CURRENT AFFAIRS PROGRAM
PRE CUM MAINS 2024
DEC 2023: BOOKLET-7

TABLE OF CONTENTS

1. GENERAL STUDIES – 3: S&T UPDATES

1) ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

» Intro

- **Artificial Intelligence** is the science and engineering of making intelligent machines, especially intelligent computer programs which can complete tasks that typically require human intelligence.
  - » With the **explosion of available data and expansion of computing capacity**, the world is witnessing rapid advancements in AI, ML, and deep learning.

- **Machine learning** is a science that involves **development of self-learning algorithms**. Machine learning uses **statistics (mostly inferential statistics)** to develop self-learning algorithm. It is a type of artificial intelligence.
  - » **Note:** All Machine Learning is AI, but not all AI is machine learning

  - » For e.g., symbolic logic (rules engines, expert systems, and knowledge graphs) as well as evolutionary algorithms and Bayesian statistics could all be described as AI, and none of them are machine learning.

  - » In Machine Learning the computer program should learn from experience "i.e., given data" such that the overall performance on doing a certain task increase.
    i. Input data
    ii. Model Training
    iii. Output

- **Applications of Artificial Intelligence** and **Machine Learning**
  - Advertisements, Online shopping suggestions etc.
  - Spam filtering
  - Search engines
  - **Fighting Black Money** (e.g., Project Insight of India)
  - **Space Exploration** (e.g., identifying exoplanets from pictures)
  - **Health Sector** (e.g., identifying cancerous lumps, development of new medicines/molecules etc, early detection and prevention of diseases.)
    - E.g., a Bengaluru based startup has developed a non-invasive, AI-enabled technology to screen for early signs of breast cancer.
    - For **COVID-19,** AI enabled chatbot was used by MyGov for ensuring communications.
  - **Developing new materials** (E.g. Google Deepmind predicted the structures of 2 million new materials)
  - **Education** (e.g., Personalized learning through adaptive tools; customizing professional development courses etc.)
  - **Agriculture:** AI enabled solutions for water-management, crop insurance, and pest control are also being developed. Technologies like image recognition, drones, and automated intelligent monitoring of irrigation systems can help farmers kill weeds more effectively, harvest better crops, and ensure higher yields.

- **ICRISAT** has developed an **AI-power sowing app**, which utilises weather models and data on local crop yield and rainfall to more accurately predict and advise local farmers on **when they should plant their seeds**

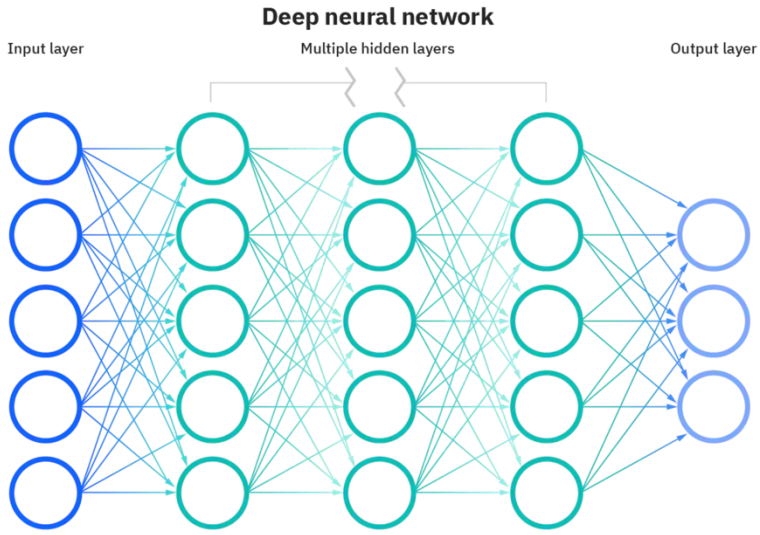
- **Disaster Management:** An AI-based flood forecasting system has been deployed in Bihar and is now being deployed throughout the country. It gives warnings 48 hours earlier about impending floods.
- **Improve Ease of Doing Business**
- Natural Language Processing (NLP)
- Image Processing (Facial Recognition)

2) ADVANCEMENTS IN MACHINE LEARNING

A) NEURAL NETWORKS

- Neural network, also known as Artificial Neural Network (ANNs) or simulated neural networks (SNNs), are a subset of machine learning and are at the heart of deep learning algorithms. Their name and structure are inspired by the human brain, mimicking the way biological neurons signal to each other.
- A neural network can fine tune its output based on the feedback given to it during stages of training.

- ANNs consist of node layers, containing an input layer, one or more hidden layers, and an output layer. Each node, or artificial neurons, connects to another and has an associated weight and threshold. If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along the next layer of the network.



- **Note:** ANN also rely on training data to learn and improve their accuracy over time.

- **Neural Networks** vs. **Deep Learning**:
  - Terms are sometimes used interchangeably. 'Deep' in deep learning is just referring to the depth of layers in a neural network. A neural network that consists of more than three layers –

which would be inclusive of the inputs and output – can be considered a deep learning algorithm. A neural network that only has two or three layers is just a basic neural network.

B) DEEP LEARNING

- Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. It can achieve state of art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architecture that contain many layers.
- Most deep learning methods use **neural network architecture**, which is why deep learning models are often referred as **Deep Neural networks**. The term deep usually refers to number of hidden layers in the neural network.
- **Where is it being used today?**
  - » **Automated Driving**: Automotive researchers are using deep learning to automatically detect objects such as stop signs and traffic lights. In addition, deep learning is used to detect pedestrians, which helps decrease accidents
  - » **Aerospace and Defence**: Deep learning are used to identify objects from satellites that locate areas of interest and identify safe or unsafe zones for troops.
  - » **Medical Research:** To detect cancer
  - » **Industrial Automation**: Improve work safety around heavy machinery by automatically detecting when people or objects are within an unsafe distance of machines.
  - » **Electronics**: Used in automated hearing and speech translation. For e.g., home assistance devices that respond to your voice and know your preferences are powered by deep learning applications.

3) GENERATIVE AI

ABOUT CHATGPT:

It is an artificial intelligent tool developed by **OpenAI**.

> **OpenAI** is a research institution and company that focuses on developing AI intelligence technology in a responsible and safe way. It was founded in 2015 by a group of entrepreneurs and researchers, including **Elon Musk, Sam Altman**, and **Greg Brockman**.

- ChatGPT is based on **Generative Pre-trained Transformer Architecture**. It is **trained on massive amount of text data from the internet**. It used 570 GB of text data mined from the internet. It is a type of **neural network** and was first introduced in 2017 in a paper titled "Attention is all you need". A neural network can fine tune its output based on the feedback given to it during stages of training. This allows the model to better understand the context and meaning of the input and to generate **conversational response**.

- **ChatGPT** is more than a chatbot. You can even ask it to write a program or a software application. It can do creative work like writing a new story or poetry. It can answer scientific concepts and answer any question that needs factual answer.

- It is fine tuned to provide **conservational responses**, as against essay-type content. It is because the neural network behind it has been additionally trained on **conversational transcripts with human feedback**.

- In addition to the conversational nature of the tool, the **creative generative capability is very appealing**. ChatGPT can become a **powerful pedagogy** tool on any topic to anyone, because we can instruct it to "explain it to me like I am a six-year-old". It can explain in simple terms anything from **philosophy** to cooking recipes, including **new recipes of its own**.

- **It is a Language Model** (rather than a chatbot) that can produce text that sound like human response in a conversation setting.

- It is also a **Neural Network**

GOOGLE BARD

- Google's Generative AI model

ABOUT GOOGLE GEMINI (DEC 2023)

- Google GEMINI is a new multimodal general AI model, which the tech giant calls its most powerful yet.
- It is now available to users through Bard, some developer platforms, and even the new Google Pixel 8 Pro phones.
- The flexible AI model comes in **three sizes** – Ultra (yet to be released), Pro, and Nano – is being seen as google's answer to ChatGPT, which has been ahead of the game so far when it comes to generative AI.
- Google claims that GEMINI Ultra is the first model to outperform human experts on massive multitask language understanding (MMLU), which uses a combination of 57 subjects such as math, physics, history, law, medicine, and ethics for testing both world knowledge and problem-solving abilities.
- **So**, IS GEMINI better than ChatGPT 4?

  Hard to say now. But it does seem to be more flexible. Its ability to work with videos and on devices without internet, gives it some edge.

Some Concerns:

- Teachers are unhappy about it as they feel that it can be used to turn in plagiarized essays which could be hard to detect for invigilators. Recently, New York City's Education department banned ChatGPT in its public schools.
- **Skilled white color jobs** like that of computer programmers in the IT sector is at threat.
- **India's IT services-based** exports may get impacted.

Way Forward (Class discussion)

4) GOOGLE DEEPMIND'S AI BREAKTHROUGH

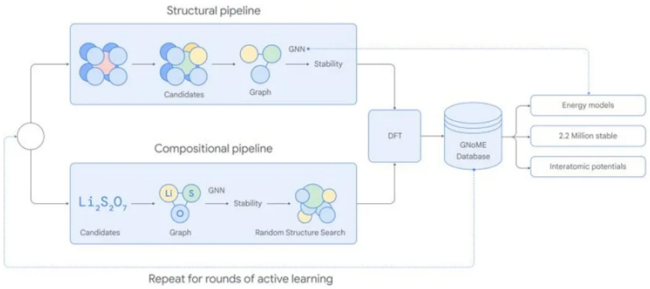
- **How are new materials discovered in Chemistry?**
  - » New stable materials are generally discovered by the practitioners of solid-state chemistry through a **process of trial and error** that involves making small tweaks to known material or by fusing elements together. This is an **expensive and time-consuming process.**
  - » **In last decades,** experimentation by humans has resulted in the discovery of the structures of some 28,000 stable materials, which are listed in the Inorganic Crystal Structure Database, the largest database of identified materials.

- **What happened?**
  - » Google DeepMind AI Tool known as **Graph Networks for Material Exploration (GNoME)** has successfully predicted the structures of more than **2 million new materials**. This was done with the help of AI.
  - » While these materials will still need to undergo the process of synthesis and testing, DeepMind has published a list of **381,000 of the 2.2 million crystal structure that it predicts to be most stable**.

- **How does GNoME actually work?**
  - » GNoME is a state of art **graph neural network model or GNN**, where the input data for the model takes the form of a graph that can be likened to connections between atoms.

  - » GNoME was **trained using active learning**, a technique to scale up a model first trained on a small, specialized dataset. Developers can then introduce new targets allowing machine learning to label new data with human assistance. This makes the algorithm well suited to the science of discovering new materials, which requires searching for patterns not found in original dataset.

  - » **GNoME** uses two pipelines to discover low energy (stable materials).
    - The **structure pipeline** creates candidates with structures similar to known crystals.
    - The **composition pipeline** follows a more randomized approach based on chemical formulas.
    - The output of both the pipelines are evaluated using established **Density Function Theory (DFT) calculations** and those results are added to the GNoME database, informing the next round of active learning.



- **Significance**:
  - » **Drastic increase in the number of 'stable materials' known to mankind by ten-fold**.

- DeepMind claims its current research is equivalent to nearly 800 years of knowledge, given that 3,80,000 of its stable predictions are now publicly available to help researchers make further breakthrough in materials discovery teams.

» **The breakthrough** has huge implications for sectors such as renewable energy, battery research, semiconductors, and computing efficiency which have been looking for new material to improve the efficiency in the sector.

5) EU DEAL ON AI

- **Why in news?**
  - » EU has reached a landmark agreement to regulate **AI** (Dec 2023)

- **Need of Regulating AI:**
  - » **Generative AI systems** like OPENAI's CHATGPT have **raised fears** about the risks the rapidly developing technology poses to jobs, privacy and copyright protection and even human rights.

- **EU has adopted the world's first law on regulating AI** in Dec 2023.
  - » The EU Parliament will now vote on the proposed act early next year (i.e. in 2024), but with the deal done, it's just a formality.

- **What does the EU law propose?**
  - » The law regulates the use of Artificial Intelligence (AI).
  - » It includes safeguards on the use of AI within the EU, including **clear guardrails** on its adoption by law enforcement agencies.
    - The deal includes **strong restrictions** on facial recognition technology, and on Using AI to manipulate human behaviour.
    - Government can only use **real-time biometric surveillance in public areas** only when there are serious threats involved, such as terrorist attacks.
  - » **Provision for strong penalties**: The deal threatens stiff financial penalties for violations of up to 35 million euros or 7% of a company's global turnover.
  - » **Consumers** have been **empowered to launch complaints** against any perceived violations.
  - » The legislation also proposes to be "**a launch pad for EU start-ups and researchers to lead the global AI race**".
    - The act works as a unique legal framework for the development of AI you can trust. It will help in development of technology which doesn't threaten people's safety and rights.

- **Significance**:
  - » Strong and Comprehensive rules in EU can set a **powerful example** for many governments considering regulations.
  - » **AI Companies** who follow these regulations in EU are also expected to extend some of these protections in other jurisdictions.

- **Comparing EU's approach with other regulations**:
  - » **EU** has taken a **tougher stance** which segregates AI as per use case scenario based primarily on the degree of invasiveness and risk;

» **UK** has seen regulation on the other end of the spectrum with a '**light-touch**' approach that aims to foster innovation in this nascent field.
» **USA**'s approach lies in between that of EU and UK.

- **Leadership in tech regulation**:
  » Over the last decade, Europe has taken **decisive lead** over the US on tech regulation.
    ▫ EU has enforced the landmark **GDPR (General Data Protection Regulation) since May 2018.** It is an overarching law focused on privacy and requires individuals to give **explicit consent before** their data can be processed and is now a template being used by over **100 countries**.
    ▫ EU has also passed a pair of sub-legislations – the **Digital Services Act** (DSA) and the **Digital Markets Act** (DMA). These take off from GDPR's overarching focus on the individual's right over her data.
      ▪ DSA focuses on issues like hate speech, counterfeit goods etc.
      ▪ DMA has defined a new category of "**dominant gatekeeper**" platforms and is focused on non-competitive practices and abuse of dominance by these players.

  » **On AI**, though, the **US has made an attempt to take a lead** by way of the new **White House Executive Order on AI**, which is being offered as an elaborate template that could act as a blueprint for every other country looking to regulate AI. In Oct 2022, USA released a blueprint on an **AI Bill of Rights** – seen as a building block for the subsequent executive order

6) GPAI AND UPDATE

- **Why in news?**
  » Global Partnership on AI (GPAI) members unanimously adopt New Delhi Declaration on AI (Dec 2023)

- GPAI is an **international and multi-stakeholder initiative** to guide the **responsible development and use of AI,** grounded in human rights, inclusion, diversity, innovation, and economic growth.
  » This is also a first initiative of its type **for evolving better understanding of the challenges and opportunities around AI** using the experience and diversity of participating countries.
  » It consist of **29 members** (28 countries and EU).
    - **Note**: India is a member. China, a major techpower is not a part of the grouping.

- **Beginning**: The partnership was proposed by Canada and France in 2018 G7 Summit, and was **officially launched in June 2020**.

- It is supported by a Secretariat hosted by OECD, Paris.

- **Dec 2023 Meeting:**
  » India hosted the summit and will also chair GPAI in 2024.
  » This summit was important as it was the first summit after the explosive release of ChatGPT.
  » The GPAI has unanimously adopted '**New Delhi Declaration**'.
  » **Key Highlights of the New Delhi Declaration:**
    - It underscores the **need to mitigate risks** arising from the development and deployment of AI systems.

- It **flagged** concerns emanating from such systems including misinformation, unemployment, lack of transparency, and fairness, protection of IP and personal data and threat to human rights and democratic values.
- It also **promotes equitable access** to critical resources for AI innovation including computing and high quality diverse data sets.
- It also says that global framework for the use of AI should be rooted in democratic values and human rights; safeguarding dignity and well-being; ensuring personal data protection; the protection of IPR etc.
- Members also agreed to **support AI innovation** in the **agriculture sector** as a new 'thematic priority".

» **Significance:**
- The declaration **attempts to find a balance** between 'innovation' and the 'risk associated with AI subsystems'.
- The New Delhi Declaration is very significant for India, which has batted for a **collaborative approach towards building AI systems** as it looks to push its model of digital public infrastructure (DPI) across the world.
- Besides, **access to computing capabilities from member nations** will also boost India's plan of building a **sovereign AI system** which will in turn counter dominance of handful of foreign companies in this space.

» **How this international cooperation can increase**:
- **Make GPAI more inclusive**: By making more developing countries join GPAI.

» **Other steps that India can take for better regulation of AI sector**
- **Statutory Authority**: TRAI has recommended setting up of a domestic statutory authority.
- **International Collaboration**: Collaboration with international agencies and government of other countries to form a global agency for the "responsible use" of AI.

Conclusion: The GPAI's commitment ensures that AI serves as a transformative force, providing clear and accountable guidelines to enable millions worldwide while upholding rights, safety, and security standards.

7) INDIA: PROMOTION OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- **India** has been ranked second on the **Stanford AI Vibrancy Index** primarily on account of its large AI-trained workforce.
- In 2018, NITI Aayog launched **National Strategy for Artificial Intelligence** detailing core strategies and recommendations of promoting the use of AI in key areas of governance.
- **Five Key Sector identified by NITI Aayog** to focus its efforts towards implementation of artificial intelligence (AI) to serve societal needs.
  - » **Healthcare:** increased access and affordability of quality healthcare
  - » **Agriculture:** enhanced farmers income, increased farm productivity and reduction of wastage
  - » **Education:** Improved access and quality of education
  - » **Smart Cities** and infrastructure

» **Transportation**

- **CBSE** has **integrated AI in the school curriculum** to ensure students passing out have basic knowledge and skills of data science, machine learning and Artificial intelligence.
- **Responsible AI for Youth –** A National Program for the youth launched by MEITY – Launched in May 2020
  - The program is designed to reach out to students from Government schools pan India and provide them with opportunity to become part of the skilled workforce in an inclusive manner.
  - It is open to students of classes 8 - 12 from Central and State government-run schools (including KVS, NVS, JNV) from across the country - all 28 States and 8 Union Territories.
- **National Education Policy 2020** provides for setting up of the **National Research Foundation**, which should boost research in AI.
- **RAISE (Responsible AI for Social Empowerment) 2020**
  - It is a first of its kind, **global meeting of minds on Artificial Intelligence** to drive India's vision and roadmap for social transformation, inclusion and empowerment through Responsible AI.
  - It was organized by **GoI through MEITY and NITI Aayog**.
- India joins **Global Partnership on Artificial Intelligence (GPAI)** as a founding member to support the responsible and human centric development and use of AI (July 2020)
- **MEITY** launches National AI Portal of India – www.ai.gov.in (May 2020)
  - The portal has been jointly developed by the MEITY and IT Industry.
  - National E-Governance Division of MEITY and NASSCOM from IT Industry will jointly run the portal.
  - It will be a one stop digital platform for AI related developments in India, sharing of resources such as articles, startups, investment funds in AI, resources, companies and educational institutions related to AI in India.

- **Key Pain Points challenges** involved in the implementation of Artificial Intelligence in India
  i. **Human Resource Shortfall** in terms of number of AI experts including PhDs.
  ii. **Lack of trained professionals**: Only around 4% of Indian AI professionals are trained in emerging technologies such as deep learning.

- **Way Forward**
  - » **Promote More R&D in AI**
    - Better facilities at HEIs
    - More academia-Industry collaboration
  - » **Human Resource Development: Rejuvenate Higher Education Sector for AI**

    Come up with a clear-cut action plan for rejuvenating Higher education system for development of AI

    Dealing with **faculty shortage** by increasing attractiveness of Indian HEIs for highly qualified PHDs and experienced faculties (salaries, infrastructure, recognitions etc.)

  AI-Startups should be encouraged through tax breaks, reduced compliance burden and increased support from R&D institutions.
  - » **Institutional commitment** to excellence, politically open environment and the motivation of individual researchers to unlock the potential of AI will, in long run success of AI in a country.
  - » **Strong, high tech regulatory framework** to deal with problems which may be created by **deep fakes** etc.

- **Conclusion:** India, with its “AI for ALL” strategy, a vast pool of AI-trained workforce and an emerging startup ecosystem, has a unique opportunity to be a major contributor in AI-driven solutions that can revolutionize healthcare, agriculture, manufacturing, education and skilling.