Introduction

- Logic is the study of reasoning and a core element of AI.
- Monotonic reasoning is a type of reasoning where the addition of new information can only increase the set of conclusions that can be drawn.
- Non-monotonic reasoning is a type of reasoning where the addition of new information can either increase or decrease the set of conclusions.

Monotonic Reasoning

- Example: If we know that “all birds have feathers” and that “Tweety is a bird,” then we can conclude that “Tweety has feathers.” Even if we add the premise that “Tweety is a penguin,” the conclusion that “Tweety has feathers” remains valid.
- In monotonic reasoning, if a conclusion can be drawn from a set of premises, then that conclusion will still be valid even if more premises are added.
- This is a fundamental property of classical logic, including propositional and first-order logic.

Non-monotonic Reasoning

- In non-monotonic reasoning, adding new information can invalidate previously drawn conclusions.
- This type of reasoning is often used in commonsense reasoning, where knowledge is incomplete and subject to change.
- Example: If we know that “birds typically fly” and that “Tweety is a bird,” we might conclude that “Tweety can fly.” However, if we add the premise that “Tweety is a penguin,” we need to retract the conclusion that “Tweety can fly.”

Types of Non-monotonic Reasoning

- Default reasoning: This type of reasoning uses default rules or assumptions that are assumed to be true unless there is evidence to the contrary.
- Circumscription: This is a formalism for specifying which predicates are assumed to be false unless they are explicitly stated to be true.
- Closed-world reasoning: This type of reasoning assumes that any fact not explicitly stated in the knowledge base is false.

Applications of Non-monotonic Reasoning

- Commonsense reasoning: Modeling how humans reason about everyday situations.
- Diagnosis: Reasoning about the possible causes of observed symptoms.
- Planning: Reasoning about the effects of actions in incompletely known environments.

Conclusion

- Monotonic and non-monotonic reasoning are fundamental concepts in AI.
- Non-monotonic reasoning is particularly important for modeling human-like commonsense reasoning.
- Understanding these concepts is important for building AI systems that can reason effectively in complex and uncertain environments.

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