Artificial Intelligence in Java

RP **by Rodrigo Martins Pagliares**

Computer Science Department - UNIFAL – Universidade Federal de Alfenas - MG - Brazil

Last update: 04/29/2025
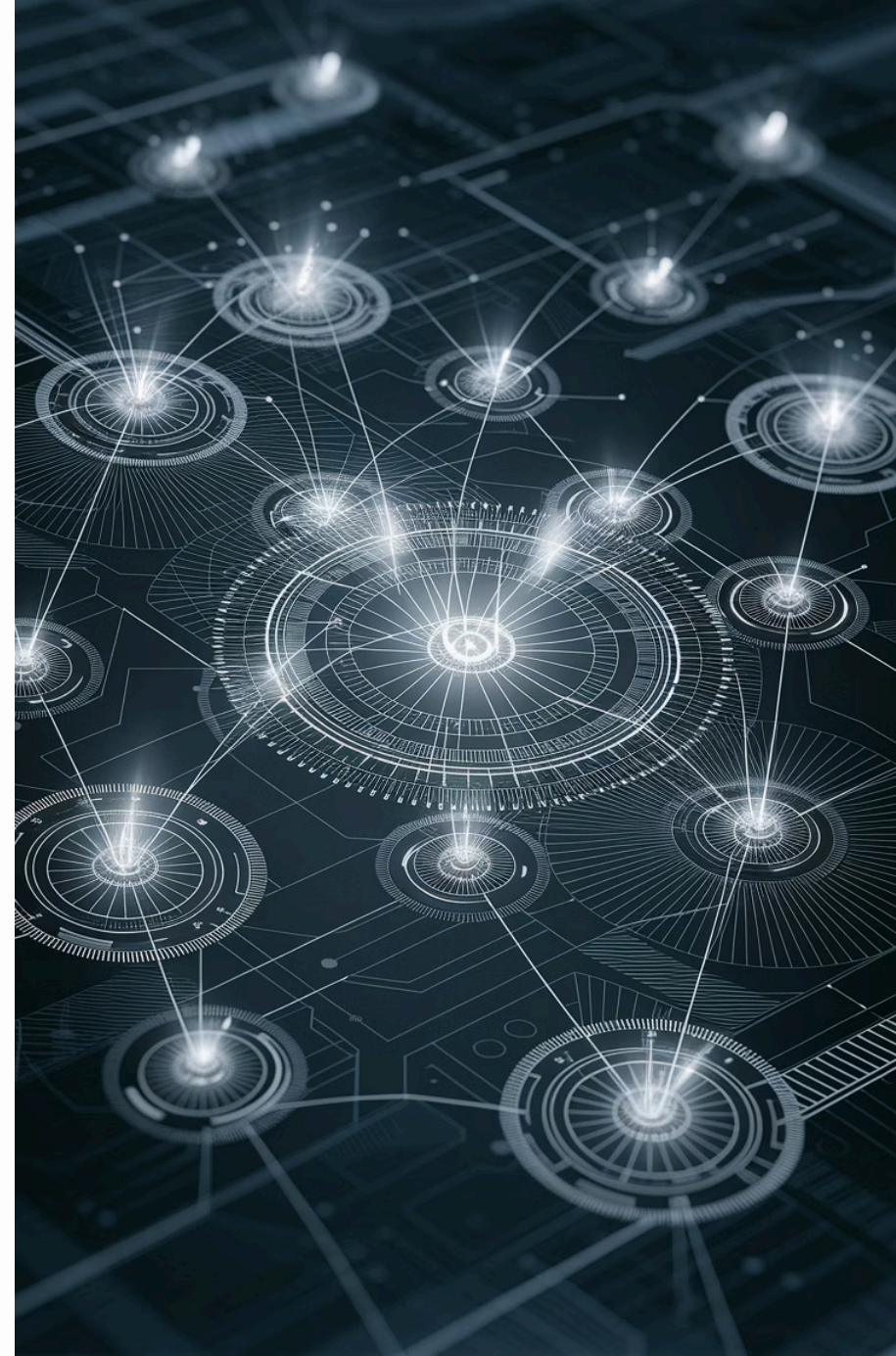
Graph Algorithms and Artificial Intelligence

Graph algorithms are fundamental in many **AI-related problems**

Initial confusion: Why study graph algorithms in AI?

Motivation: Many AI problems can be reduced to **path-finding in graphs**

Graphs offer a structured way to model **navigation, decisions, and state transitions**

RP **by Rodrigo Martins Pagliares**

Graph Algorithms in Games

Games like **Warcraft** rely heavily on graph algorithms

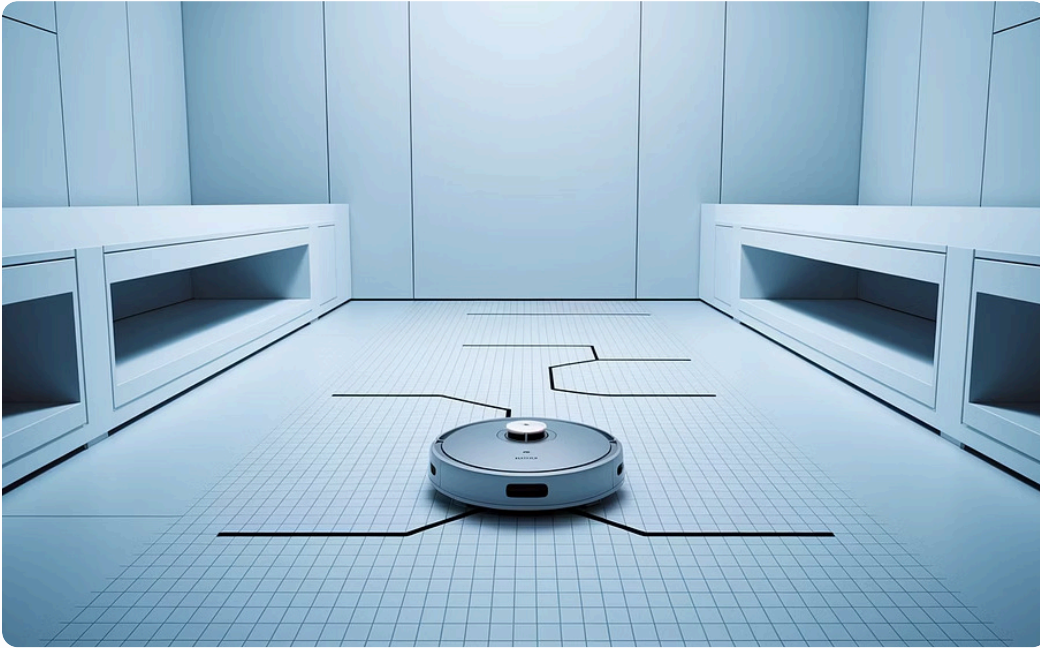- Clicking a location triggers a **shortest path computation**

Commonly used algorithms include:

- **Breadth-first search**
- **Depth-first search**
- **A search***

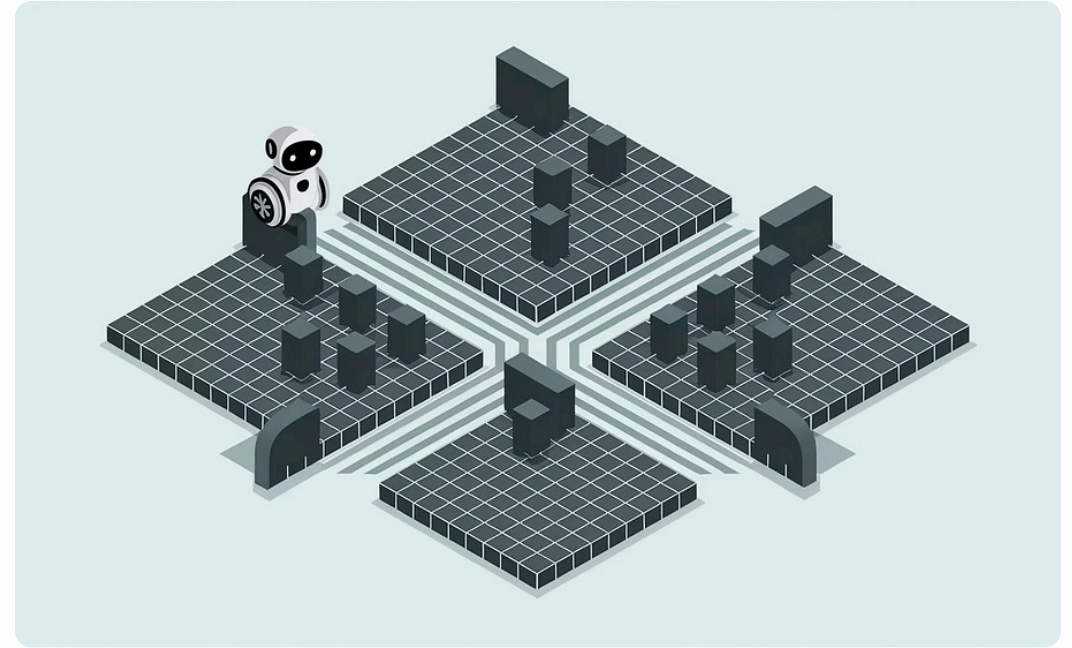A* search is particularly powerful for finding optimal paths

Graph Algorithms in Robotics

Robot Navigation

Robots (e.g., **vacuum cleaners**) also use graph-based navigation

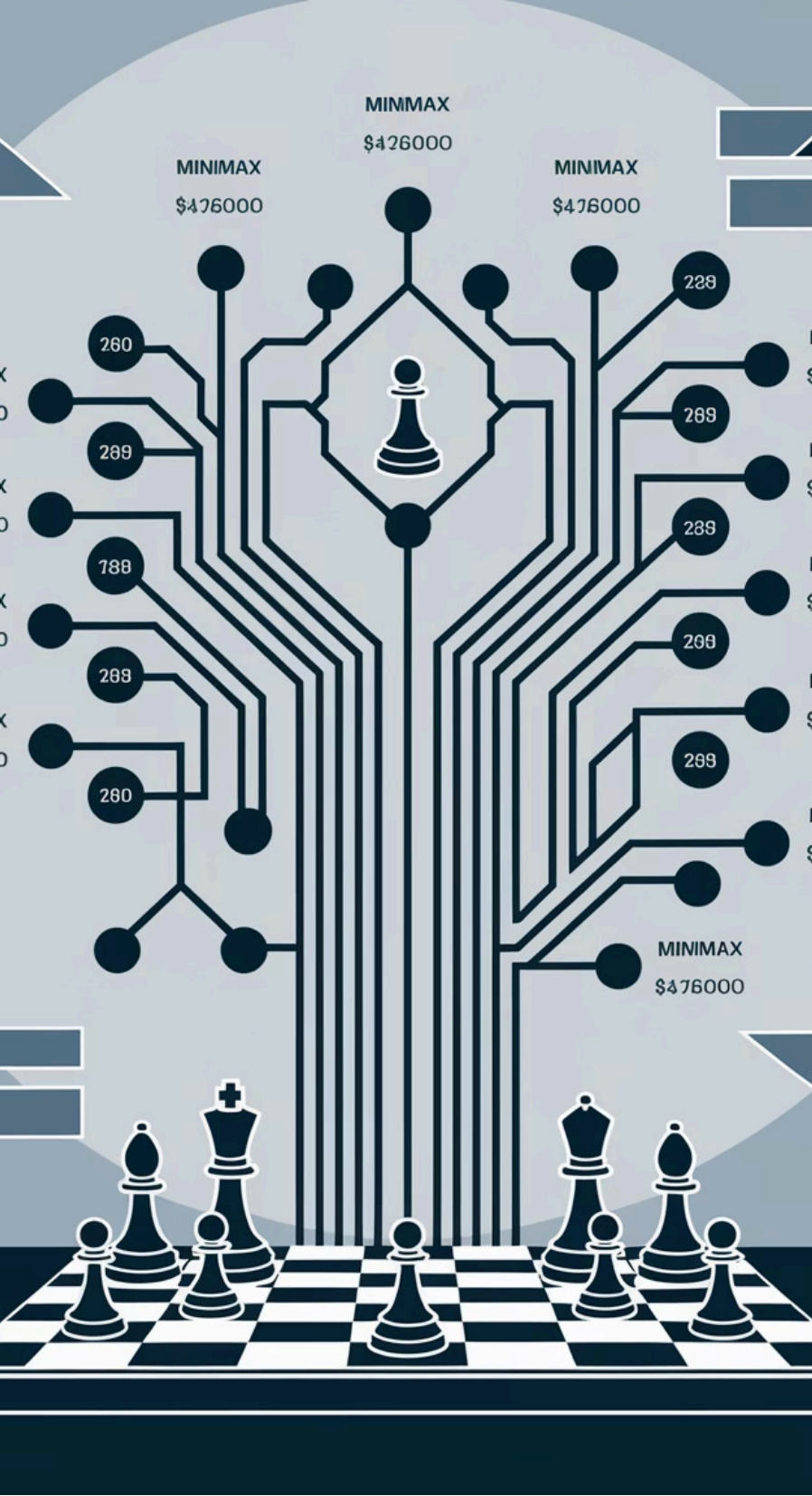They construct **2D maps** of their environment

Navigation Algorithms

Use algorithms like:

- **A search***

- **Breadth-first search**

These help the robot move efficiently between locations

Game Trees as Graphs

Game Representation

Two-player games like **chess** or **tic-tac-toe** use **game trees**
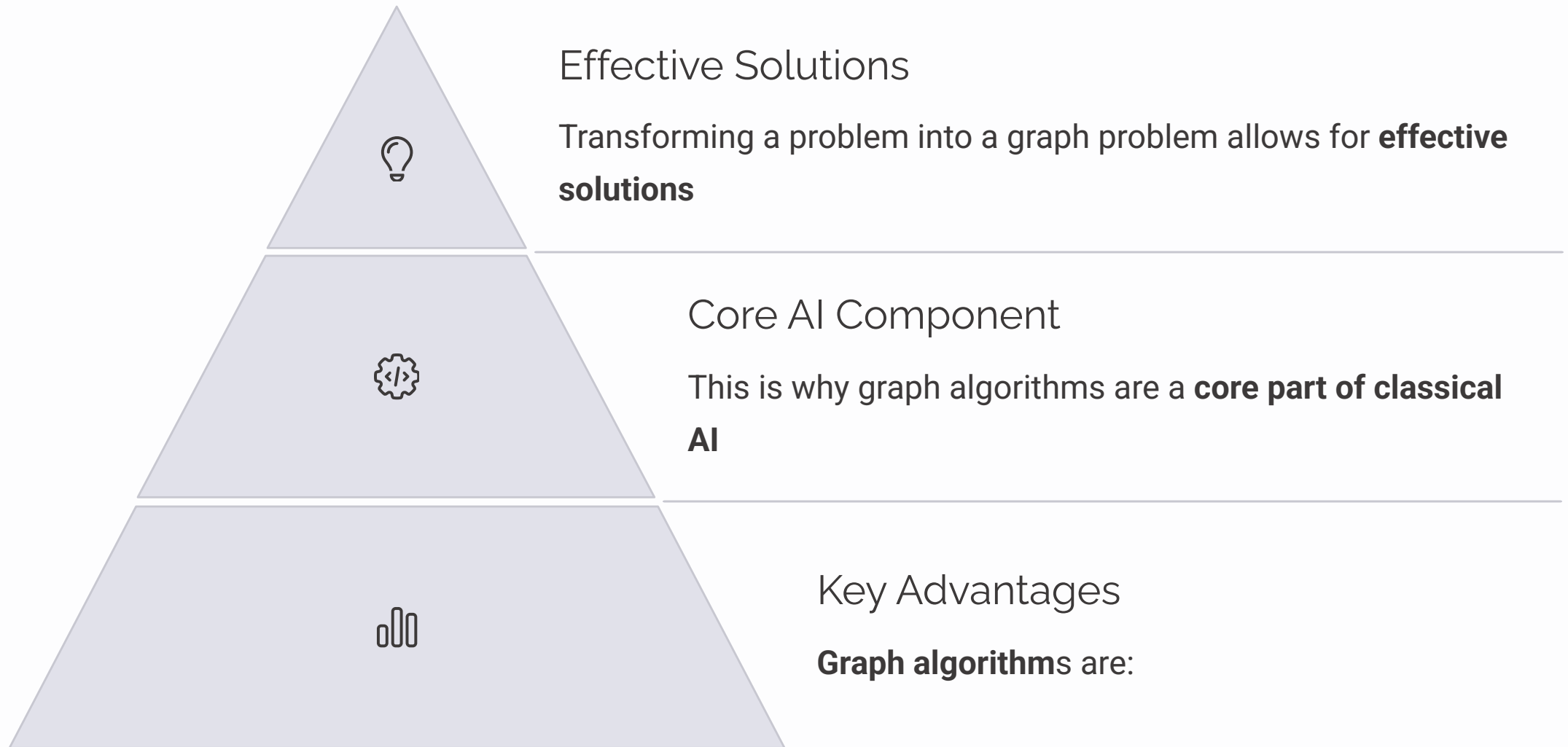
A **game tree is** essentially a **graph**

Problem Transformation

Solving game strategies = solving graph problems

Common Techniques

- Graph traversal
- Shortest path finding
- Spanning tree calculations

Why Graph Algorithms Matter in AI

Effective Solutions

Transforming a problem into a graph problem allows for **effective solutions**

Core AI Component

This is why graph algorithms are a **core part of classical AI**

Key Advantages

Graph algorithms are:

- Well-understood
- Efficient
- Flexible to model various problems

Beyond Graphs – Metaheuristics and AI History

⧖ Genetic Algorithms

Evolutionary approach to **optimization problems**

🌡 Simulated Annealing

Probabilistic technique for **approximating global optimum**

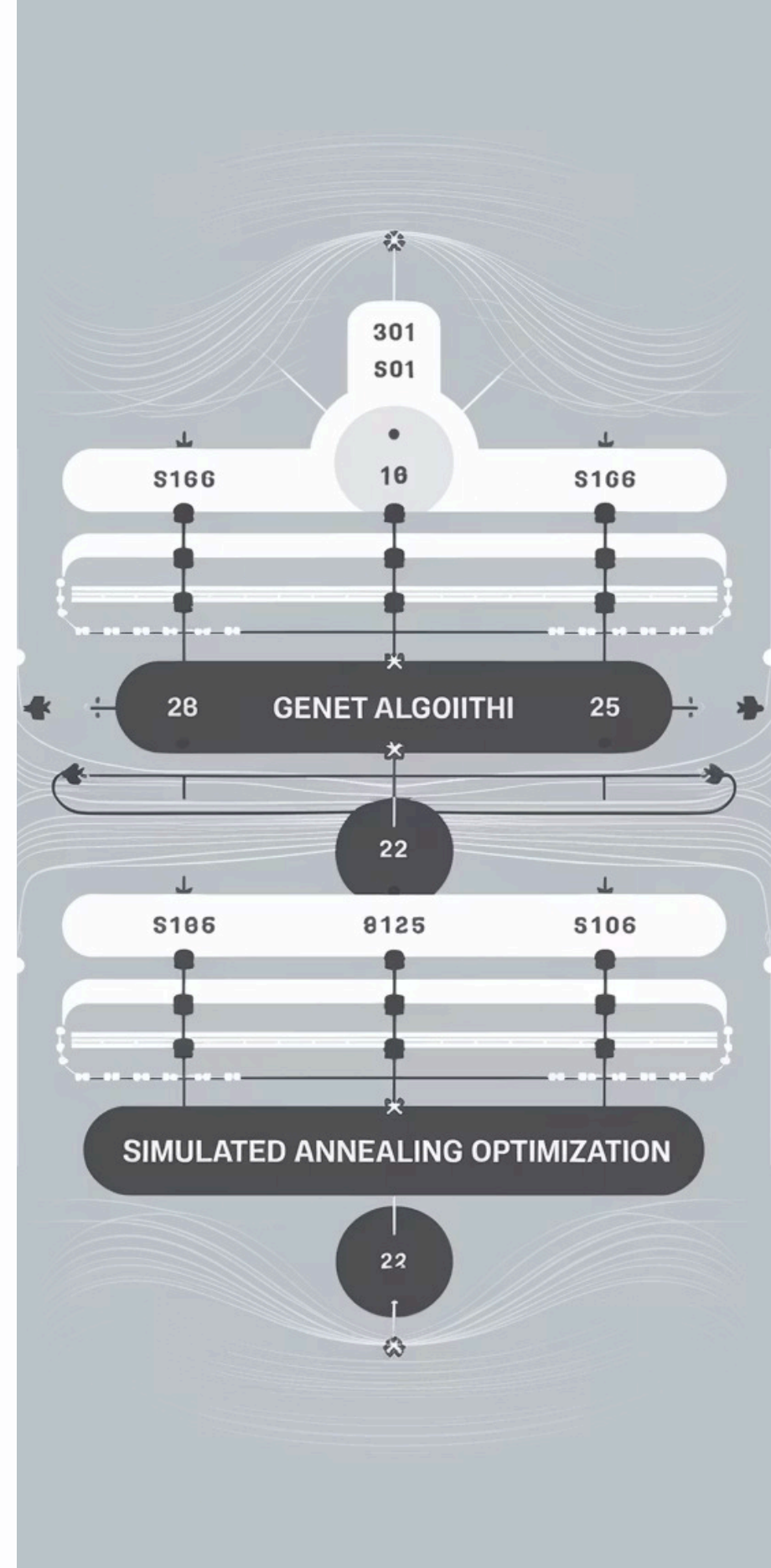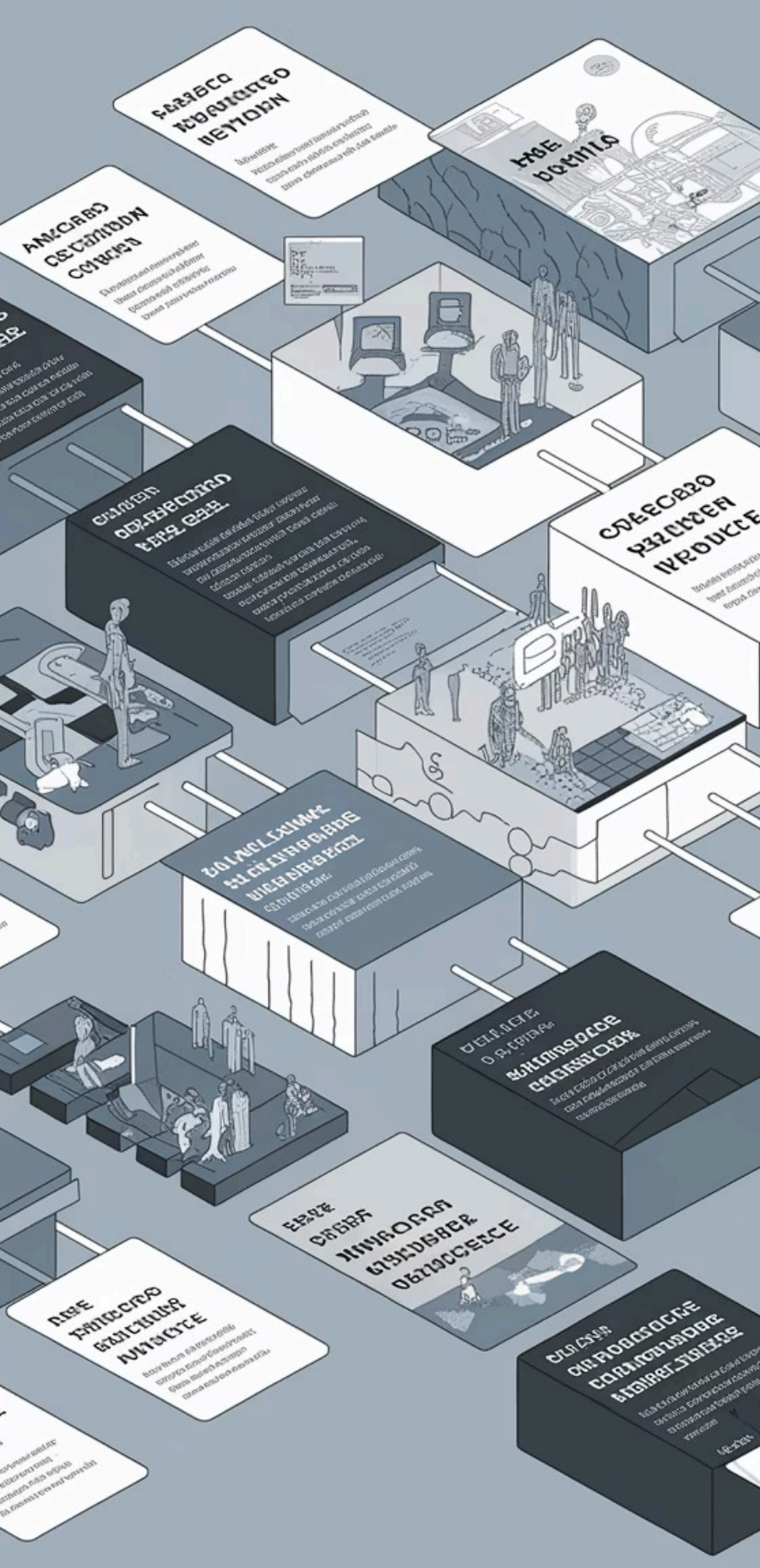### ▭ Historical Context

Before the rise of **deep learning**, **graph algorithms and metaheuristics** were **dominant**.

We will also study **metaheuristic techniques**:

These are classical tools in AI for solving complex optimization problems

Then vs Now in Artificial Intelligence

1 — **30–50 years ago**

AI relied on **symbolic methods**

- **Graph algorithms**
- **Heuristics**

2 — Transition Period

Gradual shift from **symbolic** to **statistical methods**

3 — **Today**

AI often equals deep learning, thanks to **powerful GPUs**

Important to understand classical foundations to appreciate the evolution of AI

What's Next?

Graph Algorithm Fundamentals

Upcoming lessons will explore graph algorithms in detail

Implementation & Applications

We'll look at their structure, implementation, and use in AI problems

Advanced AI Techniques

This knowledge builds a strong base for understanding more advanced AI techniques