Ministry of Higher Education and Scientific Research
University of Mohamed Boudiaf, Msila

Faculty of Mathematics and Computer Science
Department of Computer Science

1st year

Introduction to Artificial Intelligence

Dr. N.CHALABI

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Domains of Artificial Intelligence

What Do We Mean by “Domain of AI” ?

Definition:

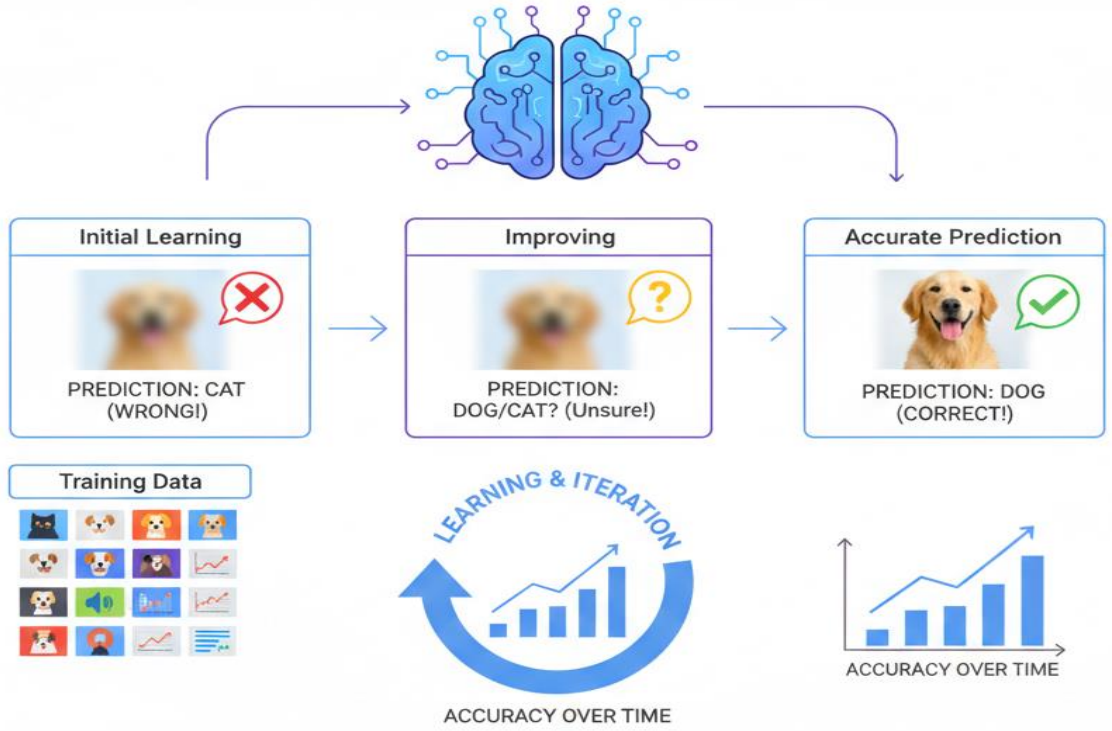
- A **domain of AI** is a specialized area focusing on a particular type of problem or data.

- “Domains tell us *what kind of intelligence* the AI is dealing with.”

Machine Learning

AI that learns from data

Machine Learning allows systems to improve automatically by learning from examples.



Key idea :

Data → Model → Prediction

Examples:

1. TikTok / Netflix recommendations

What people think:

"It just shows popular videos."

What actually happens:

- You **watch**, **like**, **skip**, **rewatch**
- The system collects **millions of such behaviors**
- ML finds patterns like:
  - *People who watched A also watched B*
  - *Users with similar behavior like similar content*

Why ML?

No human writes rules like:

•"IF user is 19 AND watched video X THEN recommend video Y"

•The system **learns automatically from data**

2. Spam detection

Old (non-ML) way:

- Rule-based:
  - IF email contains “FREE $$$” → spam
  - IF sender is unknown → spam
- **Easy to trick.**

ML way:

- Train on **millions of emails**
  - labeled *spam / not spam*
- The model learns:
  - word patterns
  - sender behavior
  - structure of messages

Why ML?

- The rules are **not written by humans**
- The system **learns what spam looks like**

3. Credit card fraud detection

Human logic fails because:

- Fraud patterns change
- Millions of transactions per second

ML approach:

Learn from past transactions:

- amount
- location
- time
- user behavior

Detect **unusual patterns** automatically

Example:

“This person never buys at 3 AM in another country.”

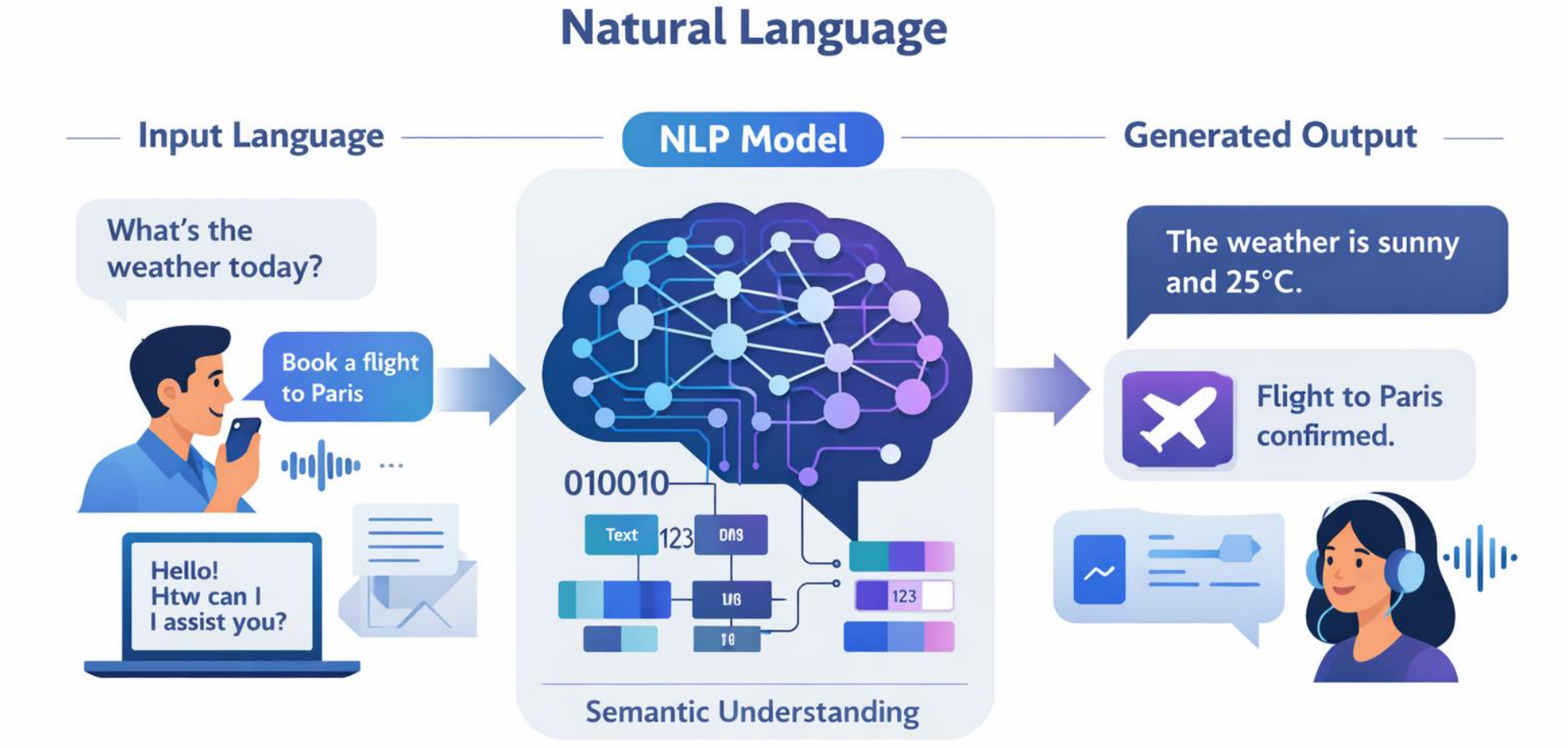
Natural Language processing(NLP)

NLP AI that understands language

NLP enables machines to understand, interpret, and generate human language.

Language is messy, ambiguous, and emotional therefore NLP is one of the hardest AI domains

- Natural Language Processing is the part of AI that allows computers to read, understand, generate, and respond to human language (text or speech).



Key idea :

- "Humans speak **language**.
- Computers speak **numbers**.
- NLP is the translator between the two."

Examples:

1. ChatGpt

What it does:

- Understands your question (text)
- Generates a human-like answer

How:

- Trained on **huge amounts of text**
- Learns:
  - grammar
  - meaning
  - context
  - how words relate to each other

Why NLP?

- Input: human language
- Output: human language
- Understanding meaning, not just keywords

2. Google Translate

What it does:

- Converts one language to another

Old way (before NLP):

- Word-by-word translation
  - Terrible results

Using NLP:

- Learns from **millions of translated sentences**
- Understands:
  - sentence structure
  - meaning
  - context

Example:

"I'm feeling blue"

Not → أنا أشعر بالأزرق

But →أنا أشعر بالحزن

Why NLP?

- Meaning > words
- Context matters

3. Voice Assistants (Siri, Google Assistant, Alexa)

What it does: in 3 steps

- **Speech → Text** (Speech Recognition)
- **Understand intent** (NLP)
- **Text → Speech** (Speech Synthesis)

Why NLP?

Understanding **intent**, not just sound

Example:

"Set an alarm for 7 tomorrow"

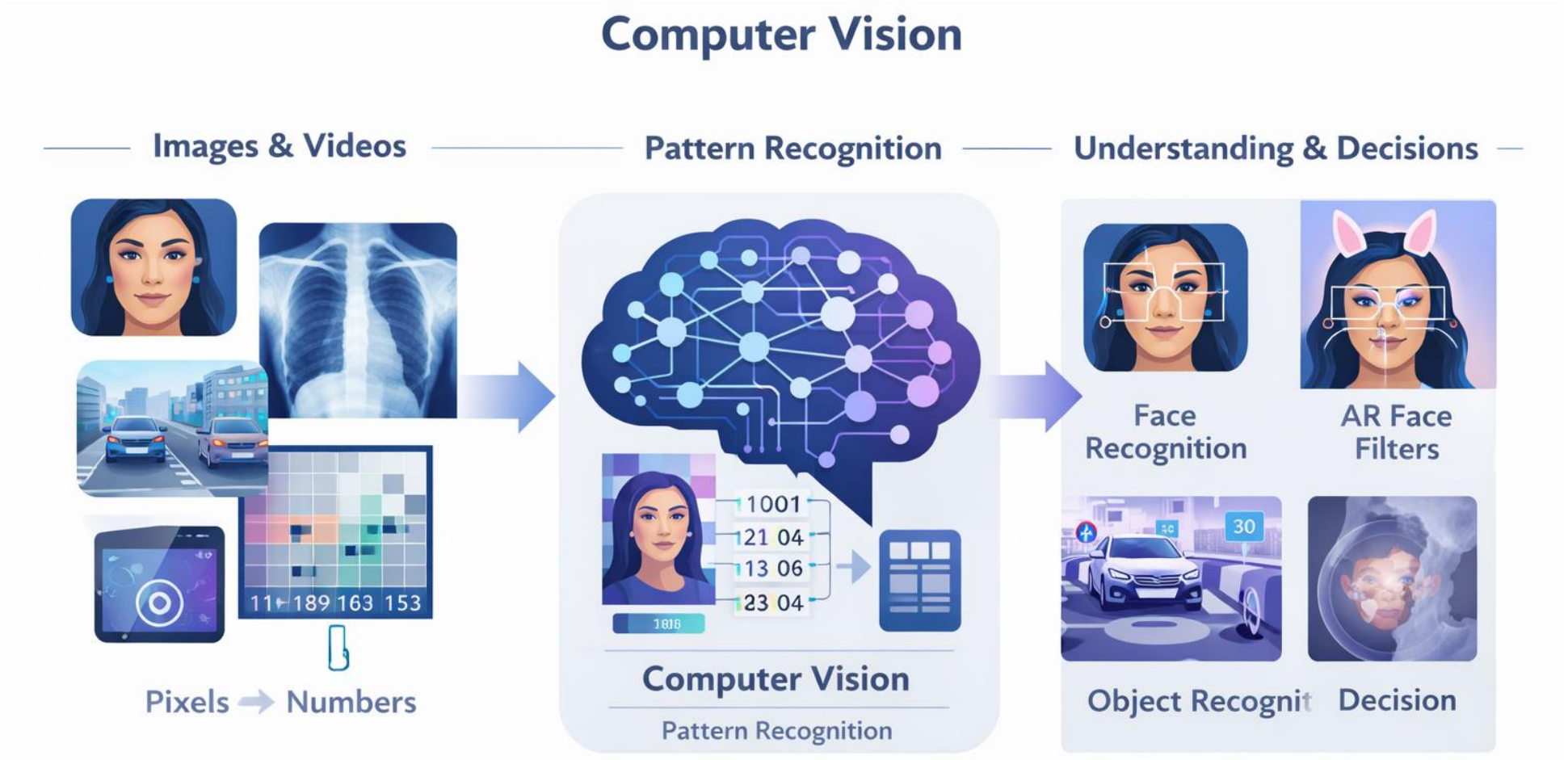
The system understands:

- Action: set alarm
- Time: 7 AM
- Day: tomorrow

Computer Vision

AI that sees

- Computer Vision allows machines to interpret images and videos.



Human Vision VS Computer Vision

Neptune's fountain

Eye

Brain

Neptune's fountain

Result

Neptune's fountain

Sensing device

Computer

84% fountains
15% monument
1% historical building

Result

Examples:

1. Face Recognition

What we see:

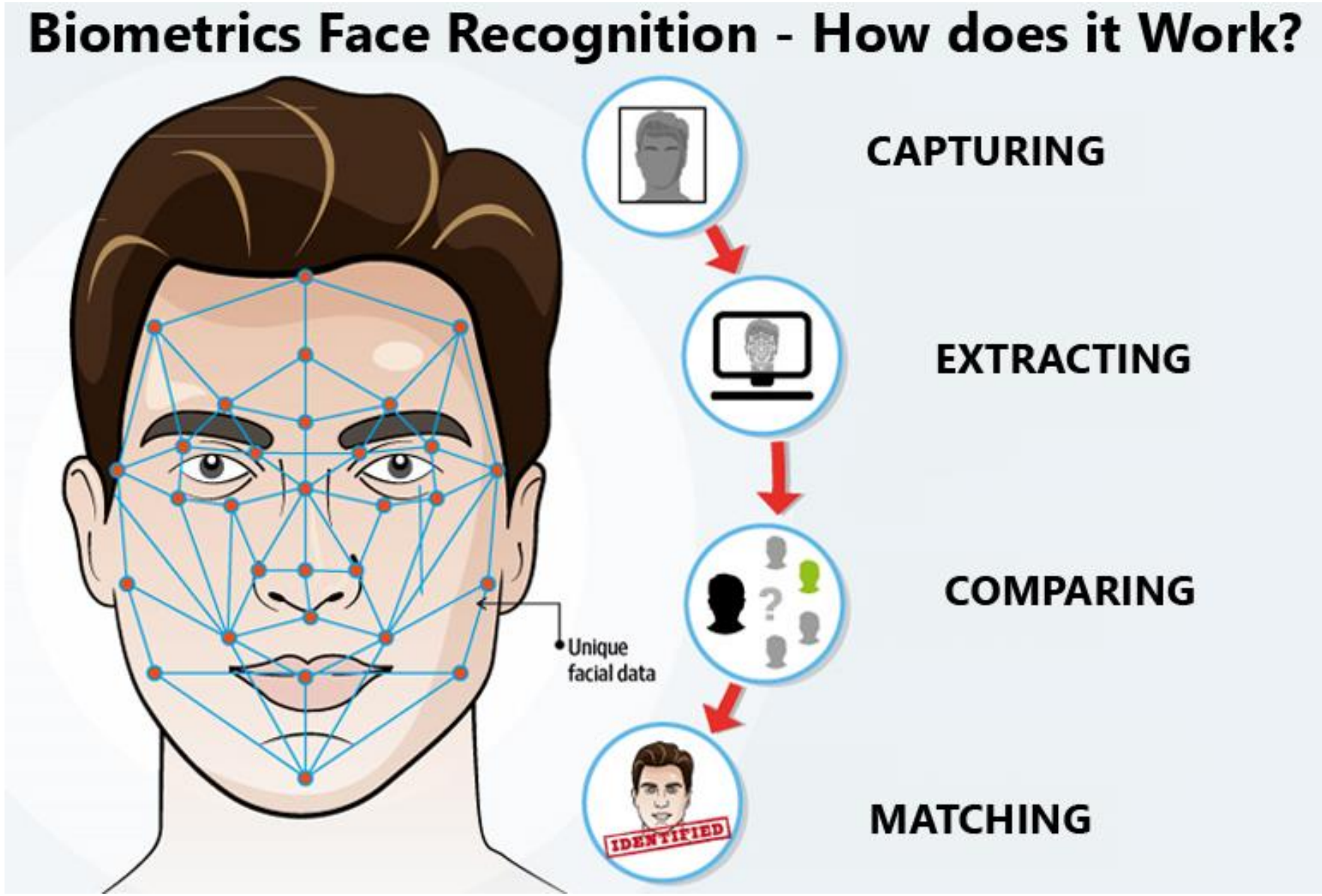
- Phone unlocks with your face
- Facebook tags people automatically

What the AI actually does:

- Detects a face in the image
- Extracts key features:
  - distance between eyes
  - nose shape
  - face contour
- Compares with stored face patterns

Why Computer Vision?

- Input = image
- Output = identity
- The system **understands visual patterns**, not names


Biometrics Face Recognition - How does it Work?
CAPTURING
EXTRACTING
COMPARING
MATCHING
Unique facial data
IDENTIFIED

2. Face Filters (Snapchat, Instagram)

What we see:

- Dog ears
- Glasses
- Makeup filters

What the AI actually does:

- Detects face landmarks (eyes, nose, mouth)
- Tracks face movement in real time
- Places virtual objects correctly

Example:

- Your head moves → filter moves with you

Why Computer Vision?

Real-time image analysis
Face tracking
Landmark detection

REAL-TIME FACE FILTER SYSTEM

1. INPUT & DETECTION

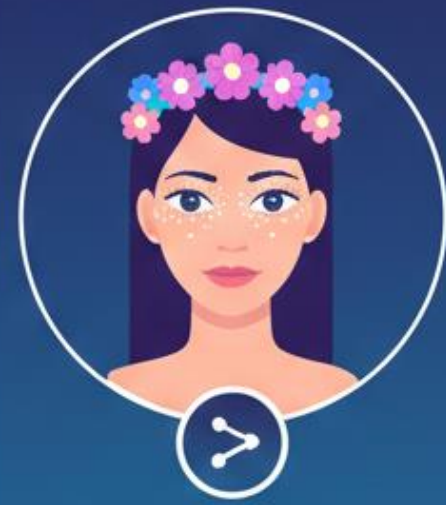
Live Camera Feed + Face & Landmark Detection

2. 3D MESH & TRACKING

Real-Time 3D Mesh Generation

Head Pose & Expression Tracking

3. GRAPHICS OVERLAY & RENDERING



2D Stickers

3D Objects

Face Doformation

3. Autonomous Vehicles

What we see:

- Self-driving car
- Lane detection
- Traffic sign recognition

What the AI actually does:

- Analyzes camera images
- Detects:
  - cars
  - pedestrians
  - traffic lights
  - road lanes
- Makes driving decisions

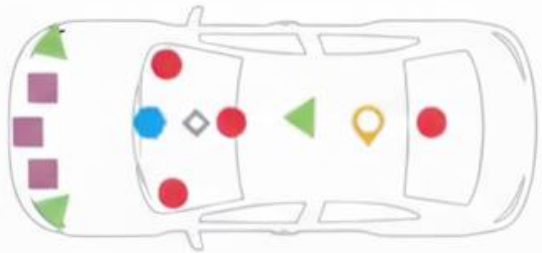
Example:

- Red light → stop
- Pedestrian → slow down

Why Computer Vision?

- The car must **see the road**
- Vision is essential before decision-making

HOW AUTOMATED VEHICLES WORK



- Cameras
- Radar Sensor
- Controller
- Lidar Sensor
- GPS Unit
- Onboard Basemap

CAMERAS

Cameras gather visual information to the controller for processing.

LIDAR

Lidar sensors bounce lasers off of detected differentiate objects.

RADAR

Radar sensors bounce radio waves off detected objects. Rader cannot differentiate objects.

GPS UNIT

The GPS unit identifies the vehicle aind vehicle and aids

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4. Medical Image Analysis (X-rays, MRI)

What we see:

- Doctor examining an image

What the AI actually does:

- Analyzes medical scans
- Detects anomalies:
  - tumors
  - fractures
  - infections
- Highlights suspicious areas

Example:

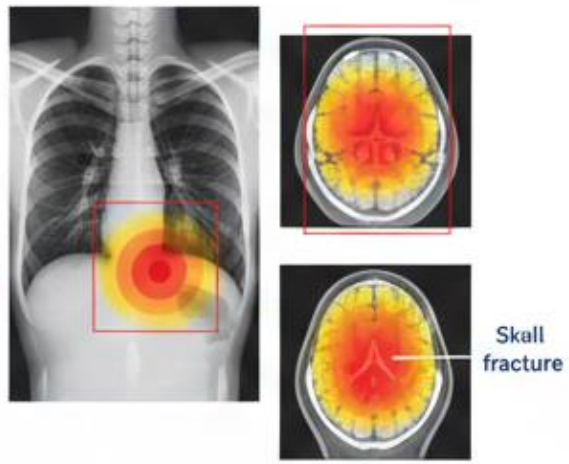
AI marks a possible tumor before the doctor reviews it

Why Computer Vision?

- Input = medical images
- Output = visual diagnosis support
- Pattern detection at pixel level

Medical Images

Pattern Recognition & Analysis

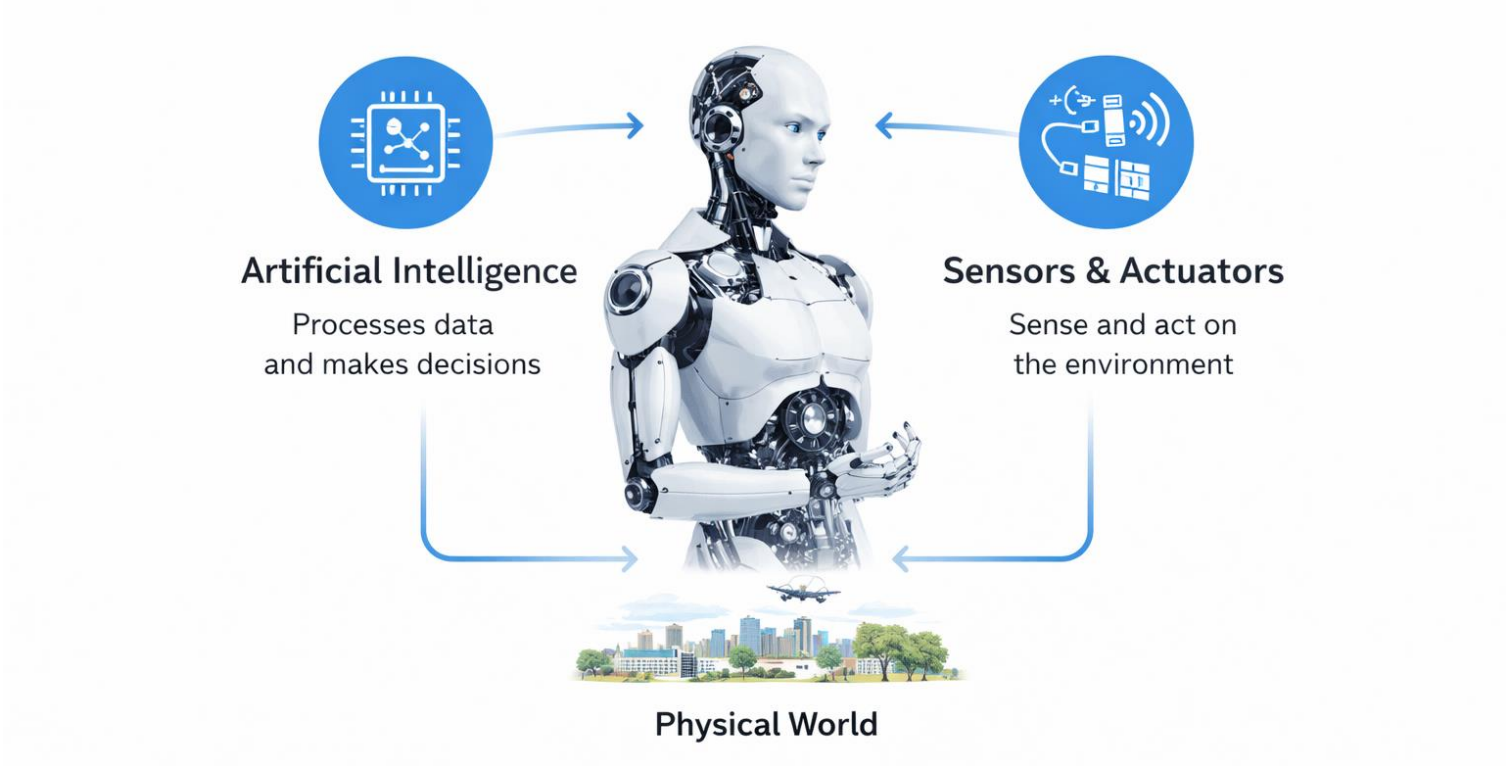


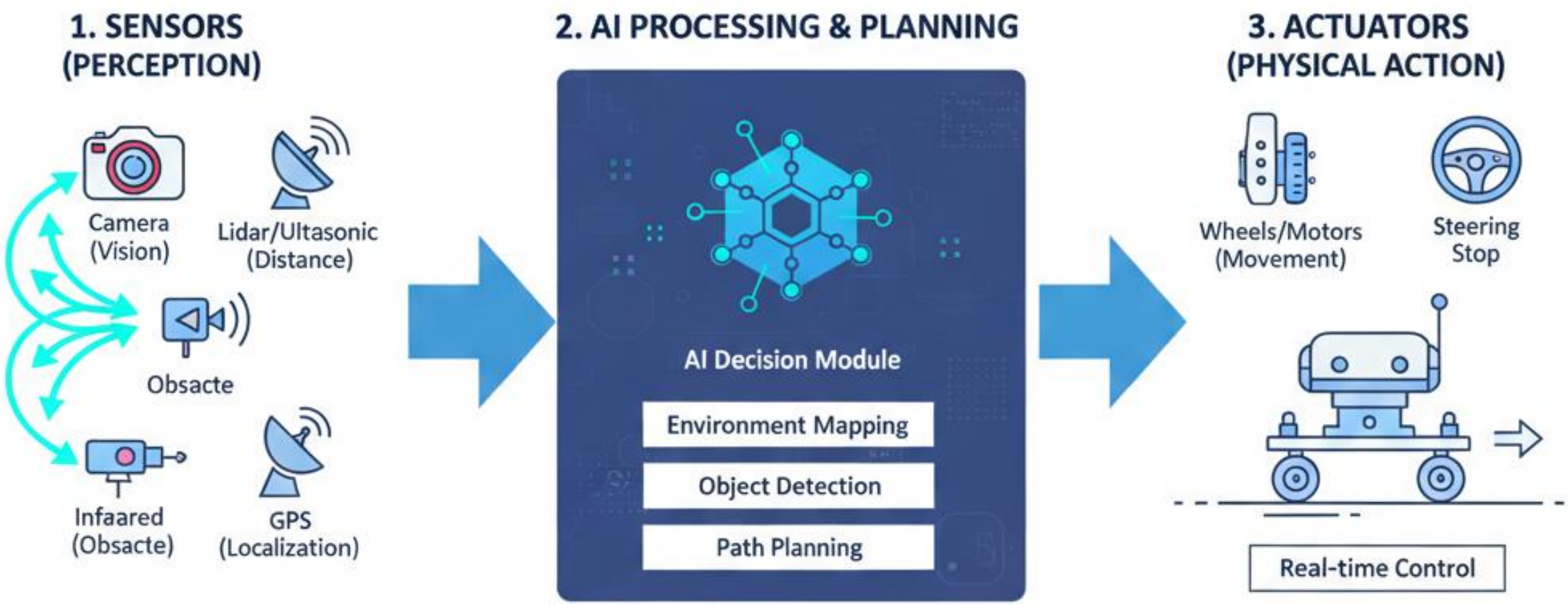
Clinical Decision Support

Robotics

AI that acts

- Robotics combines AI with sensors and actuators to interact with the physical world.
- Robotics is AI with a body.




1. SENSORS
(PERCEPTION)
Camera
(Vision)
Lidar/Ultasonic
(Distance)
Obsacte
Infaared
(Obsacte)
GPS
(Localization)
2. AI PROCESSING & PLANNING
AI Decision Module
Environment Mapping
Object Detection
Path Planning
3. ACTUATORS
(PHYSICAL ACTION)
Wheels/Motors
(Movement)
Steering
Stop
Real-time Control

Examples:

1. Industrial Robots

What we see:

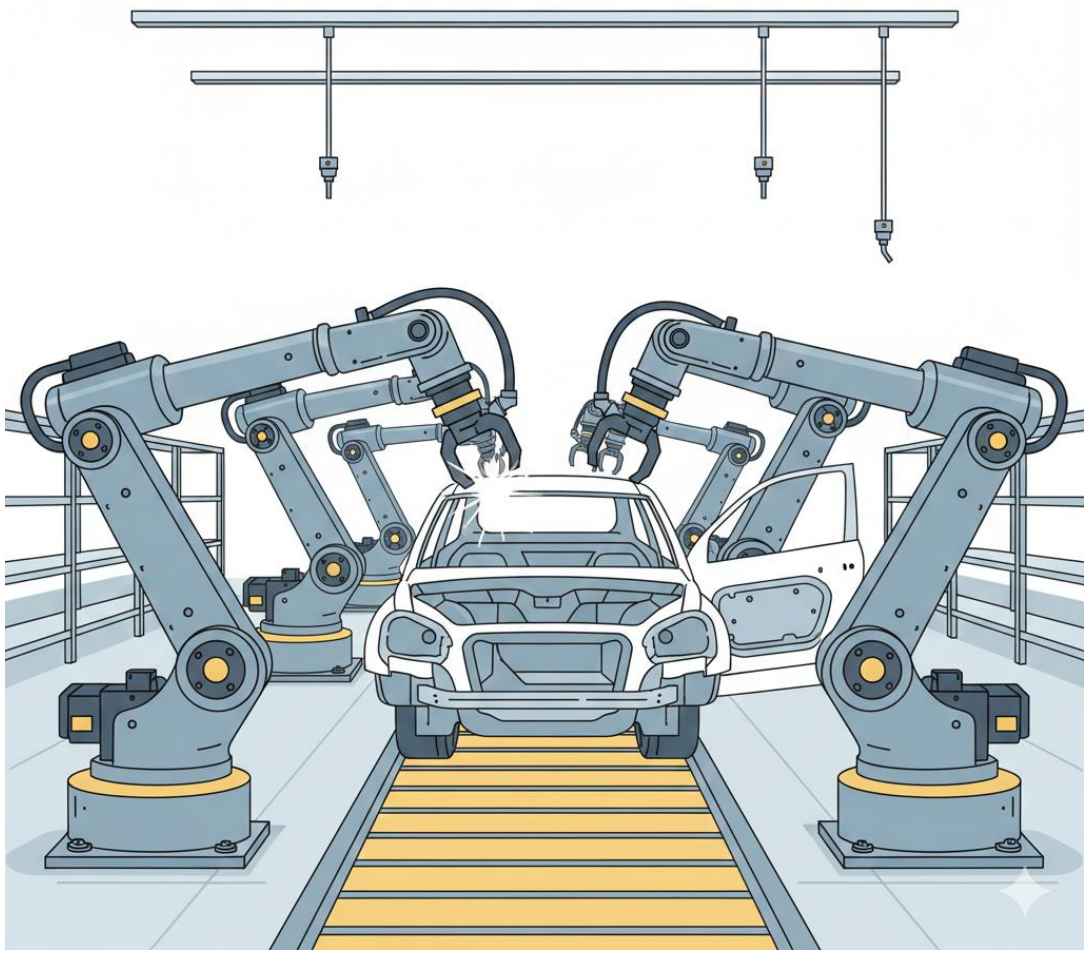
- Robotic arms assembling cars
- Welding, painting, packaging

What the AI actually does:

- Receives sensor feedback
- Executes precise programmed or learned movements
- Repeats tasks with high accuracy

Example:

- Same weld, same position, thousands of times



Why Robotics?

- Physical manipulation of real objects
- Interaction with the real world

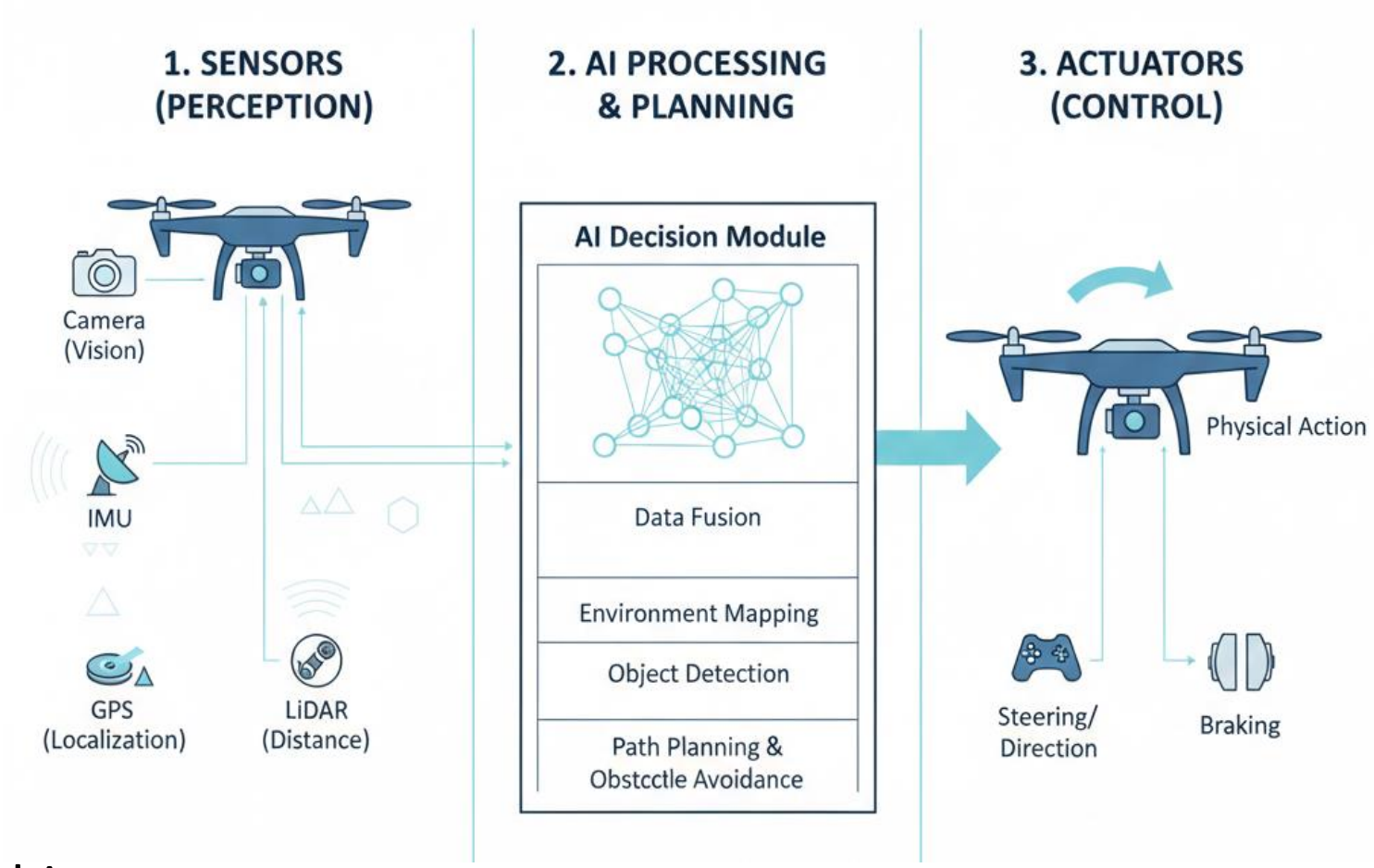
2. Drones

What we see:

- Drone flying
- Recording video
- Following targets

What the AI actually does:

- Stabilizes flight
- Avoids obstacles
- Adjusts direction and speed
- Uses vision to follow paths or objects



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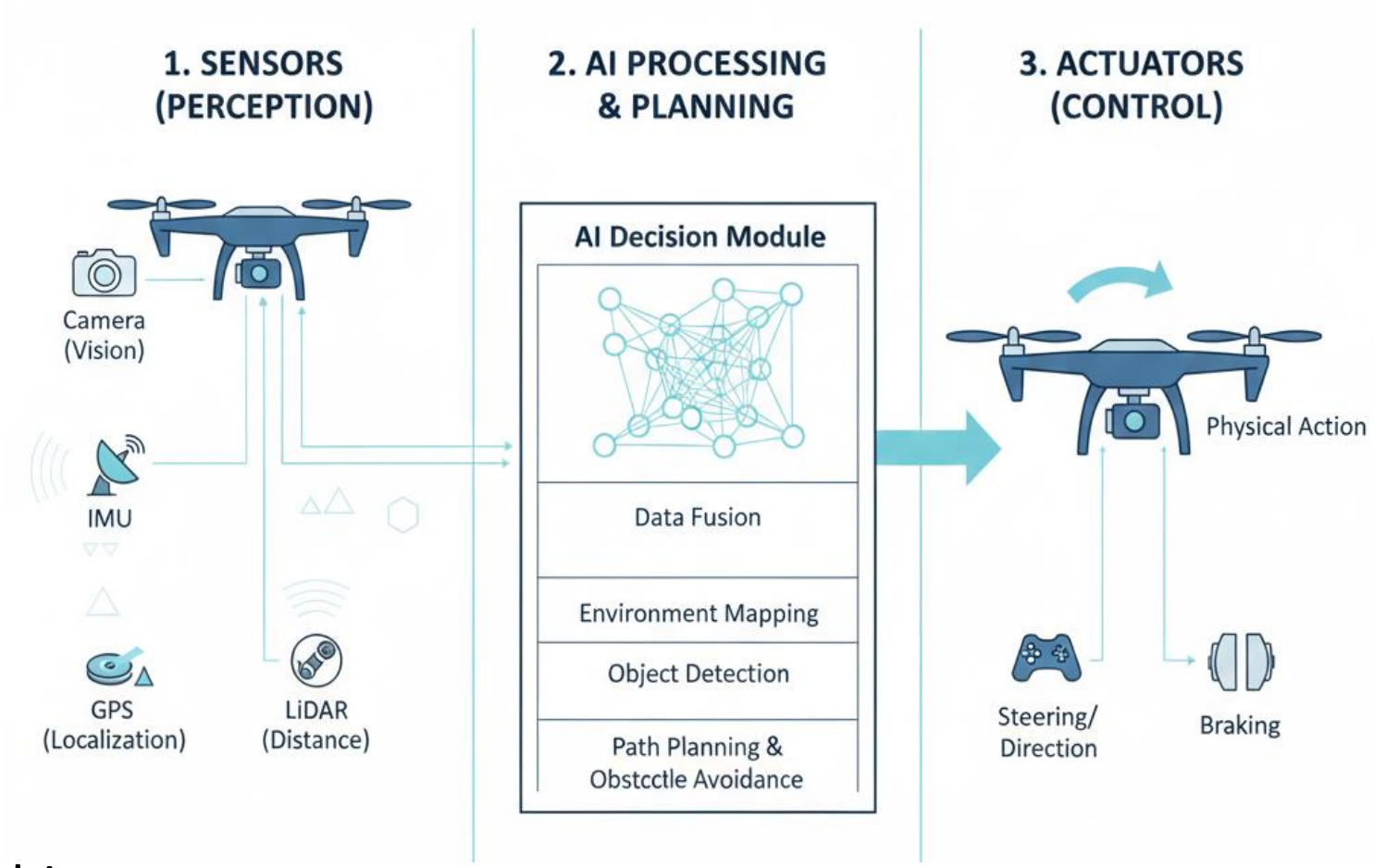

Applications of AI (Big Picture)

AI in real-world sectors

- Artificial Intelligence techniques are applied across multiple domains by combining **Machine Learning, Natural Language Processing, Computer Vision, and Robotics**.

Sector	Application	AI Techniques Used	Purpose
Medicine	Cancer detection (X-ray, MRI)	Computer Vision, Deep Learning (CNNs), Machine Learning	Detect abnormalities and support diagnosis
	Diagnosis support systems	Expert Systems, Machine Learning, Knowledge-Based AI	Assist physicians in clinical decisions
Transport	Autonomous vehicles	Computer Vision, Machine Learning, Reinforcement Learning	Perception, navigation, and decision-making
	Traffic prediction	Machine Learning, Time-Series Analysis	Reduce congestion and improve safety

Sector	Application	AI Techniques Used	Purpose
Education	Personalized learning	Machine Learning	Adapt content to student needs
	Plagiarism detection	Natural Language Processing, Machine Learning	Analyze text similarity and originality
Industry	Quality control	Computer Vision, Machine Learning	Detect defects in products
	Predictive maintenance	Machine Learning, Anomaly Detection	Predict failures before they occur

Artificial Intelligence in Academic Practice