1. As a technology under transformation, explain the positive and negative impact of artificial intelligence (AI) in society.

Computing in general helps us to optimize the processes which earlier were manual or needs human intervention for all decision making. From programmed processes to do a repetitive job, replacing the manuscripts with digital persistence of knowledge, data and with time converting print media to digital media, has placed key foundation of artificial intelligence.   
  
Over the time if we see, any new technology or reform that disrupted the market, has key focus on optimization and scaling directly or indirectly of individual or social goals. Take an example of globalized industrialization, when to reduce the cost of manufacturing the industries were moved from the west to Asian countries(because of low cost of living and suppressed life style and hence cheap raw material) and with passage of time, west has become dependent on Asia for all its demand. As the population grew in west, and manufacturing hubs moved out to Asia, there is dearth of employment in the west, also rising living cost have risen the wages of the workers. And, then comes the automation, which helped to replace significant manual work and processes with engineered and automated processes. With this some industries moved to back to home-land, which can afford to upgrade themselves. Though it caused huge impact on GDP of the Asian economy but eventually it has optimized the production and procurement cost. And we are moving towards smart and efficient localized economy.

Artificial Intelligence follows the same path, as it is just an advancement over automation, where we advanced from programmed logics on sensors observations to training machines to learn from the past experiences and apply optimal decision itself.

In processed food industry, packaging still needs human intervention for the precision and what if the human precision is replaced by AI. Yes, computing is effectively efficient than human in terms of repetitive job, due to various human factors. But this also shows, the direct tug of war between un-skilled jobs and machines.

Talking about the **positive side of AI**, with higher computing power and with efficient data modelling, AI could help humanity in larger terms like detecting the possibility of diseases in advance, this will reduce the cost of healthcare in later years, and will also help in increasing the life expectancy of society.   
  
AI is beneficial where the human capabilities are limited like ocean, earth, planetary, space exploration. Many companies like Microsoft, Hitachi Vantara among some companies that collaborating to preserve the forests, animals using AI.

AI is beneficial for person with disabilities, from the converting the text to audio for blinds, to helper robotic chairs for physically challenged.

Implementation of AI in any domain will be good, if it is ethical and is being used to enrich the human capabilities than supress the humanity for just monopolized benefits. And for humanity it is important to push the limits to acquire higher skills, to generate alternate jobs. Our creativity and passion will lead the humanity among all odds.

1. With sketch, explain the workflow stages of developing AI products.

In General terms, any existing **Business Intelligence (BI)** data project went through the following the stages (figure 2.1): this include gathering organized/un-organized data from various edge, cloud sources then filtering the data using Big-Data processes and then converting them into insightful information which can be further used to draw business decision. As we move from the BI to **artificial intelligence (AI)**, workflow draws the similar initial stages and then advanced procedure and replacing the manual insights and predictions to AI with machine learning.

Graphical user interface, diagram, application

Description automatically generated

Figure 2.1

**Workflow stages of Artificial Intelligence:**

The AI workflow can be divided into four stages,

Diagram

Description automatically generated

Figure 2.2

1. **Data Preparation**: Data preparation is the process of cleaning and transforming raw data prior to processing and analysis. It is an important step prior to processing and often involves reformatting data, making corrections to data and the combining of data sets to enrich data.

Data preparation is often a lengthy undertaking for data professionals or business users, but it is essential as a prerequisite to put data in context in order to turn it into insights and eliminate bias resulting from poor data quality.

For example, the data preparation process usually includes standardizing data formats, enriching source data, and/or removing outliers.

Data preparation requires domain expertise, such as experience in speech and audio signals, navigation and sensor fusion, image and video processing, and radar and lidar. Engineers in these fields are best suited to determine what the critical features of the data are, which are unimportant, and what rare events to consider.

AI also involves prodigious amounts of data. Yet labelling data and images is tedious and time-consuming. Sometimes, you don’t have enough data, especially for safety-critical systems. Generating accurate synthetic data can improve your data sets. In both cases, automation is critical to meeting deadlines.

1. **AI Modelling**: AI models exist within a complete system. In automated driving systems, AI for perception must integrate with algorithms for localization and path planning and controls for braking, acceleration, and turning.

Once the data is clean and properly labelled, it’s time to move on to the modelling stage of the workflow, which is where data is used as input, and the model learns from that data. The goal of a successful modelling stage is creating a robust, accurate model that can make intelligent decisions based on the data. This is also where deep learning, machine learning, or a combination thereof comes into the workflow as engineers decide what will be the most accurate, robust result.

At this stage, regardless of deciding between deep learning (neural networks) or machine learning models (SVM, decision trees, etc.), it’s important to have direct access to many algorithms used for AI workflows, such as classification, prediction, and regression. One may also want to use a variety of prebuilt models developed by the broader community as a starting point or for comparison.

1. **Simulation and Test:** Simulation and testing for accuracy are key to validating that the AI model is working properly, and everything works well together with other systems, before deploying a model into the real world.

To build this level of accuracy and robustness prior to deployment, engineers must ensure that the model will respond the way it is supposed to, no matter the situation. Questions one should ask in this stage include:

* What is the overall accuracy of the model?
* Does the model perform as expected in each scenario?
* Does it cover all edge cases?

1. **Deployment:** AI models need to be deployed to CPUs, GPUs, and/or FPGAs\* in your final product, whether part of an embedded or edge device, enterprise system, or cloud. AI models running on the embedded or edge device provide the quick results needed in the field, while AI models running in enterprise systems and the cloud provide results from data collected across many devices. Frequently, AI models are deployed to a combination of these systems.

The deployment process is accelerated when you generate code from your models and target your devices. Using code generation optimization techniques and hardware-optimized libraries, you can tune the code to fit the low power profile required by embedded and edge devices or the high-performance needs of enterprise systems and the cloud.

\* Field Programmable Gate Arrays (FPGAs) are semiconductor devices that are based around a matrix of configurable logic blocks (CLBs) connected via programmable interconnects. FPGAs can be reprogrammed to desired application or functionality requirements after manufacturing. This feature distinguishes FPGAs from Application Specific Integrated Circuits (ASICs), which are custom manufactured for specific design tasks. Although one-time programmable (OTP) FPGAs are available, the dominant types are SRAM based which can be reprogrammed as the design evolves.