**Reasoning and Problem-Solving Techniques**

Reasoning in AI is the process of solving problems by drawing conclusions based on info gained and logic. There are different reasoning approaches that are used to solve problems in different scenarios, the reasoning methods that will be compared in this essay will be heuristic reasoning and Bayesian reasoning. This essay compares the 2 different methods and explores their core principles and analyzes how they are used in problem-solving with AI.

**Heuristic Reasoning**

The fundamental idea of heuristic reasoning is the process of finding quick solutions by applying experience-based strategies and basic logic. It does not guarantee the best and most efficient solution but provides an answer in reasonable time. It works by breaking down complex problems into smaller parts; it also prioritizes speed over in-depth analysis. It solves problems by relying on previous experiences. Heuristic usually goes for a good enough rather than the best solution possible.

**Uses in AI**

In AI, heuristic reasoning is used in:

• **Searching algorithms:** Methods like A\* algorithm use heuristics to estimate the best path to a target state.

• **Optimization problems:** Methods or algorithms to find satisfactory solutions in large search spaces.

**Bayesian Reasoning**

The fundamental of Bayesian reasoning is an approach based on probabilities; it involves a mathematical formula to update the probability estimate for a hypothesis as new evidence or new information becomes available. Bayesian usually requires a large amount of data as it calculates the probability; it also prioritizes accuracy.

**Uses in AI**

In AI, Bayesian reasoning is used in:

• **Machine Learning Algorithms:** Used in Naïve Bayes classifiers and Bayesian regression uncertainty in predictions.

• **Probabilistic models:** Used in Bayesian networks to represent variables and their dependencies for reasoning under uncertainty.

| **Aspect** | **Heuristic Reasoning** | **Bayesian Reasoning** |
| --- | --- | --- |
| **Definition** | Experience-based shortcuts for quick decision-making. | Probabilistic approach updating beliefs with new evidence. |
| **Core Principle** | Simplification and efficiency over exhaustive analysis. | Bayes’ Theorem for probabilistic inference and updating. |
| **Approach** | Uses rules of thumb and intuition. | Relies on mathematical probability and statistical data |
| **Data Requirements** | Can operate with limited or qualitative data. | Requires quantitative data for probability assessments. |
| **Handling Uncertainty** | Often overlooks uncertainties due to simplification. | Explicitly quantifies and incorporates uncertainty. |
| **Accuracy vs. Efficiency** | Prioritizes speed; may sacrifice accuracy. | Prioritizes accuracy; may require more computation. |
| **Cognitive Biases** | Susceptible to biases and errors due to oversimplification. | Aims to minimize biases through formal updating; priors may bias. |
| **AI Applications** | Search algorithms, optimization problems, expert systems. | Probabilistic models, machine learning, robotics. |
| **Strengths** | Fast, simple, and practical for immediate problem-solving. | Accurate, robust to uncertainty, and continuously learning. |
| **Limitations** | May not find optimal solutions; can overfit to known scenarios. | Computationally intensive; sensitive to prior assumptions. |
| **Best Used When** | Quick decisions are needed; limited data; low-stakes situations. | Precision is crucial; ample data; managing uncertainty is key. |

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