

Artificial Intelligence: Exercise 5

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1. Let the three-place predicate “Child” and the one-place predicate “Female” from the family tree example in the lecture be given.

Define:

- (a) A one-place predicate “Male”.
 - (b) A two-place predicate “Father” and “Mother”.
 - (c) A two-place predicate “Siblings”.
 - (d) A predicate “Parents(X, Y, Z)”, which is true if and only if X is the father and Y is the mother of Z .
 - (e) A predicate “Uncle(X, Y)”, which is true if and only if X is the uncle of Y (use the predicates that have already been defined).
 - (f) A two-place predicate “Ancestor” with the meaning: ancestors are parents, grandparents, etc. of arbitrarily many generations.
2. Adapt Exercise 1 (b) and replace the predicate “Mother” by a one-place function symbol. How can the function be defined using the predicates Female(X) and Child(X, Y, Z)?

Solution:

$$\forall X \forall Y \exists Z X = \text{mother}(Y) \Leftrightarrow \text{Female}(X) \wedge \text{Child}(Y, X, Z)$$

3. Formalize the following statements in predicate logic:
 - (a) Every person has a father and a mother.
 - (b) Some people have children.
 - (c) All birds fly.
 - (d) There is an animal that eats (some) plant-eating animals.
 - (e) Every animal eats plants or plant-eating animals which are much smaller than itself.
4. Give predicate logic axioms for the two-place relation “ $<$ ” as a total order. For a total order we must have (1) Any two elements are comparable. (2) It is asymmetric. (3) It is transitive.