

Knowledge Representation with First-Order Logic

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We will show how to harness the representation power of First-order logic (FOL) to represent the kinship domain (familial relationships).

Kinship Domain Description

Objects in the kinship domain are people.

Objects (People) in the kinship domain have a biological property: Male or Female.

Relations in the kinship domain include Parent, Father, Mother, Grandparent, Grandmother, Grandfather, Spouse, Husband, Wife, Child, Daughter, Son, Sibling, Brother, Sister, Cousin, Aunt, Uncle, etc.

A person's **Mother** is one's parent who is a female.
Father is defined similarly.

A person's **Husband** is a person's male spouse.
A person's **Wife** is defined similarly.

If A is the **Parent** of B, then B is the **Child** of A.

The **Grandparent** of A is the parent of A's parent.

A **Sibling** of A is another child for the parent of A.

**Let us use First-Order
Logic to represent
each of these axioms.**

A person's **Mother** is one's parent who is a female.
Father is defined similarly.

$$\forall m, x \text{ Mother}(x) = m \iff \text{Parent}(m, x) \wedge \text{Femal}(m)$$

$$\forall f, x \text{ Father}(x) = f \iff \text{Parent}(f, x) \wedge \text{Male}(f)$$

A person's **Husband** is a person's male spouse.
A person's **Wife** is defined similarly.

$$\forall h, w \text{ Husband}(h, w) \iff \text{Spouse}(h, w) \wedge \text{Male}(h)$$

$$\forall h, w \text{ Wife}(w, h) \iff \text{Spouse}(w, h) \wedge \text{Female}(w)$$

If A is the **Parent** of B, then B is the **Child** of A.

$$\forall p, c \text{ Parent}(p, c) \iff \text{Child}(c, p)$$

The **Grandparent** of A is the parent of A's parent.

$$\forall g, c \text{ Grandparent}(g, c) \iff \exists p \text{ Parent}(g, p) \wedge \text{Parent}(p, c)$$

A **Sibling** of A is another child for the parent of A.

$$\forall s, c \text{ Sibling}(s, c) \iff \exists p \text{ Parent}(p, c) \wedge \text{Parent}(p, s)$$

First-Order Logic provides means to **represent** the world as **objects** with **properties** and **relations** among them, as well as representing **rules** that apply to the objects.