Assignment Eight: Inference with FOL

Brandon Trinkle

Arizona State University

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Professor Durgesh Sharma

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**Given Knowledge Representation in FOL**

The knowledge provided describes how various environmental and structural factors contribute to increased carbon dioxide (CO₂) production in Phoenix due to a specific concrete and glass building, Building XYZ. Below are the FOL representations for each statement:

1. The city of Phoenix has a concrete, glass building called Building XYZ.
   1. Symbols:
      1. XYZ: Represents Building XYZ.
      2. Phoenix: Represents the city of Phoenix.
   2. Predicates:
      1. CGBuilding(XYZ): XYZ is a concrete and glass building.
      2. City(Phoenix): Phoenix is a city.
      3. In(XYZ, Phoenix): Building XYZ is in Phoenix.
2. Phoenix is in a desert.
   1. Symbols:
      1. Desert: Represents a desert environment.
   2. Predicates:
      1. In(Phoenix, Desert): Phoenix is located in a desert.
3. Cities in deserts have more sunlight and heat.
   1. Rule: In(x, Desert) ⇒ MoreSunlightHeat(x): If a city x is in a desert, it has more sunlight and heat.
4. A concrete and glass building in a desert city receives more sunlight and heat.
   1. Rule: CGBuilding(x) ∧ In(x, c) ∧ In(c, Desert) ⇒ MoreSunlightHeat(x): If a concrete and glass building x is in city c, and city c is in a desert, then the building receives more sunlight and heat.
5. The more sunlight and heat a concrete glass building receives, the higher its inner temperature becomes.
   1. Rule: MoreSunlightHeat(x) ⇒ HigherTemperature(x): If a building x receives more sunlight and heat, its temperature becomes higher.
6. Concrete glass buildings with high temperatures use AC to lower the temperature.
   1. Rule: CGBuilding(x) ∧ HigherTemperature(x) ⇒ Use(x, AC): If a concrete and glass building x has a higher temperature, it uses air conditioning (AC).
7. When a building has higher temperature and uses the AC, it consumes more energy.
   1. Rule: HigherTemperature(x) ∧ Use(x, AC) ⇒ MoreEnergy(x): If a building x has a higher temperature and uses AC, it consumes more energy.
8. When the building consumes more energy, it produces more carbon dioxide in the city.
   1. Rule: MoreEnergy(x) ∧ In(x, c) ∧ City(c) ∧ CGBuilding(x) ⇒ ProduceMoreCO₂(c): If a concrete and glass building x consumes more energy and is located in city c, it causes more CO₂ production in that city.

**Inference Task**

We will use Forward Chaining to infer that Phoenix will have increased CO₂ production due to the concrete and glass building, Building XYZ.

1. Initial Facts:
   1. CGBuilding(XYZ): XYZ is a concrete and glass building.
   2. City(Phoenix): Phoenix is a city.
   3. In(XYZ, Phoenix): XYZ is in Phoenix.
   4. In(Phoenix, Desert): Phoenix is in a desert.
2. Inference Process:
   1. Apply Rule 3: In(Phoenix, Desert) ⇒ MoreSunlightHeat(Phoenix).
      1. *Result*: MoreSunlightHeat(Phoenix).
   2. Apply Rule 4: CGBuilding(XYZ) ∧ In(XYZ, Phoenix) ∧ In(Phoenix, Desert) ⇒ MoreSunlightHeat(XYZ).
      1. *Result*: MoreSunlightHeat(XYZ).
   3. Apply Rule 5: MoreSunlightHeat(XYZ) ⇒ HigherTemperature(XYZ).
      1. *Result*: HigherTemperature(XYZ).
   4. Apply Rule 6: CGBuilding(XYZ) ∧ HigherTemperature(XYZ) ⇒ Use(XYZ, AC).
      1. *Result*: Use(XYZ, AC).
   5. Apply Rule 7: HigherTemperature(XYZ) ∧ Use(XYZ, AC) ⇒ MoreEnergy(XYZ).
      1. *Result*: MoreEnergy(XYZ).
   6. Apply Rule 8: MoreEnergy(XYZ) ∧ In(XYZ, Phoenix) ∧ City(Phoenix) ∧ CGBuilding(XYZ) ⇒ ProduceMoreCO₂(Phoenix).
      1. *Result*: ProduceMoreCO₂(Phoenix).

Through Forward Chaining, it is deduced that the city of Phoenix will experience increased CO₂ production due to the concrete and glass building, Building XYZ. Each rule systematically applies knowledge about the building's environmental and structural characteristics to reach the final inference, demonstrating how the interconnected nature of environmental factors leads to this outcome. Specifically, this reasoning starts by identifying Phoenix as a desert city, where increased sunlight and heat affect the buildings within it. Building XYZ, being a concrete and glass structure, absorbs more heat, which raises its internal temperature, necessitating the use of air conditioning to maintain a comfortable environment.