

Descriptions

Please use deductive, inductive and abductive reasoning abilities to answer these questions.

Deductive Reasoning	Inductive Reasoning	Abductive Reasoning
Fact1: (Tom, parentOf, Amy) Fact2: (Bob, childOf, Alice) Fact3: (Lisa, sisterOf, Alice) Fact4: (Alice, motherOf, Bob) Rule: $\forall x, y, z: \text{sisterOf}(x, y) \wedge \text{motherOf}(y, z) \rightarrow \text{auntOf}(x, z)$ Q: True or False? (Lisa, auntOf, Bob) A: True	Fact1: (Tom, parentOf, Amy) Fact2: (Alice, parentOf, Bob) Fact3: (Bob, childOf, Alice) Fact4: (Amy, childOf, Tom) Q: $\forall x, y: ?(x, y) \rightarrow \text{childOf}(y, x)$ A: $\forall x, y: \text{parentOf}(x, y) \rightarrow \text{childOf}(y, x)$	Fact1: (Lisa, sisterOf, Alice) Fact2: (Alice, motherOf, Bob) Fact3: (Bob, childOf, Tom) Rule1: $\forall x, y, z: \text{sisterOf}(x, y) \wedge \text{motherOf}(y, z) \rightarrow \text{auntOf}(x, z)$ Rule2: $\forall x, y: \text{parentOf}(x, y) \rightarrow \text{childOf}(y, x)$ Q: Explain (Lisa, auntOf, Bob) A: Fact1, Fact2 $\xrightarrow{\text{Rule1}}$ (Lisa, auntOf, Bob)

- **Deductive reasoning** is a logical process in which a conclusion can be derived from given premises or principles, meaning predicting new facts based on existing facts and logical rules. For example, given the two facts (Lisa, sisterOf, Alice) and (Alice, motherOf, Bob) along with a logical rule $\forall x, y, z: \text{sisterOf}(x, y) \wedge \text{motherOf}(y, z) \rightarrow \text{auntOf}(x, z)$, the new fact (Lisa, auntOf, Bob) can be derived through deductive reasoning. The task is to predict the True/False of a predicted fact given facts and rules.
- **Inductive reasoning** involves making generalizations based on specific observations or evidence. In other words, a logical rule can be induced from given facts. For instance, given a set of observations that person A is the parent of person B and person B is the child of person A, inductive reasoning is to conclude the logical rule $\forall x, y: \text{parentOf}(x, y) \rightarrow \text{childOf}(y, x)$. Given multiple facts with similar patterns and a rule template, the goal is to induce a rule that entails these facts.
- **Abductive reasoning** is a logical process of seeking a hypothesis that best fits or explains a set of observations. For example, given a lot of facts including (Lisa,

sisterOf, Alice) and (Alice, motherOf, Bob), along with a set of logical rules including $\forall x, y, z : \text{sisterOf}(x, y) \wedge \text{motherOf}(y, z) \rightarrow \text{auntOf}(x, z)$, if we observe Lisa is Bob's aunt, one possible explanation is that Lisa is Alice's sister and Alice is Bob's mother. Given a *theory* including facts and logical rules, the task is to select specific facts and a logical rule from the given theory to explain the *observation*.