**Question 1 of 1**

**Programming Morality - The Trolley Problem**  
Self-driving cars are already cruising the streets today. And while these cars will ultimately be safer and cleaner than their manual counterparts, they can’t completely avoid accidents altogether.   
Describe in a minimum of 500 and a maximum of 1,000 words how would you program a car if it encounters an unavoidable accident?  
Please see the TEDEd video for reference:  
[The ethical dilemma of self-driving cars](https://www.youtube.com/watch?v=ixIoDYVfKA0)  
You are *not* required to write code or pseudo-code as a response to this question.  
Write in text your idea(s) on how to solve this ethical dilemma and your thought-process supporting your idea(s).

**PROPOSAL**

**PROEM**

A self-driving car is a vehicle that is capable of sensing its environment and moving safely with little or no human input.

**Self-driving car AI pipeline or process of steps:**-

input [image/radar/lidar + using - GPS and IMU] ->

car/pedestrian detection, lane detection, traffic light detection, obstacle detection ->

trajectory prediction ->

motion planning ->

output [steer/accelerate/brake]

**Benefits:-**

* Removing human error from driving equation.
* Eased road congestion.
* Decreased harmful emissions.
* Minimised unproductive and stressful driving time.

**TERMS**

**Transfer learning**: Let's say you bought a self-driving car, and you've trained your AI system to detect cars. But you didn't deploy your vehicle to a new city and somehow this new city has a lot of golf carts travelling round, and so you need to also build a golf cart detection system. You may have your car detection system with a lot of images, say 100,000 images, but in this new city where you just start operating, you may have a much smaller number of images of golf carts. Where transfer learning really shine is if having learn from a very large dataset of car detection, you can now do pretty well on golf cart detection, even though you have a much smaller golf cart dataset. Because some of the knowledge it has learned from the first task, of what the vehicles look like, what the wheels look like, how the vehicles move, may be that will be useful also for golf cart detection.

**Edge deployments:** If you are building a self-driving car, there's not enough time to send data from a self-driving car to a Cloud server to decide if you should stop the car or not, and then send that message back to the self-driving car. So, the computation has to happen usually in a computer right there inside the car. That's called an edge deployment, where you put a processor right where the data is collected so that you can process the data and make a decision very quickly without needing to transmit the data over the Internet to be processed somewhere else. The main advantage of Edge deployment is it can increase response time of the system, and also reduce the amount of data needed to send over the network.

To mention a sense of the scale, a self-driving car may collect multiple gigabytes of information every single minute of operations. So, self-driving cars actually generate lot of data and saving the data for many days or weeks or months or years of operation requires serious data engineering.

**EXAMPLE** (for better understanding)

A group of researchers from UC Berkeley, University of Michigan and other universities, showed that if you affix stickers onto a stop sign, you can fool an AI system into not seeing the stop sign at all. It thinks there's something else there other than a stop sign. Most humans will still see this as a stop sign quite easily. But if you have a computer vision system built into a self-driving car for example, it would be really unfortunate if the car doesn't see the stop sign anymore, because of these stickers applied on top of it.

**SOLUTION**

As discussed above, many technical challenges are to be faced by the self-driving cars in real-time.

* Autonomous cars may require very high-quality specialised maps to operate properly. These maps may be out of date, so they need to be updated every time.
* The road infrastructure may need changes for automated cars to function optimally.
* Frequently check the susceptibility of the car's sensing and navigation systems, to different types of weather (such as snow) or deliberate interference, including jamming and spoofing, and then take necessary actions required like increasing the dataset.
* A car's computer could potentially be compromised, as could a communication system between cars. So integrated testing should be done to find and then fix the technical complications.
* Field programmability for the systems will require careful evaluation of product development and the component supply chain.
* The machine needs to be imprinted cautiously to take the right decisions with quick resolutions during unexpected incident-happenings.

**PERORATION**

Different perceptions are considered to make the machine adopt a moral decision in the sight of any mishappening. Global trends of the MIT study highlight that, overall, people prefer to save the lives of humans over other animals, prioritize the lives of many rather than few, and spare the lives of young rather than old. Men are slightly more likely to spare the lives of women, and religious affiliates are slightly more likely to prioritize human life. The lives of criminals were prioritized more than cats, but the lives of dogs were prioritized more than the lives of criminals. The lives of homeless were spared more than the elderly, but the lives of homeless were spared less often than the obese.

People overwhelmingly express a preference for autonomous vehicles to be programmed with utilitarian ideas, that is, in a manner that generates the least harm and minimizes driving casualties. While people want others to purchase utilitarian promoting vehicles, they themselves prefer to ride in vehicles that prioritize the lives of people inside the vehicle at all costs. This presents a paradox in which people prefer that others drive utilitarian vehicles designed to maximize the lives preserved in a fatal situation but want to ride in cars that prioritize the safety of passengers at all costs. People disapprove of regulations that promote utilitarian views and would be less willing to purchase a self-driving car that may opt to promote the greatest good at the expense of its passengers.

**CRUX**

* Self-driving cars, combine a variety of sensors to perceive their surroundings, such as radar, lidar, sonar, GPS, odometry and inertial measurement units, to predict the appropriate path.
* Transfer learning is the technology that lets you gain knowledge from a task and use the knowledge to help you on a different task.
* In Edge Deployment, the computation has to happen in a computer itself without involving any data transmissions to the Cloud server.
* A self-driving car may collect multiple gigabytes of information every single minute of operations.
* Updated maps, optimal road infrastructure, adaptation of sensors and navigators to weather, competent communication system, assessed technical complications, moral decision-taking capabilities can enhance self-driving cars from its challenges.
* Various perceptions are considered to make the machine adopt a moral decision, if it encounters any unavoidable accident.