

Introductory Concepts for Artificial Intelligence and Machine Learning for Marketing

Concept 1: Rule-based Systems

Rule-based systems represent one of the earliest and most fundamental forms of artificial intelligence. They operate through explicitly defined **IF–THEN rules** created by human experts to automate decision-making. In marketing and other business domains, these systems can perform tasks such as loan approvals or product recommendations based on pre-established conditions.

Although **machine learning (ML)** has emerged as a more flexible and adaptive approach, rule-based systems remain relevant as simpler, more transparent AI tools. Their main limitation lies in their **rigidity and dependence on manual rule creation**—they cannot easily adapt to changing data or exceptions. For instance, a rule suggesting an umbrella for rain may fail under different weather nuances.

By contrast, ML systems are **probabilistic** and **data-driven**, learning from past patterns to predict future outcomes. Despite this, rule-based systems are still valuable for **fast, well-defined, or expert-driven applications**, especially in marketing, where they often serve as the foundation before integrating ML models.

Concept 2: Inference Engines

An **inference engine** is a core component of an AI or machine learning (ML) system that applies logical rules to data to infer or predict outcomes. It typically operates alongside two other components: a **database** that stores facts and data, and a **user interface** that enables interaction with the system.

Originally developed for **expert systems**, inference engines relied on human experts to define and analyze rules. Today, ML algorithms can perform these tasks automatically, updating the knowledge base as new data arrives. Inference engines use two reasoning methods: **forward chaining**, which deduces future outcomes from known facts, and **backward chaining**, which starts from a goal and determines the necessary conditions to achieve it.

They are widely used in applications such as **classification, medical diagnosis, financial analysis, credit scoring, chemical analysis, and product design**. The main distinction from traditional rule-based systems is that an inference engine can **generate and apply its own rules**, whereas rule-based systems depend entirely on predefined, human-specified rules.

Concept 3: Hierarchical Learning

A **heuristic** is a form of experiential or intuitive knowledge expressed as an algorithm. It represents a **practical reasoning shortcut**—a strategy humans use to make decisions faster and more efficiently, often without full information. Heuristics may not always yield the optimal solution but typically produce a satisfactory and timely one. Common heuristic methods include **trial and error, rules of thumb, educated guesses, and workarounds**.

In marketing, heuristics can guide strategic decisions; for example, recognizing that warmer weather increases sales of water, cold foods, and swimwear. Such experiential rules can serve as a **foundation for machine learning algorithms**, which then refine predictions quantitatively.

Heuristic knowledge reflects the **imperfect, “fuzzy” nature of human cognition**—it is sometimes biased or inaccurate, yet it fuels **creativity, innovation, and non-linear progress**. Many great human achievements emerge from this imperfect reasoning, illustrating that progress often stems from intuitive leaps rather than strictly logical systems.