Ontology of the Alpine-Club World

- **Individuals** (represented in FOL by constants)

  > tony, mike, john, ann, ...
  > alpine-club, polar-club, ...
  > rain, snow, ...
  > skis1, skis2, skis3, ...
  > mtn-climbing-gear1, mtn-climbing-gear2, ...

- **Types** (i.e., expressed by "*x* is a *y*", i.e., NP+be+NP)
  > > (represented in FOL by 1-place predicates)

  > Person, Club, Man, Woman, Weather, Skis, Skier, Mtn-Climber, Athlete, ...

- **Attributes** (i.e., expressed by "*x* is *y*", i.e., NP+be+Adj)
  > > (represented in FOL by 1-place predicates)

  > Red, Tall, Rich, ...

- **Relations** (represented in FOL by *n*-place predicates, where *n* > 1)

  > Belong, Member, Likes, Married, ...

- **Functions** (represented in FOL by *n*-place function symbols)

  > the-skis-of, the-father-of, ...

- **Basic Facts** (represented in FOL by "literals": atomic wffs or negations of atomic wffs)

  > Person(john)
  > Man(john)
  > Woman(ann)
  > Club(alpine-club)
  > Weather(rain)
  > Skis(skis2)
  > Skier(ann)
  > ¬Mtn-Climber(ann)
  > Married(ann, john)
  > Skis(the-skis-of(ann))
  > the-skis-of(ann) = skis2
  > Belong(alpine-club, tony)
  > Belong(alpine-club, mike)
  > Belong(alpine-club, john)
  > ...

- **Complex Facts**

  1. $\forall x[\text{Belong(alpine-club}, x) \wedge \neg \text{Skier}(x) \supset \text{Mtn-Climber}(x)]$
  2. $\forall x[\text{Mtn-Climber}(x) \supset \neg \text{Likes(rain}, x)]$
  3. $\forall x[\neg \text{Like(snow}, x) \supset \neg \text{Skier}(x)]$
  4. $\forall x[\text{Like}(x, \text{tony}) \supset \neg \text{Like}(x, \text{mike})]$
  5. $\forall x[\neg \text{Like}(x, \text{tony}) \supset \text{Like}(x, \text{mike})]$
  6. $\forall x \forall y[\text{Member}(x, y) \equiv \text{Belong}(x, y)]$
     - (a "full definition")

and:

incomplete information:	Member(alpine-club, ann) $\vee$ Member(polar-club, ann)	
closure information:	$\forall x[\text{Person}(x) \supset x = \text{ann} \vee x = \text{mike} \vee x = \text{tom} \vee \ldots]$	
terminological facts (general rules):	$\forall x[\text{Man}(x) \supset \neg \text{Woman}(x)]$	disjointness
	$\forall x[\text{Man}(x) \supset \text{Person}(x)]$	subtypes/supertypes
	$\forall x[\text{Person}(x) \supset \text{Man}(x) \vee \text{Woman}(x)]$	exhaustiveness
	$\forall x[\text{Married}(x, y) \supset \text{Married}(y, x)]$	symmetry (etc.)(*)
	$\forall x \forall y[\text{Member}(x, y) \supset \text{Person}(y)]$	type restriction
	$\forall x[\text{Member(polar-club}, x) \supset \text{Woman}(x)]$	type restriction

(*)Can we say the following in FOL?

- Symmetric(Married)

- $\forall R \forall x \forall y[\text{Symmetric}(R) \equiv (R(x, y) \supset R(y, x))]$

Why?