

# An Introduction to Artificial Intelligence in Pharmacy & Biomedicine

Ehsan Aboutaleb  
Pharm.D, PhD of Pharmaceutics  
Assistant professor at GUMS  
2023



# What is AI?

- ▶ Artificial intelligence (AI) is intelligence demonstrated by **machines**, as opposed to natural intelligence displayed by animals including humans. It is the field as the study of "intelligent agents": any system that perceives its environment and takes actions that maximize its chance of achieving its goals.

# What is AI?

- ▶ AI is a field of computer science that aims to develop machines capable of intelligent behavior.
- ▶ Machine Learning is a subset of AI, focusing on systems that can learn from data.
- ▶ Deep Learning, a subset of Machine Learning, uses neural networks inspired by the human brain for complex tasks."

# What is Machine learning (ML) ?

- ▶ Machine learning (ML) is the study of computer algorithms that can improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence.
- ▶ Machine learning algorithms build a model based on sample data, known as **training data**, in order to make predictions or decisions without **being explicitly programmed to do so**

# ARTIFICIAL INTELLIGENCE

A program that can sense, reason,  
act, and adapt

## MACHINE LEARNING

Algorithms whose performance improve  
as they are exposed to more data over time

## DEEP LEARNING

Subset of machine learning in  
which multilayered neural  
networks learn from  
vast amounts of data



# Timeline of AI in health

**1955**

Term coined by John McCarthy. Founded as an academic discipline in 1956 in US.

**1980s-1990s**

Growth of microcomputer and new levels of network connectivity. AI systems in healthcare was designed to accommodate the absence of perfect data and build on the expertise of physicians.

**2019 & onwards**

- Discovery and development of drugs
- Preclinical research
- Personalized Health Care
- And many more

**1960-1970**

Produced first problem-solving program, or expert system, known as Dendral assisting to identifying bacteria and recommending antibiotics

**2010-2019**

- Genomic sequencing databases
- AI in electronic health record systems
- Natural language processing and computer vision,
- Robot-assisted surgery, etc



# ML Approaches

- ▶ **Supervised learning:** The computer is presented with example inputs and their desired outputs, given by a "teacher", and the goal is to learn a general rule that maps inputs to outputs.
- ▶ **Unsupervised learning:** No labels are given to the learning algorithm, leaving it on its own to find structure in its input. Unsupervised learning can be a goal in itself (discovering hidden patterns in data) or a means towards an end (feature learning).
- ▶ **Reinforcement learning:** A computer program interacts with a dynamic environment in which it must perform a certain goal (such as driving a vehicle or playing a game against an opponent). As it navigates its problem space, the program is provided feedback that's analogous to rewards, which it tries to maximize.



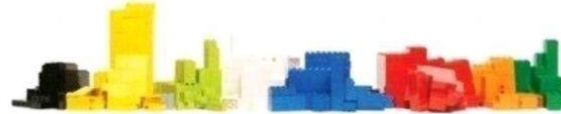
DATA



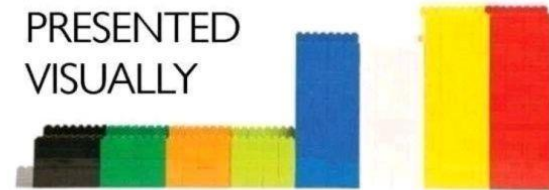
SORTED



ARRANGED

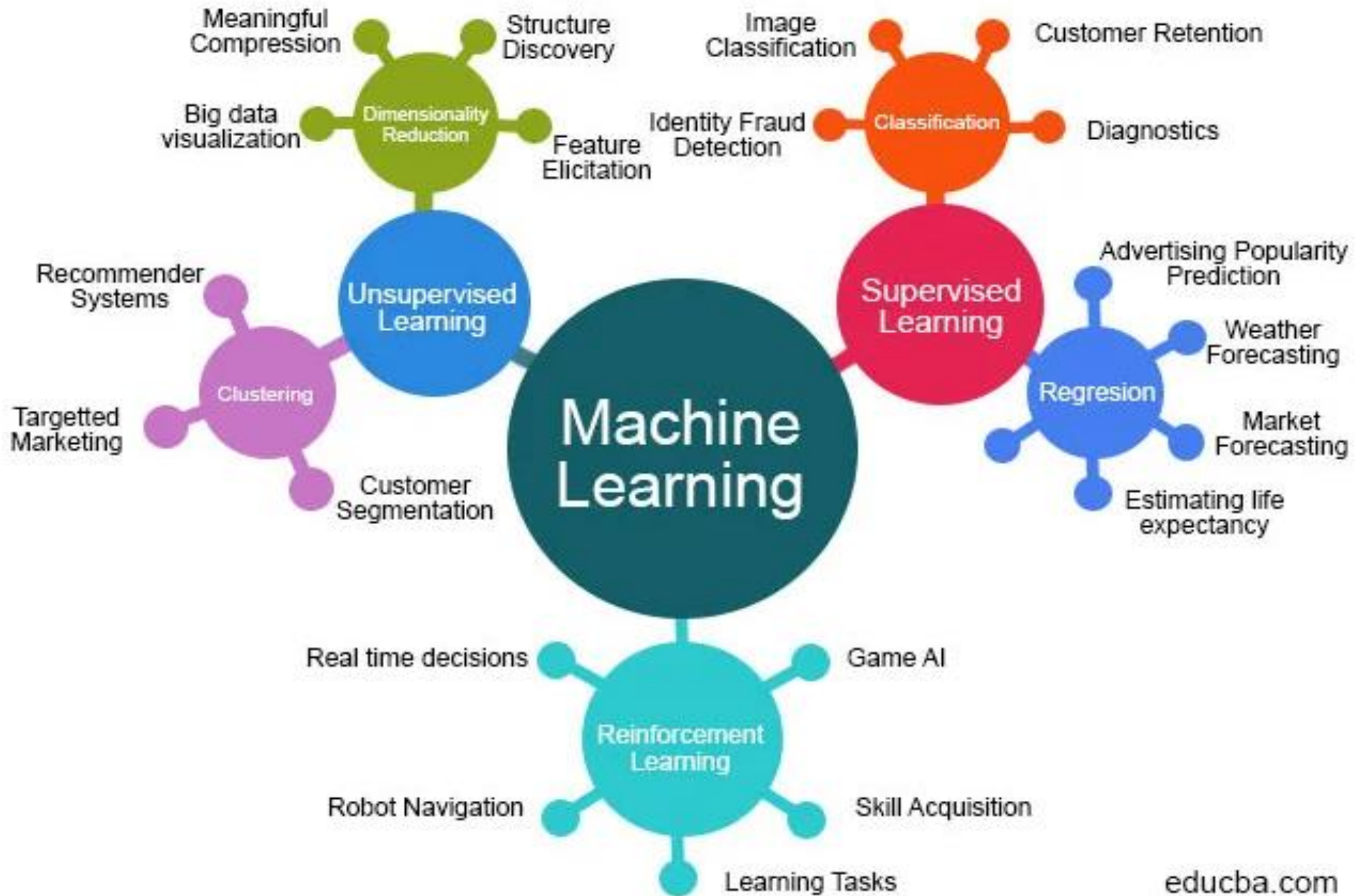


PRESENTED VISUALLY



EXPLAINED WITH A STORY





Gene regulatory network

Drug-target networks

Drug-disease networks

Metabolic networks

Various networks or interactions; which literally make computation and analysis beyond human comprehension and intelligence

Target-disease networks

Protein-protein networks

Drug-drug networks

Disease-disease networks

Drug-adverse effect networks

**Figure 1:** Focus areas in an AI quality assurance master plan, including internal and external drivers.



# Challenges of AI in Manufacturing

## ▶ 1- High Initial Costs

Developing and implementing AI structures may be high-priced. Manufacturers want to put money into hardware, software, professional personnel, and education. Smaller organizations may additionally find it difficult to justify those in advance charges.

## ▶ 2- Data Quality and Availability

AI relies closely on data. Ensuring data efficiency, accuracy, and availability may be tough, particularly when managing legacy systems or when integrating data from numerous sources within the enterprise.

## ▶ 3- Data Security

Manufacturing centers generate and keep sensitive records, together with highbrow belongings and proprietary processes. Protecting this data from cyberattacks and making sure information privacy is a sizable challenge.

## ▶ 4- Lack of AI Talent

There's a shortage of AI and records technological know-how expertise inside the activity marketplace. Finding and keeping professional AI specialists can be difficult, particularly for smaller producers competing with large tech corporations for skills

# Challenges of AI in Manufacturing

## ▶ 5- Integration with Legacy Systems

Many production centers operate with legacy devices and systems that won't effortlessly integrate with AI answers. Retrofitting or upgrading these structures may be complex and pricey.

## ▶ 6- Ethical Concerns

As AI structures become more self-sufficient, ethical considerations increase. Manufacturers want to ensure that AI systems make moral decisions and cling to enterprise standards, mainly in safety-crucial applications.

## ▶ 7- Workforce Adaptation

Introducing AI and automation can lead to personnel concerns, which include fears of process displacement. Manufacturers look for a skilled team to establish smooth transition.

## ▶ 8- Regulatory Compliance

The production enterprise is subject to numerous rules and requirements. Implementing AI may require changes to conform with new rules or adapt current tactics to satisfy unique industry requirements.

## ▶ 9- Complexity of AI Models

AI models, particularly deep mastering models, may be complex and difficult to interpret. Manufacturers need to ensure transparency and understandability in AI choice-making approaches, mainly in critical programs.

# Challenges of AI in Manufacturing

## ▶ 10- Scalability

As manufacturing operations grow, scaling AI structures can be tough. Manufacturers ought to bear in mind the way to extend AI implementations efficiently and efficiently as their operations enlarge.

## ▶ 11- Maintenance and Updates

AI systems require ongoing preservation and updates to stay powerful and steady. Manufacturers need to allocate assets for those activities to prevent gadget degradation or vulnerabilities.

Resistance to Change: Employees can be proof against adopting AI and automation technology due to worry of process loss or unfamiliarity with new systems. Change control strategies are important to cope with this undertaking.

## ▶ 12- ROI Uncertainty

Calculating the return on investment (ROI) for AI implementations may be tough, as it may take time to recognize the total blessings. Manufacturers want to set practical expectations and degree overall performance towards clear targets.



Ethics



# AI Ethics

- ▶ Machine learning poses a host of ethical questions. Systems which are trained on datasets collected with biases may exhibit these biases upon use (**algorithmic bias**), thus digitizing cultural prejudices
- ▶ Using job hiring data from a firm with racist hiring policies may lead to a machine learning system duplicating the bias by scoring job applicants by similarity to previous successful applicants.
- ▶ AI can be well-equipped to make decisions in technical fields, which rely heavily on data and historical information. These decisions rely on objectivity and logical reasoning.
- ▶ Because human languages contain biases, machines trained on language corpora will necessarily also learn these biases.
- ▶ Other forms of ethical challenges, not related to personal biases, are seen in health care. There are concerns among health care professionals that these systems might not be designed in the public's interest but as income-generating machines.

# AI Ethics

- ▶ **Privacy and data security**

protecting patient privacy and ensuring the security of sensitive health data when using AI in medical education and practice

AI can be used to protect patient privacy and data security by data anonymization and encryption

- ▶ **Transparency and explainability** in AI systems are of prime importance particularly in the context of medical decision-making

- ▶ Accountability and responsibility

- ▶ **Ethical and legal responsibilities** of those who develop and deploy AI systems and the need for accountability and oversight

- ▶ Establishing clear **guidelines and standards** for AI development and deployment