences between reinforcement learning, supervised learning and unsupervised learning.

Supervised learning	**reinforcement learning**	**unsupervised learning.**
Supervised works on existing labeled or sample labeled data	works on interacting with the environment	works on existing data that is not labeled
The two main tasks of supervised learning are regression and classification.	Reinforcement learning has different tasks such as exploration vs. exploitation, Markov decision process, deep learning, value learning, and policy learning.	Unsupervised learning has tasks such as clustering and association.

(c). The similarities and differences between classical reinforcement learning and deep reinforcement learning.

Differences

The classical reinforcement learning uses the Q function, i.e. Q (s, a) to estimate the return reward. The function is defined in a table which maps the (state, action) pairs to rewards. However, when the environment becomes large, or the number of states becomes larger, it becomes problematic to store the mappings in a table; hence approximation of the function becomes difficult. This is where deep reinforcement learning takes the floor. Deep reinforcement learning is used to generalize or approximate the function without storing the mappings. Deep reinforcement learning will be able to capture the intricate details of the function because it has many hidden layer and units.

Similarities

The classical and deep reinforcement learning both have agents who takes actions and get rewarded or penalized.

(d).

1. Supervise learning models are easy to work with as compared to reinforcement learning.

2. Reinforcement learning requires more computations than supervised learning.

Question 3

Coordinate descent	Gradient descent
Coordinate descent is an optimization algorithm that successfully minimizes a multivariable function along one direction at a time. In other words, given an objective function, the algorithm minimizes the function concerning each coordinate at a time.	Gradient descent is also an optimization algorithm that takes a step proportional to the negative of the gradient from the current location to minimize the objective function.
Coordinate descent updates one parameter at a time	gradient descent attempts to update all parameters at once

Finding the gradient of the k-means objective function can sometimes be challenging.