Subject: Introduction to Artificial Intelligence (AI)

Introduction

Artificial Intelligence (AI) is no longer a technology of the future—it has become a reality. It is everywhere and is profoundly transforming our society, our economy, and our daily lives. From voice assistants on our smartphones to recommendation systems on streaming platforms, from self-driving cars to AI-assisted medical diagnosis, AI is already shaping the world we live in.

In this context, this module aims to demystify AI, stimulate curiosity, and introduce its concrete and appropriate use in an academic setting. It offers an accessible, practical, and engaging introduction to AI by combining theoretical input with hands-on activities focused on academic uses.[1]

This module is composed of six chapters and is based on the proposed program for first-year Mathematics students (LMD, Semester 2).

By the end of the course, the student will be able to:

- Understand the fundamental principles of artificial intelligence.
- Identify areas where AI is applied in everyday life and in university studies.
- Discuss the ethical, social, and economic issues related to AI.
- Use a few practical AI tools to improve scientific activities.

Module Content

- Chapter 1: Definitions of AI
- Chapter 2: Benefits and risks of AI

- Chapter 3: AI for literature searching
- Chapter 4: AI for time and task management[1]
- Chapter 5: AI for scientific writing
- Chapter 6: AI and academic creativity

Chapter 1: Definitions of Artificial Intelligence

Introduction

Artificial intelligence (AI) is a branch of computer science that seeks to create programs and machines capable of imitating certain human abilities. These abilities include learning, understanding information, solving simple problems, and making decisions.

Unlike human beings, a machine does not truly "think." It executes instructions and analyzes data according to programs designed by humans. AI therefore enables machines to operate in a more intelligent and more autonomous way than a traditional program.

1.1. A Simple Definition of AI

AI can be explained in several ways.

1) AI as imitation of humans

Simple definition: AI is when a machine does things that we consider intelligent when a human does them. (Boden, 1977).

Examples:

- Recognizing a face in a photo

- Understanding what you say
- Playing chess
- Driving a car

2) AI as problem solving

Simple definition: The study of how to program computers so that they can perform tasks for which humans are currently better. (Rich & Knight, 1991).

AI helps computers solve complex problems quickly.

Examples:

- Finding the best route in a city with heavy traffic
- Diagnosing a disease from symptoms[1]
- Translating a text into another language[1]

3) AI as learning

Simple definition: The automation of activities we associate with human thinking, such as decision-making, problem solving, or learning. (Bellman, 1978).

AI allows machines to learn from experience, as humans do.

Examples:

- A system that becomes better at recognizing spam after seeing many emails
- A video game that adapts to your level
- An assistant that understands your preferences better over time

Complete definition (summary)

In short, AI means creating machines capable of:

- Perceiving: seeing, hearing, sensing what happens around them[1]
- Understanding: analyzing and making sense of information[1]
- Deciding: choosing what to do
- Acting: performing actions to achieve a goal

1.2. History of Artificial Intelligence

The history of AI is closely linked to the development of computing. From the earliest computers, researchers wondered whether a machine could imitate human intelligence.

The beginnings of AI (1940s–1950s)

In the 1940s, the first computers were created. In 1950, British mathematician Alan Turing proposed a simple test: if you converse with a machine and cannot tell whether it is a machine or a human, then the machine is intelligent.

The official birth: 1950–1970

- **1956: AI gets its name.** John McCarthy organizes a conference and coins the term "Artificial Intelligence," marking the official birth of AI as a research field.
- **1959: "Machine Learning" is coined.** Arthur Samuel (IBM) creates a program that learns to play checkers by itself and introduces the term "Machine Learning."
- **1965: ELIZA, the first chatbot.** MIT researchers create ELIZA, a program that can converse like a psychologist—an ancestor of today's chatbots.

The era of expert systems (1970–1980)

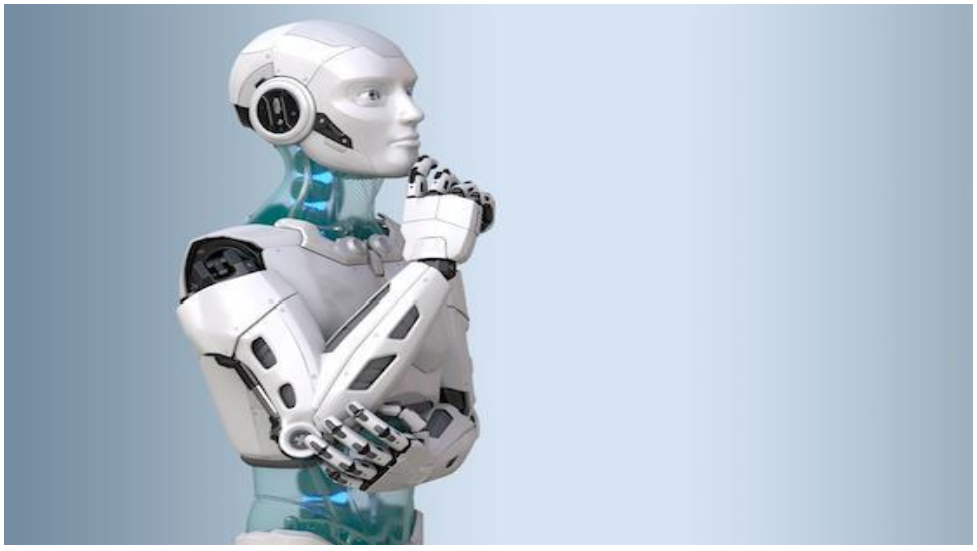
During this period, researchers develop “expert systems,” programs that contain human expert knowledge in specific domains (medicine, chemistry, engineering). The problem: these systems could only do one thing and could not learn new knowledge.

AI in industry (1980–1990)

AI begins to be used in factories and companies: machine control, industrial robots, diagnostic systems. An important development is the renewed interest in neural networks.

The Internet era (1990–2000)

From the 1990s onward, AI experiences a revival thanks to machine learning: instead of coding fixed rules, machines learn from data. A major event is IBM’s Deep Blue defeating world chess champion Garry Kasparov in 1997, showing that machines can outperform humans in some specific tasks.
In 1997, the first robot soccer championship takes place, marking the beginning of RoboCup.



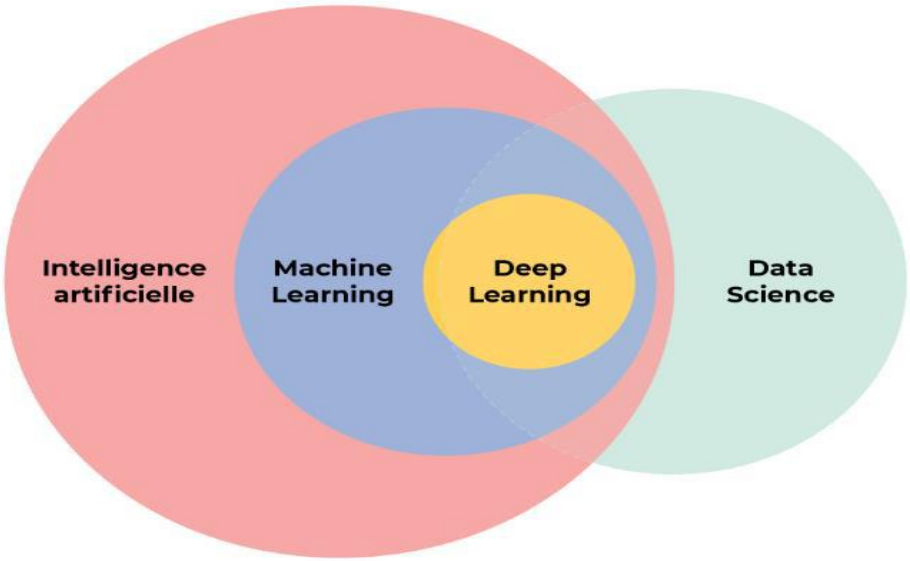
Modern AI (2000–today)

Since the 2010s, AI has grown spectacularly thanks to deep learning, enabled by processor power, massive data availability, and improved algorithms.

- **2016:** AlphaGo defeats the world's best Go player.
- **November 2022:** OpenAI launches ChatGPT; within one week, one million people use it.
- **2023:** AI becomes multimodal—new AI systems like GPT-4 can understand and generate text, images, and audio.

Today, AI systems are highly effective in image recognition, machine translation, and speech recognition, and are used in smartphones, smart cars, medicine, and industry.

Currently, AI is mainly "weak AI" (narrow AI), specialized in specific tasks, while research continues toward more autonomous, reliable, and ethical systems.



1.3. Types of Artificial Intelligence

There are several types of AI depending on how they work.

1) Weak AI (or Narrow AI)

Designed to perform a specific task.

Characteristics:

- Does one specific thing very well
- Cannot do anything else
- This describes all AI systems that exist today

Examples:

- Siri: understands voice commands but cannot drive a car
- AlphaGo: world champion in Go but cannot play chess
- Facial recognition: identifies faces but cannot understand a conversation

2) Strong AI (or General AI)

AI capable of thinking likes a human and understanding its environment; this type remains theoretical and does not exist yet.

3) Symbolic AI (rule-based AI)

Based on logical rules and symbols and uses knowledge programmed in advance; it is easy to understand but limited (like a recipe book).

How it works?

- ✓ humans write rules,
- ✓ AI follows them,

- ✓ and it reasons logically.

Examples:

- A simple medical expert system: “If the patient has a fever and cough, then suggest flu.”
- An old chess program using fixed rules (piece values, favorable positions, predefined strategies).
- A rule-based chatbot with predefined answers.

Advantages:

- We understand exactly what the AI is doing
- We can verify correctness
- Requires less data

Disadvantages:

- All rules must be written manually
- Hard to handle complex situations
- Rigid; does not adapt easily

4) Connectionist AI (brain-inspired AI)

Inspired by the human brain; uses artificial neural networks and learns from data,

widely used today.

How it works: show many examples, the AI discovers patterns, and improves with experience.

Example: show 10,000 cat photos so the AI learns what makes a cat and can recognize new cats it has never seen.

Advantages:

- Very effective on complex tasks
- Learns automatically
- Handles uncertainty well

Disadvantages:

- "Black box": hard to explain decisions
- Requires a lot of data
- Can be fooled

Simple comparative summary: Types of Artificial Intelligence

Type d'Intelligence Artificielle	Définition	Principe de fonctionnement	Exemple concret
IA faible	IA conçue pour une tâche précise	Exécute une seule fonction définie à l'avance	Assistant vocal, reconnaissance faciale
IA forte	IA capable de penser et raisonner comme un humain	Compréhension générale, autonomie complète	N'existe pas encore (théorique)

IA symbolique	IA basée sur des règles et des symboles	Utilise des règles logiques « si… alors… »	Système expert, chatbot à règles
IA connexionniste	IA inspirée du cerveau humain	Apprend à partir des données grâce aux réseaux de neurones	Reconnaissance d'images, traduction automatique

Comparison with a metaphor

Imagine you want to teach a child to recognize dogs:

Symbolic approach:

● You give them a list: "A dog has 4 legs, a tail, pointed or floppy ears, it barks..."

● The child follows this list to identify the dogs.

Connectionist approach:

● You show the child lots of pictures of dogs.

● The child learns to recognize the dogs on their own.

● They can't really explain how they know; they "feel" it.

The future: Combining the two

Researchers are now trying to combine these two approaches to achieve:

- The performance of connectionist AI
- The explainability of symbolic AI

1.4. Examples of AI in Everyday Life

AI is increasingly present in our daily life.

At home: robot vacuum cleaners, washing machines that detect fabric type and adjust cycles, smart air conditioning that learns habits.
Entertainment: Netflix/YouTube recommendations; video games with adaptive opponents.
On **smartphones**: voice assistants (Siri/Google Assistant/Alexa), camera modes (portrait/night/scene recognition), predictive keyboards and instant translation.
Online: search engines, social networks (feed selection, face recognition, content moderation), e-commerce recommendations and dynamic pricing.
Transport: navigation systems, driver assistance (automatic parking, adaptive cruise control, emergency braking).
School/work: email replies and sorting, writing tools (Grammarly/Antidote/ChatGPT), plagiarism detection, fraud detection, antivirus systems, and customer-service chatbots.

1.5. Domains of Artificial Intelligence

AI includes several major areas.

1.5.1. Machine Learning

Machine learning enables machines to learn from data; the more data the system receives, the better it becomes.

Three types: supervised learning (with correct answers), unsupervised learning (finding patterns without labels), and reinforcement learning (trial-and-error with rewards/punishments).
Machine learning is at the core of most modern AI applications because it allows AI to improve over time.

1.5.2. Natural Language Processing (NLP)

NLP enables machines to understand human language (spoken or written) and is used in translation tools and virtual assistants.[1]
It can understand texts, extract information, detect sentiment, generate text, summarize documents, answer questions, translate, recognize speech, and synthesize voice.
Large Language Models (LLMs) are trained on massive text corpora and can generate human-like language; examples mentioned include ChatGPT, Gemini, and Claude.

1.5.3. Computer Vision

Computer vision allows machines to analyze images and videos and is used for object detection, facial recognition, OCR, and image generation.
It often relies on Convolutional Neural Networks (CNNs), which learn patterns from simple features to complex objects.
Applications include medicine, security, automotive, retail, and agriculture.

1.5.4. Robotics

Robotics combines AI with physical machines; intelligent robots can perceive their environment (cameras, LiDAR, microphones, tactile sensors), move, plan, adapt, act, and communicate.

Examples include robot vacuums, Boston Dynamics robots, and social robots like Pepper.

1.6. Applications of AI

AI is used in many sectors.

- **Medicine**: AI supports early disease detection; the document cites a 2019 MIT project where an algorithm could identify breast cancer risk up to four years before it becomes visible to the human eye on imaging, trained on 60,000 patients and 90,000 digitized images.
- **Transport**: AI can manage road traffic in real time (e.g., smart traffic lights adjusting durations) and improve safety through driver-assistance systems like automatic braking and obstacle detection.
- **Education**: AI-enabled learning platforms analyze student levels and propose suitable exercises, enabling personalized learning at each student's pace.
- **Industry**: AI improves production by optimizing machine use; predictive maintenance anticipates failures before they occur, reducing downtime and repair costs while increasing productivity and reliability.