3 Applications of AI in Solving Real-World Issues

Learning Objectives:

- To appreciate complexity of real-world issues
- To identify leverage points which are appropriate for achieving Sustainable Development Goals (SDGs) using AI solutions

Background and Context

"...Climate change is a massive problem across nearly every sector and measure of human development. To address it at the speed and scale that current conditions require, we will need to take a more data-driven approach—one that harnesses the full power of Artificial Intelligence and other advanced technologies to accelerate discovery and innovation at a truly planetary scale."

—Lucas Joppa, Chief Environmental Scientist, Microsoft

From creating the perfect crop to early stage prognosis of diseases to inclusive quality education for all, AI can actually help in solving global internally developed Millennium Sustainable Development Goals (SDGs).

AI FOR SOCIAL GOOD

Artificial Intelligence is frequently portrayed in apocalyptic terms as the technology that will take over our jobs or even our lives or at least make human beings a slave to technology. But what if AI could also become a valuable tool in worldwide efforts to achieve goals of our society?

In 2017, after the passage of Hurricane Harvey, many streets in downtown Houston were flooded and impassable—but others weren't. An AI application that used satellite-based imagery with object detection and identification algorithm enabled the rescue team to identify safer escape routes for those trapped by the rising water levels.

AI-powered object detection could bring relief to visually impaired people, most of whom live in developing countries. The app works through a smartphone and uses AI to recognize known people and their attributes as well as specific objects such as currency bills.

These are just two small examples of AI being used for social good—and we have scratched the surface on the possibilities of AI. Although Artificial Intelligence is not a panacea, it could help in solving some of the world's most challenging social problems such as curing cancer and climate issues. AI doesn't always require scientific breakthroughs; it can add to existing efforts in both developed and developing economies which are experiencing significant societal challenges or crises and often live beyond the reach of traditional solutions that worked in the past.

Fig. 3.1: AI and Social Good (Source: *Pew Research Centre*)

Several AI capabilities are applicable to a wide range of societal challenges; however, they are more pertinent in the domains of health and hunger, education, security & justice and equality and inclusion, where typically a large population would be affected. In the field of health, *for example*, as per McKinsey Global Institute, people afflicted with diabetes could be helped by an AI-enabled wearable device that can detect potential early signs of diabetes through heart rate sensor data. AI could also analyze mobile phone images to distinguish between a benign skin lesion and melanoma, potentially helping millions of rural dwellers who do not have access to dermatologists.

In education, adaptive learning technology, which tailors content for students based on their abilities, could benefit around 1.5 billion students worldwide.

AI AND SDGs

In 2015, 193 countries of the world agreed to the United Nations (UN) 2030 Agenda for Sustainable Development to set up goals for the betterment of the world. These countries identified 17 global goals to end poverty, protect the planet and ensure peace and prosperity for people, now and in the future. These 17 Sustainable Development Goals (SDGs) are defined for joint global cooperation between the developed and developing countries.

Fig. 3.2: UN's 17 Sustainable Development Goals (SDGs) (Source: *imf.org*)

Sustainable Development Goals

1. **No Poverty:** Bring advances in AI to the most vulnerable to ensure algorithmic equity
2. **Zero Hunger:** Use AI to improve agriculture for better food security
3. **Good Health and Well-being:** Standardize a framework for the performance benchmarking of 'AI for Health' algorithms to address health issues
4. **Quality Education:** Education can enable students to thrive in a world increasingly augmented by AI-powered technologies
5. **Gender Equality:** Actionable and thoughtful ways to identify and address gender inequalities
6. **Clean Water and Sanitation:** Tackle the challenges such as lack of expertise, climate change, resource optimization, and consumer trust
7. **Affordable and Clean Energy:** Improve photovoltaic energy capture
8. **Decent Work and Economic Growth:** Industrial AI to accelerate economic growth
9. **Industry Innovation and Infrastructure:** Bridge the digital divide and increase connectivity gains
10. **Reduced Inequalities:** Align all stakeholders in civil society and improve transparency
11. **Sustainable Cities and Communities:** More resilient, innovative systems in smart cities
12. **Responsible Consumption and Production:** Promote the use of AI and other frontier technologies such as IoTs, Big Data analytics, and 5G
13. **Climate Action:** Take advantage of frontier technologies in combating climate change and achieving a circular economy
14. **Life Below Water:** Advanced deep-sea technologies for autonomous, fast, high-resolution ocean exploration
15. **Life on Land:** AI-powered drones to help fight ocean plastic and poachers
16. **Peace, Justice and Strong Institutions:** Digital transformation to ensure connectivity
17. **Partnerships for the Goals:** Bring diverse stakeholders from around the world together and develop skills for the digital economy and society

(Source: *UN*)

Achieving SDGs across the world is not just a moral prerogative but an economic imperative. These 17 goals are integrated in such a manner that action on one will impact others. While the world is making good progress in some areas, we are falling behind in delivering the SDGs overall.

We need all stakeholders—businesses, governments, academia, international forums, non-profit organizations and others—to come together and scale their efforts to deliver the SDGs using every tool at their disposal, including Artificial Intelligence.

In December 2017, the 2030 Vision published its first report: Uniting to Deliver Technology for the Global Goals. In this report, role of digital technology—big data, robotics, internet of things, AI and other technologies—was identified in achieving SDGs. In this chapter, we will discuss how AI can be an effective tool in accomplishing almost all of these SDGs.

SDG 1: NO POVERTY

Recognizing the causes of poverty is key to tackling the problem using AI technology. From natural disasters, war and conflict, unavailability and unaffordability of food, lack of life skills, education—AI can help identify the region's most needy. The possible solutions involve improving farming lands and agriculture, increasing education and helping the inhabitants learn new skills to support communities in distribution in poorer and war-torn areas, or where natural disasters have wreaked havoc. AI can be used in all these cases.

To identify the most needy individuals, groups and regions, images taken by satellites on a continuous stream can help identify global activities that reflect poor and rich regions. *For example*, geographic areas with a high light density at night-time tend to be typically wealthier than those which are dark with little or no access to electricity at night. A team of researchers from Stanford University used satellite images of areas in daylight and night-time images to identify the most poverty-stricken regions of Africa. They were able to predict poverty with an 81-99% accuracy as compared to the household survey data. AI can help identify areas which are badly in need of help.

Improving Agriculture

AI can help farmers analyze a variety of things in real time such as weather conditions, temperature, water usage or soil conditions collected from their farms to make informed decisions. AI technology helps in detecting diseases in plants, pests, and poor plant nutrition on the farms; in preventing over-application of herbicides and excessive toxins that find their way in our food and in creating seasonal forecasting models to improve agricultural accuracy and predict upcoming weather patterns months in advance.

Fig. 3.3: AI enabling smart agriculture

Improving Education Levels

Poverty and lack of education go hand in hand. AI can help improve education levels (both access and quality) in poor areas. Intelligent chatbots as teachers for students without access to other forms of schooling, are not very far off. This AI-teacher could guide students through a syllabus and assess the learning levels of individual students using real-time analytics. It could eradicate the money barrier in accessing quality education. Tailored learning through AI addresses different learning preferences of individuals instead of the current methods of just one form of learning and creates a level playing field.

SDG 2: ZERO HUNGER

The world will soon witness a hunger crisis. According to the United Nations, by 2050, we will need to increase the world's food production by 70% to feed the world's population. Even today, one in eight people in the world doesn't get enough food to eat.

AI systems could be deployed for smarter and more efficient food production. Traditionally, food production is increased by expanding cultivable land. But this cannot be done any more as nearly half of the potentially productive farmland has already been used for agriculture. Considering the risk of fragile ecosystem and the impact of global warming, it is necessary that we go beyond the traditional ways to solve the world hunger problem.

Fig. 3.4: Precision Farming
(Source: *Enterprise IoT Insights*)

Growing the Perfect Crop

AI technology can help grow seeds with right genetic make-up that generate the highest yield, have most nutrition and are largely disease-resistant. AI will process all the growth, genetic and environmental data. It will review all the parameters and varieties to identify the patterns and insights faster than humans. Besides, more efficient plants will be chosen for production.

Maximizing Current Output

At present, a large quantity of the world's food ends up in trash. AI can separate food more specifically as "good" and "bad." It can evaluate food to determine the best way to use it. *For example*, a tomato might not be good enough to make it to the salad plate, but it would be perfect to be used in making ketchup or soup.

Precise Application of Herbicides

Rather than "spray-and-pray" approach to herbicide application, AI can be used to distinguish between a weed and a sprout of a plant based on learning from more than a million images of young plants. When it identifies a weed, it can spray on it directly. This can cut losses by up to 90%.

Early Warning of a Crisis

AI can help identify the areas which are at an increased risk of food shortages due to lack of water, rising food prices and crop failure. Such a system has already been deployed in Colombia to warn the farmers of a potential drought and suggest them to skip the planting season. The farmers who heeded the advice and skipped the planting season, saved on planting costs when the drought occurred.

SDG 3: GOOD HEALTH AND WELL-BEING

When it comes to healthcare and well-being, AI has the potential to provide data-driven clinical decision support (CDS) to physicians and hospital staff by identifying patterns, using algorithms and data to provide automated insights into healthcare providers. Second, an AI system can be generated that predicts the outcomes of hospital visits. This prevents readmissions and reduces the duration of patients' stay in hospitals. AI can improve healthcare by fostering preventive medicine and new drug discovery. It can also help by identifying specific treatment for patients.

Integrating AI into healthcare ecosystem has many benefits. According to *Business Insider*, 30% of healthcare costs are associated with administrative tasks. AI can automate cognitive tasks like pre-authorizing insurance based on rule engine, following up on outstanding bills and maintaining health records to ease the workload of healthcare professionals and ultimately saving them time and money.

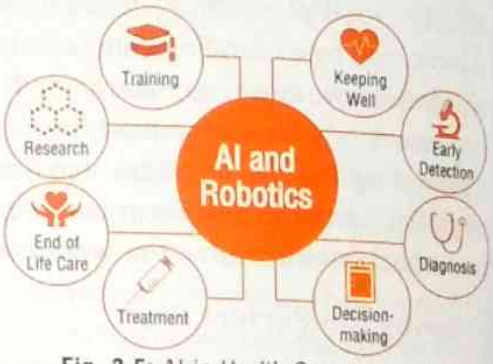

Fig. 3.5: AI in Health Care (Source: *PwC*)

Wearable healthcare technology using AI helps serve patients better. Algorithm that uses AI, like FitBits and smartwatches, can analyze health data and the underlying patterns to alert the users and their health care providers on potential health risks in future. Assessing one's own health through technology eases the workload of professionals and prevents unnecessary hospital visits or remissions.

SDG 4: QUALITY EDUCATION

One of the goals of the United Nations is to ensure quality education for all and promote lifelong learning. Easy access to internet has already made education accessible and more uniform around the globe. However, AI can bring drastic changes in the existing education system in the following ways:

Personalized Learning

In traditional education system, the curriculum is designed to suit as many learners as possible by targeting 80% of the normal distribution curve. However, students struggle to

attain their full potential when they are in the top 10% or bottom 10%. They have difficulties following along. But with the introduction of AI, teachers can offer personalized assistance to each student based on their learning needs and the kind of learners they are (text, audio, video, action-oriented). AI can customize homework assignments as well as final exams, ensuring that students get the best possible personalized assistance.

Intelligent, Supportive Learning Environments

Research indicates that instant feedback is one of the keys to successful tutoring. But in a conventional classroom setting, teachers typically do not have the time for one-on-one tutoring and feedback. Instead, work is set to be reviewed later, leading to a lag between effort and feedback. This dilutes the learning experience and makes it harder for the teachers to tailor content to their students' needs. Through AI-powered apps, students are targeted, customized and get real-time responses from their teachers.

Simplifying Administrative Tasks

AI can automate administrative tasks for teachers and academic institutions. Teachers spend a lot of time grading exams and assessing homework. AI can be used to automate the grading tasks where multiple tests are involved. This way, teachers can spend more time on their students.

Smart Content

AI can produce smart content of superior quality which includes virtual content like videoconferencing and video lectures. Textbooks are already taking a new turn. AI systems can create customized textbooks. As a result, textbooks are being digitized and new learning interfaces are being created to help students of all academic grades and ages.

AI in Education

Problems		AI Solutions
Standardized curriculum does not cater to individual needs	→	Personalized learning
Limited one-to-one tutor time available for university students	→	Personal virtual tutors
Grading and assessment is time-consuming, with an over-reliance on multiple choice	→	AI can assess open-ended questions—and in real time
Large class sizes in K-12 schools means children's questions often go unanswered	→	Virtual classroom assistants
Personalized communication is almost impossible due to scale	→	Chatbots can answer administrative questions from parents, staff and students on the fly
Selecting the best students from a large application pool	→	AI can shortlist candidates based on multiple data points
Increasing drop-out rates at universities	→	AI sentiment analysis
The need to effectively combat plagiarism and ensuring authorship	→	Natural language processing can identify patterns and source facts

Fig. 3.6: AI in Education (Source: *EduTech Asia*)

SDG 5: GENDER EQUALITY

Can Artificial Intelligence help bridge the traditional gap between the genders? Most studies show that gender discrimination will perpetuate the bias in AI and more parity must be ensured in the society before AI is fully adopted. But this has a flip side too. AI, to some extent, can help in bridging gender gap too.

Fig. 3.7: Gender Disparity (Source: *IMF*)

Addressing Wage Disparity

Artificial Intelligence can be used to address the gender pay gap which exists in most places. Often, companies try to quickly solve their gender pay gap problems by offering high fresher salaries and other benefits to attract more female applicants. But if inequalities exist in levelling and later promotions and pay structures, this won't result in a long-term solution. AI can remove discrepancies in a more sustainable way that doesn't disadvantage either gender. Using machine learning algorithms, they are able to merge and analyze the data together providing expertise in three key areas:

- Identifying existing pay discrepancies based on gender, ethnicity, disability or any other factor.
- Insights into the causes behind these gaps, based on data and academic expertise from the backend.
- Opportunities to take data-driven decisions to narrow these gaps.

With the use of AI, companies can address the problem of salary-based inequalities and, *for example*, identify discrepancies which could arise from less obvious factors like leave travel allowances, maternity benefits, housing and car allowances, etc. Using this information, companies can zero in on which functions or at which levels real gaps exist and use data-driven approach to take decisions to create real actionable change.

Detecting Online Sexual Harassment

AI programmes can be designed to monitor internal communications such as company documents, emails and chats, and flag inappropriate content and bring it to the notice of employers. However, some AI experts say that such technology has some challenges such as protection of data privacy and that AI can only look for certain triggers but cannot pick up on broader cultural or unique interpersonal dynamics.

SDG 6: CLEAN WATER AND SANITATION

The challenge of ensuring availability of safe drinking water for all is at the heart of SDG 6. Sanitation and hygiene are key related issues since the lack of these may lead to many diseases, especially among young children.

AI can be used for detecting any dangerous bacteria and harmful particles in water. You would be shocked to know that about 2 billion people use a drinking water source contaminated with faeces. A prototype device was made that uses pattern recognition and machine learning to monitor and inspect water quality. The application also marks the contaminated sites on a map. For regions in the world where access to clean drinking water is a challenge, simple test systems like this could dramatically help in preventing diseases and saving thousands of lives.

Artificial Intelligence can be used for more effective water treatment processes as well as for detecting problems and assuring an early allocation of efforts. AI can offer accurate and timely information about the kinds of pollutants in water and make recommendations for their treatment.

SDG 7: AFFORDABLE AND CLEAN ENERGY

It is well known that with the rise in per capita incomes, global energy demands are growing every year and conventional fossil fuels won't be able to fulfil our energy needs in the future. Emissions from fossil fuels hit an all-time high in 2018 due to increased energy consumption and power requirements.

There have also been calls for making emission norms more stringent in the automotive industry and factories globally.

On the other hand, renewable energy is rapidly being accepted as a reliable alternative to fossil fuels. Look at the growth of electric vehicles around us. These resources are much safer and cleaner than conventional sources like petrol, diesel, etc. With the advancements in technology, renewable energy sector has made significant progress in the last decade especially in terms of its reliability, production, efficiency and cost.

However, there are still a few challenges to this sector that can be addressed with the help of emerging technologies. Artificial Intelligence and Machine Learning technologies can analyze the past, optimize the present and predict the future.

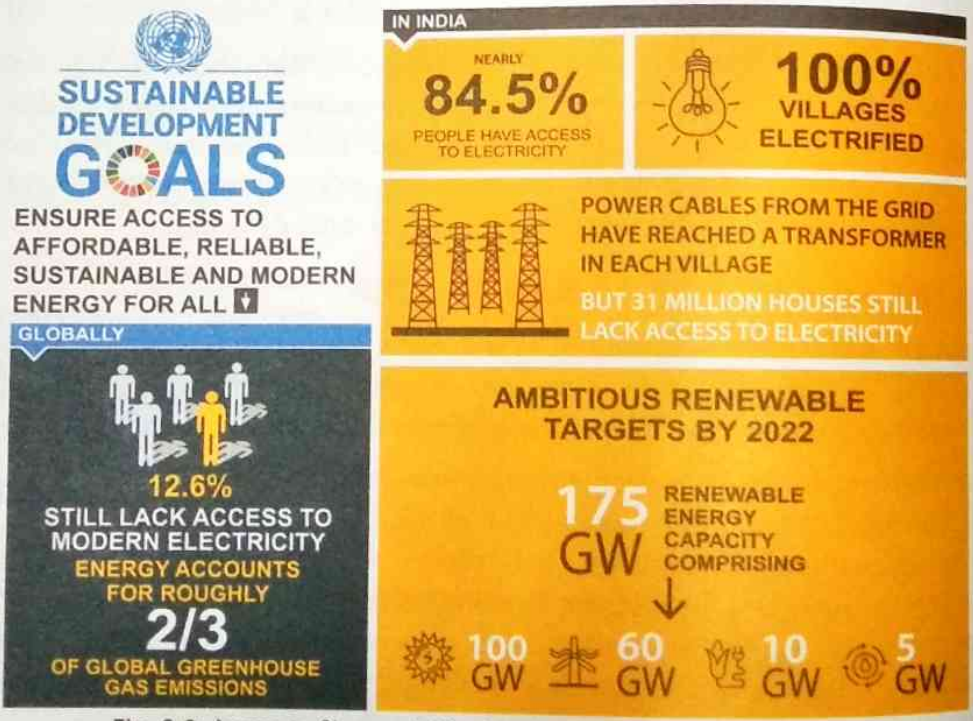

Fig. 3.8: Access to Clean and Affordable Energy (Source: *United Nations, India*)

Smart, Centralized Control Centres

The energy grid can be interconnected with IoT devices and sensors to collect a large amount of data and interpret it to make sense. When combined with the power of AI, this data can give new insights to the grid operators for better control over operations by offering flexibility to the energy suppliers to smartly adjust supply with demand. Advanced control systems such as industrial furnaces, boilers or large air conditioning units, can be installed with equipment which can automatically switch off when power supply is low or certain scenarios are achieved. Intelligent storage units can also be optimized based on the flow of supply. AI machines and sensors can make weather and load predictions. This will improve overall integration and efficiency of renewable energy.

Improved Integration of Microgrids

Using AI, we can do integration of microgrids and manage distributed energy. The AI-powered control system can play a vital role in resolving quality and congestion issues.

Improved Safety and Reliability

AI can manage irregularity in the energy sector and also offer improved safety, efficiency and reliability. It can trace energy consumption patterns, identify energy leakage and monitor health of the devices. *For example*, in production units, the AI-powered predictive analysis can collect data to monitor wear and tear, monitor overall health of the equipment and alert the operator when the maintenance is needed.

Expanding the Market

AI-powered systems can provide insights into energy consumption by analyzing data on energy collection. This would help suppliers optimize existing services, launch new service models and help retail suppliers to target new consumer markets.

Smart Grid with Intelligent Storage

Smart Grid with Intelligent Energy Storage (IES) can analyze a vast amount of data captured from several IoT sensors and make timely decisions on energy allocation, helping microgrids to efficiently manage local energy needs while continuing power exchange with the main grid.

SDG 8: DECENT WORK AND ECONOMIC GROWTH

Skills for Jobs of the Future

There is a large gap between the jobs and skills available. Young people are generally engaged in low-skilled jobs with fewer opportunities for permanent sustainable employment as education system remains out of step with the needs of rapidly changing workplaces. Low-skilled jobs are losing to automation.

So, it will be critical that young people are equipped with the necessary skills to secure quality work. AI can bridge this gap between the desired and delivered skills, through tailored learning.

Financial Access

Globally, two billion people lack access to formal financial services such as banking, transactions, investments, etc. When people from underprivileged backgrounds gain access to basic financial services (e.g., savings, investment), they take the first step towards greater security. AI can analyze data to identify people in need of loan or those who are unable to access it. AI can also identify good and bad debtors based on previous transaction data. However, those looking to start a new business, lack of credit history can be a barrier.

Insufficient Labour Demand

By 2030, job landscape will look vastly different from today as the economy will witness profound evolution or disruption through digital technology. Most of the children entering primary school now will work in jobs that do not exist today. AI technology could create job opportunities for highly skilled workers. It can help bridge the gap between labour demand and supply mismatch.

SDG 9: INDUSTRY, INNOVATION AND INFRASTRUCTURE

Structural Defects

AI is being used to identify problems with structures or equipment before they cause critical systems' failure. Organizations can use AI to detect cracks or faults in design or concrete or broader issues in the structure, highlighting the severity of the problem. By identifying and segmenting an issue, engineers can figure out the exact shape, size and scale of the issue, and associate it with other pieces of critical information to formulate a solution before the problem goes out of hand.

Landscape Designing

As we have learnt in the previous two chapters, autonomous vehicles and equipment can use CV to identify objects in front of them and take appropriate action according to the object type. Using AI, it can learn and understand to identify the typical behaviour of other users of cars such as direction, distance and speed of approach and take appropriate steps to avoid it.

In everyday life as well, we see smartphones deploying AI and ML for object identification and learning user behaviour. Such systems can be used to design and create, for example, upgrading or creating roads without trees on either side of the road, etc.

Waste Management

AI can also be used for waste management, a problem staring into our faces. Intelligent trash can, equipped with AI programs, RFID tags, IoT sensors, is a revolutionary concept in the waste management sector. This can be used to measure waste levels of the garbage thrown inside them and send data to the main disposal system for processing. The system identifies the type of the garbage, the quantity of each type of garbage and the respective waste disposal method. Garbage dumps have started deploying waste-sorting robots which can sort tons of garbage tirelessly in a day.

Smart Recycling

AI-powered smart bins can think for themselves while sorting and sending garbage. When garbage is put into the bin, it uses sensors to study trash and decides by itself what needs to be done with the garbage. It sends the garbage to the appropriate disposal system, be it a dumping ground or a recycling factory. This way, there can be a significant decrease in the waste generated globally.

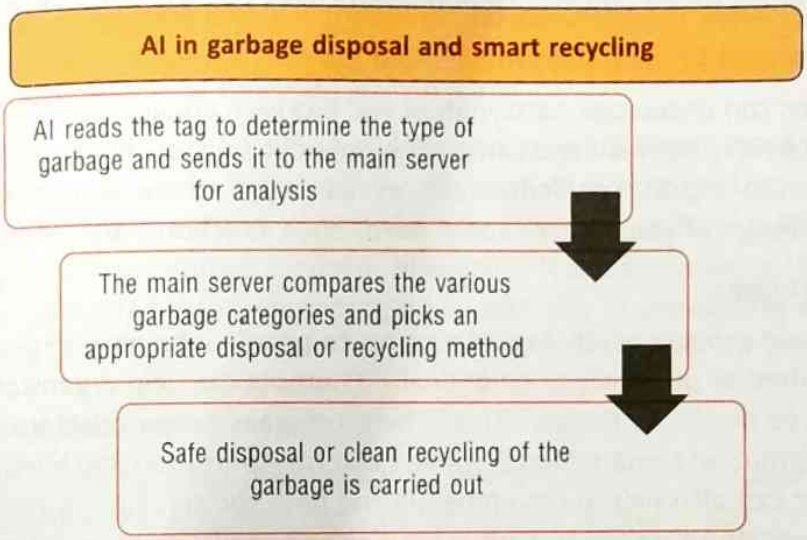

Fig. 3.9: AI in Garbage Disposal (Source: *Allerin*)

SDG 10: REDUCED INEQUALITIES

Growing inequality is a challenge for developed and developing countries alike. The income disparity has grown wider over the years. Across OECD, average income of the richest 10% of the population is roughly nine times that of the poorest 10%. This is up seven times as compared to what it was 25 years ago. Not just within a country, inequality between countries is also growing. From 1960 to 2016, the gap between the average incomes of people in the richest and the poorest countries grew by 135%.

Fig. 3.10: Growing Income Inequalities (Source: *Economic Policy Institute*)

Tailored Technology

Tailored technology products and services to serve the needs of low-income and vulnerable groups can be a significant move to address inequalities. The goal is to make them more affordable and accessible for remote populations which can be achieved with AI such as by creating mobile tariffs and service bundles focused on increasing affordability.

Social Media and Crowdsourcing Platforms

Such platforms can encourage participation and inclusive engagement. Social networks can support positive activism and campaigns aimed at solving critical social challenges. Communities can report problems such as damaged roads and graffiti, promote participative design of solutions to social needs such as schools and infrastructure.

Helping Refugees

AI programs can provide psychological support to people who have experienced shock and trauma whether physically or emotionally. Chatbots can help organizations connect and respond to displaced people. AI can help refugees prepare before departing by providing information about national borders and transportation and advice on security. AI technology can also help them embed in the new society. Access and connectivity allow them navigate local services such as housing and employment, access opportunities, ensure safety, etc.

Automating Justice and Equal Employment

Companies or governments can use machine learning to predict good candidates to hire or the likelihood of repeat offences to decide on sentencing, which, in turn, would reduce individual biases.

Creating Accessibility

New education opportunities are popping up every day, many of which are free or low-cost and provide equal training for this constantly developing industry. These low-cost options remove entry barriers created by private (or even public) institutions allowing low-income or underprivileged people access these benefits.

Helping Visually Impaired to Navigate their Environment

By providing navigational assistance via smartphone, object recognition and reading text in any language, converting handwritten or printed text into digital text so that it can be spoken aloud using text to speech converters, AI can make life easier for the visually impaired.

SDG 11: SUSTAINABLE CITIES AND COMMUNITIES

Smart Cities (Indian Government too started the concept of Smart Cities a few years ago) would give many benefits to society, including enhanced opportunities for education, improved skills and, hence, job prospects, better access to healthcare and cleaner drinking water.

There will also be a lot of societal and environmental challenges when cities start to become smarter. Inefficient planning and non-inclusive management practices lead to certain unsustainable settlements that do not enable people to advance emotionally, socially and economically. Smart and innovative technologies, including AI, are revolutionizing the way cities can address the challenges associated with smart hyper growth.

Maximum Utilization of Existing Resources

AI technologies can help cities utilize and allocate existing assets more effectively and efficiently. It can also help improve how information is managed and shared across systems. Satellite data is transforming the way cities are managed. From identifying power outages to smart routing for traffic management and allocation of resources during disasters, AI can truly help in optimizing a city and also in connecting and integrating multiple cities.

Planning and Zoning

AI can help in managing urban governance, *for example*, when green spaces are converted into built-up structures. AI system can look for satellite images to quickly reveal how the city development aligns with original planning and zoning layouts or which communities are most prone to flooding or natural disasters. AI can also help detect and map different types of land cover, land use and type across space and time, and generate important insights, analytics and data visualizations.

Planning for Scalability and Sustainability

AI systems can detect feasibility of upscaling activities to other locations or cities, consider the sustainability of the project and how the hardware/equipment may be used during and after it has been completed.

SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

The key goal here is to change the way we produce and consume goods and services. It is important to acknowledge that production and consumption of goods and services drive economic growth and improve quality of life. But this should be done with fewer natural resources as consumption of resources impacts environment across the life cycle. The focus is to do more with less: use minimum resources and create least wastage.

Business Model and Product Innovation

By studying consumer behaviour through AI, business models can be designed to optimize consumption and reduce wastage. Smart refrigerators, equipped with sensors and vision cameras accessible through smartphone apps, allow users to check their contents while shopping. This helps reduce wastage of food which, based on consumption levels, can be recorded automatically. Similarly, smart buildings and offices can help users optimize their energy consumption.

To look up green buildings,
Scan QR code or visit:
https://www.youtube.com/watch?v=ESIHwiV8l6k

Precision Recycling

AI-enabled robots can ensure that all products, including nanoscale materials, are recovered and reused or recycled. Metal detectors, precision weight measurement, 3D scanning and printing and spectral analysis enable more sophisticated and precise waste sorting.

Materials Tracking Systems

Use of RFID (Radio Frequency Identification Device) and other IoT sensors can provide sophisticated tracking of materials to optimize planning and movement of the material in the supply chain. AI can go through all the data and predict various stages of disposal and limit illegal disposal of hazardous materials and waste.

3D Printing

It can improve the efficiency of materials by simplifying the processes and avoiding waste that comes with mass production. It promises longer life span of products by making it possible to produce replacement parts on demand.

SDG 13: CLIMATE ACTION

Climate change impacts all countries of the world. However, the poor and vulnerable population is disproportionately affected. Artificial Intelligence can help us understand the current climate situation, draw patterns and predict future weather events to create new products and services to minimize human impact on environment.

Climate Study

By analyzing data from sensors, gauges and monitors, machines can spot patterns quickly, accurately and automatically. The more accurate our current climate stats are, the better climate models can be designed. We can also identify our biggest vulnerabilities and risk zones.

Developing Better Solutions

Artificial Intelligence can help climate researchers and innovators to test theories and solutions as well as "what-if" scenarios that involve environment-friendly measures. By using data provided by machine learning algorithms, organizations have been able to cut the amount of energy used or reduce their carbon footprint.

Green Initiatives

The easier we make green initiatives for people while making them feel responsible, the higher is the adoption rate. Artificial Intelligence and machine learning algorithms can help curate products and services that are easy to adopt. There are several AI devices such as smart thermostats and smart irrigation systems that help conserve energy resources. If we all do our individual contribution, our planet will be greener very soon.

Better Weather Event Predictions

Early warning signs of catastrophic weather events can reduce damage to human lives and property. Historical data across geographies is available for analysis. AI has made significant progress in using machine-learning algorithms to assess the duration and severity of these catastrophic events.

SDG 14: LIFE BELOW WATER

As you know, the earth is covered almost 70% by water and our oceans are home to a wide variety of flora and fauna. With the advancement in satellite imagery and machine learning, we are able to analyze this massive amount of data to help protect underwater life.

Monitoring and Regulation of Illegal Fishing

Intelligent systems using motion sensors, GPS and cameras can increase accountability in the fishing industry by detecting anomalies and make it more efficient for regulators and boat owners to review footage.

Traceability and Identification of Species

Tracking and monitoring of species will be easier and efficient with digital tools like facial or species-recognition software. RFID and barcode scanners in supply chains can help prevent sale of endangered or vulnerable species.

Smart Aquaculture

With the growing demand for fish protein, reliance on aquaculture to become smarter will increase. Expanding wild fish stocks is no solution. Aquaculture presents an opportunity to

track fish and seafood from "farm to plate" with the help of intelligent tracking systems and IoT sensors. This can inform the market about limiting or increasing fish stocks based on demand and help in reducing seafood fraud which is widespread. Sensors can also detect and optimize water quality parameters and streamline feeding protocols.

Environmental Monitoring and Smart Conservation

IoT sensors can collect data on temperature, salinity and pH which can be developed into usable information using machine learning algorithms. This will help in planning and balancing the needs of fishermen, transport and ocean conservation. Tools can be used to monitor fish, track conservation progress and make well-informed decisions like limiting the capture of unwanted marine lives.

Tracking Fishing Vessels

AI uses satellite-based monitoring system to track all fishing vessels in real-time which can help protect fisheries around the world. They can collect satellite imagery and analyze movements of boats with a specially designed form of machine learning algorithms to determine if they are fishing vessels. This can be posted on to their open source platform so that researchers, government, law enforcement agencies and the general public can keep an eye on any fishing boats that venture into protected waters by mistake.

Ocean Cleaning

AI can also be used in ocean cleaning. Satellite imaging can be used to detect polluted patches; sensors can be used to identify the type of pollution—oil spills, plastic, etc. Using smart systems, this waste can be suitably treated or recycled.

SDG 15: LIFE ON LAND

The key challenges to protecting life on earth include addressing species and habitat extinctions, which are driven by climate change, pollution, unsustainable exploitation, invasive species and habitat conversion due to agriculture. Climate change is a major threat to ecosystems around the world, clean water availability, habitat and biodiversity which, in turn, increases our vulnerability to climate change.

Preventing Wildfires

Climate change threatens to increase the number and size of wildfires. AI algorithms can help in early detection, help firefighters combat blazes and aid in recovery. AI can trace the pattern of climatic or anthropogenic events, eventually leading to wildfire.

Checking Deforestation

AI can be used to track deforestation in real time in remote communities. Sometimes, seeing the change in trees is easy but working out why it is happening requires complex pattern recognition. *For example*, forests could be cut down because they are a planted crop such as palm oil or lumber. Forests could be destroyed by weather events, illegally

cut for lumber, firewood or most commonly cleared to make way for agriculture. So, AI and ML methods need to be used to figure out which of these causes is at play and what is their individual impact. AI is yielding optimal consumption and production levels with vertical green farms, eliminating waste and vastly improving yields and resource efficiency.

Spotting and Stopping Poachers

Foot patrolling and drone-based surveillance have not been effective in preventing poaching. These efforts are labour-intensive and costly. AI-based methods have got some initial success in combating poachers. This method uses image classification and object detection to find animals and poachers on infrared video captured by a drone.

Artificial Intelligence can be deployed to catch wildlife poachers.

Six steps from offline training of AI model to online detection

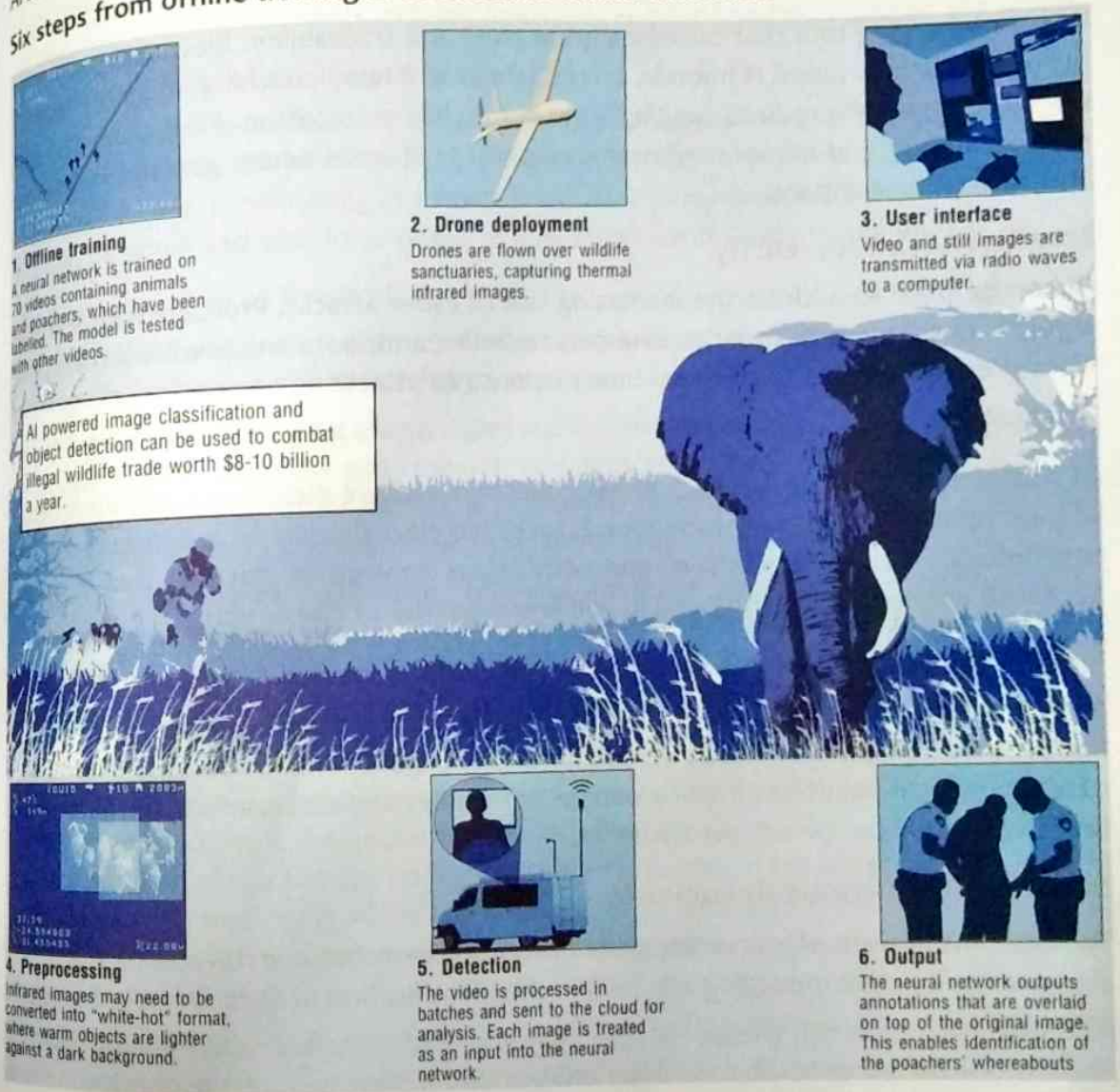

Fig. 3.11: AI to spot and stop poachers (Source: *McKinsey & Co*)

SDG 16: PEACE, JUSTICE AND STRONG INSTITUTIONS

This goal focuses on promoting peace, justice and accountable and inclusive institutions. Some countries still face prolonged armed conflicts and a large population is living under security threat. Various forms of violence against children, human trafficking, bribery, etc., persist worldwide. Steps need to be taken to make transparent and traceable supply chains, improve effectiveness and transparency in governance, create safer communities, promote freedom of expression and opposition, reduce cybercrimes and economic espionage, etc. Digital technology will play a key role in handling these challenges.

Blockchain

It is an emerging tool that promises great trust and traceability. Blockchain can solve problems such as blood diamonds, forced labour and ivory poaching. It can be used to track the origin of products ranging from coffee beans to cotton. Blockchain may also eliminate fraud and misappropriation of resources in areas where governance is weak and corruption rampant.

Intelligent Cybersecurity

AI can be used to address the increasing risk of cyber attacks. Products with adaptive algorithms that can study large data sets to better anticipate and predict threats learn from previous attacks to give real-time response to attacks.

Automating Processes

AI deployment in processes such as tax collection, welfare distribution and designation of land rights, etc., where information is recorded electronically on a distributed ledger technology (such as Blockchain) and with access controls in place so that it can be accessed only by those who need it, will lower the risk of corruption.

E-Governance

App-based platforms and chatbots can help citizens connect and engage with governments and provide transparency and better accountability of government. Access to information, contacting local politicians, tracing people, companies and assets across the globe are a few things that can be achieved with AI.

Detecting Suspicious Behaviours

The real-time analysis of transactions, use of anomaly detection and risk-scoring algorithms alongside predictive modelling can help in the identification of illicit financial flows and payments.

SDG 17: PARTNERSHIPS FOR THE GOALS

Goal 17 aims at renewed partnership across governments, civil society, private sector, the United Nations system and other actors. The aim is to mobilize resources to address all the goals. It also aims at supporting developing countries for equitable progress by increasing capacity, collaboration and knowledge-sharing, enhancing use of enabling technologies and improving data monitoring and accountability.

Digital Collaboration Platforms

Collaborative software using machine learning can make decision-making within and between institutions more efficient. Through information exchange, education and training platforms can improve capacity-building. AI can enable partnerships to plan, implement, manage and improve initiatives to meet individual needs of partners around the globe.

Measurement and Tracking of Goals

IoT and AI will enable measurement and tracking of progress towards the goals which is crucial for improved decision-making. AI is also expected to improve analytical abilities and guide us in decision-making in a smart and sustainable manner keeping in mind data security, personal and emotional needs of the citizens and safety of the planet.

Applications of AI at Present

Although a lot remains to be done, AI has already been applied for non-commercial purposes by various companies and organizations.

Planet Labs, an earth-imaging Silicon Valley startup, partnered with Paul Allen (Microsoft co-founder), philanthropists and research scientists to create a map of shallow water coral reefs by applying object detection to satellite imagery in correlation to geospatial data. The map is used to monitor reef ecosystems that are under threat.

At Thorn, an international anti-human trafficking non-profit organization, a combination of Computer Vision, NLP and Big Data, is being used to identify victims of sexual exploitation on the internet. It works with a group of technology companies, including Google, Microsoft, and Facebook, and has identified a total of 5,791 victims since 2016.

Researchers at the MIT Media Lab have applied reinforcement learning-based algorithms in clinical trials with patients diagnosed with glioblastoma (a form of brain cancer) to successfully reduce toxic chemotherapy and radiotherapy doses. This is very encouraging because reducing chemotherapy doses helps improve quality of life of cancer patients and cuts cost of their treatment. As research continues to improve reinforcement learning, practical applications of solutions will extend beyond clinical trials to customization of patient treatment.

A South Korean city, Songdo, deploys RFID tags to classify garbage categories. A pressurized garbage disposal system can read this tag from a distance and an appropriate method to dispose of total waste generated is decided dynamically.

Smartfin is another great example of an innovative surfboard fin with ocean health sensors and a community initiative intended to galvanize communities to become custodians of coastal ecosystems. It integrates temperature, motion and GPS sensors into performance surfboard fins so that surfers can collect data simply by doing what they love. Sounds amazing, no?

Microsoft's Seeing AI is accessible to users in 70 countries around the world and is free of charge. Similar solutions include OrCam MyEye camera, which is mounted on standard glasses and can convert visual information input into spoken output. The device is portable and operates without the need for a smartphone.

There are fintech startups such as ZestFinance and Lenddo that capture data by device, browser and social media trail to generate a predictive model of creditworthiness through various parameters. M-Shwari banking, which leverages the M-Pesa mobile money system in Kenya, incorporates history of telecommunications in its assessment of credit risk. One in five adults in Kenya is currently an active user of the service, and M-Shwari is regarded as one of the most successful solutions for financial inclusion. Besides, its SMS and internet-based interface, predictive algorithms leverage several AI capabilities to analyze social and telecom data and assess their creditworthiness. The information is then processed in minutes and produces a credit score, which determines the size of the loan to be sanctioned.

Researchers at the University of Southern California's Centre for Artificial Intelligence in Society built the SPOT system which automates the process of detecting poachers through infrared video feeds and increases the reliability of surveillance.

Challenges Before AI

Scaling up AI use for social good will require overcoming some significant bottlenecks like data accessibility as, in many cases, such data capturing may not be commercially viable or data may be unstructured. Hence, data is not readily accessible to social or non-governmental organizations. Bureaucratic inertia keeps useful data locked up with government agencies. In other cases, the required data has never been collected.

AI capabilities need to be continuously improved but availability of talent with high-level expertise in AI is in short supply. In other cases, implementation and program management becomes a challenge as well.

Non-profit organizations may lack skilled resources such as data scientists and NLP engines needed to address the AI tools and techniques. Sometimes, these tools may be prone to misuse by authorities and others having access to them.

Therefore, the principles for their use need to be established. Human bias may be embedded in AI models or data sets that could amplify existing inequalities. Data privacy needs to be protected to prevent sensitive personal information from being made public. AI applications need to be safe for human use and must comply with law and social norms. Social acceptance, transparency and quality checks still remain areas of concern.

EXERCISES

Objective Type Questions

A. Fill in the blanks:

1. AI can overcome ..... barrier in accessing education.
2. ..... and ..... are examples of wearable health care technology.
3. Key challenges to protecting life on Earth include ..... and ..... .
4. AI can trace the pattern of both ..... and ..... events leading to wildfires.
5. AI deployment in processes such as ..... and ..... can lower the risk of bribery and corruption.
6. Human biases are embedded in AI amplifying existing ..... .
7. Smart Grid with ..... can analyze a vast amount of data captured from several IoT sensors and make timely decisions on energy allocation.
8. Intelligent systems using ....., ... and ..... can increase accountability in the fishing industry by detecting anomalies and make it more efficient for regulators and boat owners to review footage.

B. State whether the following statements are True or False.

1. AI-based systems can help detect crime using CCTV footage proactively.
2. AI can be used to track deforestation in real time in remote communities.
3. Average income of the richest 10% is roughly five times that of the poorest 10%.
4. AI can help detect bullying and sexual harassment online and on social media.
5. AI can enable satellite-based monitoring system to track all fishing vessels in real time which can help protect fisheries around the world.
6. True Personalized Learning can be enabled through AI.
7. AI-assisted Clinical Decision Support (CDS) can replace doctors.
8. According to the United Nations, by 2050, we will need to increase the world's food production by 70% to feed the world's population.

C. Multiple Choice Questions (MCQs):

1. Read the given statements:
   I: AI can solve challenges which are beyond traditional solutions.
   II: Drawback with AI is that it always requires scientific breakthroughs.
   Identify the correct statements.
   (a) I (b) II (c) Both I and II (d) None of these
2. Which of the following is not a feasible option any more to improve agricultural productivity?
   (a) Precision farming (b) Genetically modified seed varieties
   (c) Expanding area under agriculture (d) Using climate-resilient crop varieties
3. AI can change current education models. However, which of the following cannot be substituted by AI?
   (a) Grading and assessment (b) Content creating and content delivery
   (c) Accessibility and affordability (d) Emotional assistance

4. Which of the following is an understandable ground for wage disparity among teachers in a school?
   (a) Gender (b) Ethnicity
   (c) Physical disability (d) Academic merit
5. Blood diamond, forced labour, ivory poaching and tracing origin of products. Which of the following technologies is best suited to solve this issue?
   (a) Satellite imaging (b) Robotics
   (c) Blockchain (d) Deep learning
6. Which of the following are the challenges before AI? (More than one option possible)
   (a) Talent availability (b) Scalability
   (c) Data availability (d) Social acceptance
7. Which of the following is not an example of using AI in managing energy needs of the world?
   (a) Integration of microgrids
   (b) Tracking of energy consumption patterns
   (c) Predictive analysis of energy equipment health
   (d) Logging of energy data
8. AI and IoT can be used for facial recognition to understand species and trace them below water. Which SDG do they impact?
   (a) SDG 10 (b) SDG 14 (c) SDG 5 (d) SDG 9

Subjective Type Questions

1. Productivity is a big challenge in agriculture. How can AI solve this?
2. How can AI address hunger issues at present? Mention any two ways.
3. What are the challenges to marine life?
4. What do you understand by Intelligent trash cans?
5. How is AI helpful in infrastructure development?
6. You have read how AI can be helpful in meeting SDGs. Can you think of instances where AI is an inhibitor to any of these goals?
7. Discuss any three applications of AI in health care.
8. Transparency is a challenge in present-day governance in many countries. How can AI address this problem?
9. List any two disadvantages of AI.
10. What are the barriers to AI realizing its full potential? List any four.

Quick Activity

AI FOR IMPROVING COOKING OPERATIONS

Read how Akshaya Patra, the largest NGO-run school meal programme, with support from Accenture Labs improved cooking operations with the AI system.

Fun Time

If you could design an AI system, which social problem will you target? How will this system function? Are there any negative impacts of this technology?

Activity 1

Please note these facts:

The **United Nations** estimates that we will need a 70% rise in food production to feed the world by 2050.

According to the UK's Institution of Mechanical Engineers, as much as **half the world's food** (or two billion tonnes) ends up in trash. Approximately **20%–40% of crop losses** are caused by pathogens, animals and weeds.

In the US, *for example*, farmers use 310 million pounds of herbicide on corn, soy and cotton fields.

Africa's famine crisis is the gravest emergency since the Second World War, **according to the United Nations**, with six million people at risk of starvation in Somalia and 14 million more in South Sudan, Nigeria and Yemen. In addition, one in four persons in sub-Saharan Africa is malnourished.

With this background, can you think of an AI-powered solution to these problems?

Activity 2

GO-GOALS BOARD GAME

Link to Download Go-Goals Game Material:
https://go-goals.org/downloadable-material/

Let your imagination flow and make your own tokens for the Go-Goals Game! Think of your favourite superhero or your favourite cartoon character and draw it on your token. Cut it out, shape it, and win the Game!

You can also make your own dice using the DIY kit! Just cut it out, fold it and paste it!

Great! You are all set to begin!

Go-Goals Board Game

This is what your game board looks like. We are going to play in groups of 5. Have you played 'Snakes and Ladders' before? This game is very similar to 'Snakes and Ladders'. Players advance the number of spaces by rolling a single dice. If a player lands at the bottom of a ladder, they can immediately climb to the top. If a player lands at the top of the slide, they immediately move to the bottom of the slide. If a player lands on SDG goal field (1-17), they will draw a card corresponding to the goal number. Another player will read the card question. A correct answer from the card drawer will allow the player to roll the dice again. The first player to reach '2030' is the winner. Let's Play!"


SUSTAINABLE DEVELOPMENT GOALS
The purpose of the Go GOALS game is to help you understand the Sustainable Development Goals, how they impact your life and what you can do every day to help achieve the 17 Goals by 2030. Let's play together to make the world a better place!
www.go-goals.org
2030
GO GOALS!
START
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Activity 3

We have read about Future Skills in Chapter 1. We need to now research how jobs will evolve to use those future work skills. This research can be used to help us decide what we want to learn to be ready for these jobs. As there are numerous jobs that will be created due to AI, we will conduct this research in teams! Each team will be given a theme, some guiding resources and laptop to research on AI-related jobs. The themes include **Health**, **Security**, **Education**, **Entertainment**, **Service**, **Transport**. You will search for current and emerging trends in employment and fill in the Research Template given in the handbook. The company can even be a start-up, big organization or community project.

Make even number of teams and divide, give one theme to two teams. *For example*, if you have 10 teams, divide any 5 themes giving same theme to two teams. This will help in the activities of next modules.

Put your Research Skills in action:

Here is a set of themes—you will be getting one theme out of these to work on in a group of 4. Research on the given theme and find out various organizations incorporating AI in your theme sector. Also, look at the skill-sets required for such jobs today. With this, try to analyze what skill-sets would be required 10 years down the line?

What are the names of the organizations in our country working around this theme?	Write briefly what they do.

What kind of skill-sets (look at both soft skills and technical skills) do they look for in their new hires? Would the skill-sets required today still be the same after 10 years?

Soft Skills (Today)	Technical Skills (Today)
Soft Skills (10 years later)	Technical Skills (10 years later)

What are the ethical concerns revolving around the theme?
(Keywords: AI ethics, AI bias, AI access, AI privacy)

Topic	Examples

Once we have completed this activity, we have to prepare a Job Advertisement for 2033—10 years from now!

Activity 4

Job Advertisement for 2033!

Now, on the basis of the research you have made, make a **"Future Job Ad"** for 2033. Your Job Ad should include information about the company that is hiring and what kind of skills they are looking for in their employees. Share the reasons why you chose this job or jobs. Be creative about the Job Ad you are making. Remember, it is something from the future. What jobs will be relevant 10 years from now?

Let's begin.

Be as creative and sound futuristic in your tone as possible!

What to do:

- Search for current and emerging trends in employment to make a Future Job Advertisement.
- The job description is for a job which will occur ten years from now, *i.e.*, the current date.
- To help you, the job advertisement must include the following information.
  - **Required Skills:** Technical and Soft Skills
  - **Company Background:** Is the company a big organization?
  - **Analysis:** Share the reason why you chose this job or jobs.

List the kinds of futuristic job opportunities that would be available for you.

Write the skills you will require to do these jobs.

Create a Job Advertisement for the Future below: