🧠 What is an Intelligent Agent?

An **agent** = anything that perceives its environment through **sensors** and acts upon it with **actuators**.

An **intelligent agent** = one that **chooses actions rationally** to achieve its goals (best possible outcome given what it knows).

💡 Analogy: Student as an Agent

- **Sensors**: eyes, ears → see slides, hear lecture
- **Actuators**: hands, mouth → write notes, ask questions
- **Goal**: pass the course with good grades

🌍 Types of Agent Environments

According to **Russell & Norvig**, environments are classified using several dimensions:

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1. Observable vs. Partially Observable

- **Fully Observable**: Agent has access to the complete state of the environment.
  - *Example*: **Chess** → the board is fully visible.
  - *Analogy*: Open-book exam → you see all the information.
- **Partially Observable**: Agent only has limited information.
  - *Example*: **Poker** → you can't see the opponent's cards.
  - *Analogy*: Closed-book exam → rely on memory, not all info is visible.

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2. Deterministic vs. Stochastic

- **Deterministic**: Next state is fully determined by current state + action.
  - *Example*: Solving a math equation.
  - *Analogy*: Following a recipe → exact ingredients = exact result.
- **Stochastic**: Involves randomness or uncertainty in outcomes.
  - *Example*: **Self-driving car in traffic** → can't predict pedestrians perfectly.
  - *Analogy*: Playing football → strategy helps, but outcomes are uncertain.

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3. Episodic vs. Sequential

- **Episodic**: Each action is independent of the previous one.
  - *Example*: Image classification → each picture is separate.
  - *Analogy*: Quiz show → each question is unrelated.
- **Sequential**: Current decision affects future decisions.
  - *Example*: Driving a car → each turn affects destination.

- *Analogy*: Choosing university courses → affects prerequisites and graduation path.

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4. Static vs. Dynamic

- **Static**: Environment doesn't change while the agent is deciding.
  - *Example*: Crossword puzzle → grid doesn't change.
  - *Analogy*: Paused game → time frozen while you think.
- **Dynamic**: Environment changes during decision-making.
  - *Example*: Driving in traffic → cars keep moving.
  - *Analogy*: Group discussion → people add points as you think.

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5. Discrete vs. Continuous

- **Discrete**: Finite set of states, actions, or percepts.
  - *Example*: Chess → 64 squares, fixed moves.
  - *Analogy*: Multiple-choice exam → limited answers.
- **Continuous**: Infinite possible states or actions.
  - *Example*: Driving → continuous speed and steering.
  - *Analogy*: Essay exam → endless possible answers.

📊 Comparison Table

Property	Discrete Example	Continuous Example
Observable	Chess (see everything)	Poker (hidden cards)
Deterministic	Solving equations	Weather prediction (uncertain)
Episodic	Spam filter (each email separate)	Self-driving car (turns affect future)
Static	Sudoku puzzle	Stock market (changes while you think)
Discrete	Tic-tac-toe, multiple-choice exam	Driving, handwriting recognition

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✅ Key Idea

The **design of an intelligent agent** depends on its environment:

- **Chess-playing agent** → needs **strategy & search**.
- **Self-driving car** → needs **perception, uncertainty handling, and real-time decision-making**.