

1. Applying resolution requires to convert sentences to conjunctive normal form (CNF). All propositional sentences have an equivalent 3-CNF sentence (each clause contains three distinct literals). Convert the following rule of the wumpus-world into a 3-CNF sentence: $R_3 : B_{2,1} \Leftrightarrow (P_{1,1} \vee P_{2,2} \vee P_{3,1})$.
2. Define the required predicates and represent the following sentences in first-order logic.
 - (a) Some students took French in spring 2012.
 - (b) Every student who takes French passes it.
 - (c) Only one student took Greek in spring 2012.
 - (d) The best score in Greek is always higher than the best score in French.
 - (e) There is a barber who shaves all men in town who do not shave themselves.
 - (f) A person born in the UK, each of whose parents is a UK citizen or a UK resident, is a UK citizen by birth.
 - (g) A person born outside the UK, one of whose parents is a UK citizen by birth, is a UK citizen by descent.
 - (h) Politicians can fool some of the people all of the time, and they can fool all of the people some of the time, but they can't fool all of the people all of the time.
3. Write axioms describing predicates: GrandChild, Brother, Daughter, Aunt, Uncle, BrotherInLaw, and FirstCousin.
4. Explain what is wrong with the proposed definition of the set membership predicate \in :

$$\forall x, s: x \in \{x \mid s\}$$

$$\forall x, s: x \in s \Rightarrow \forall y: x \in \{y \mid s\}.$$

5. For each pair of atomic sentences, give the most general unifier if it exists:
 - (a) $P(A, B, B)$ and $P(x, y, z)$
 - (b) $Q(y, G(A, B))$ and $Q(G(x, x), y)$
 - (c) $\text{Older}(\text{Father}(y), y)$ and $\text{Older}(\text{Father}(x), \text{John})$
 - (d) $\text{Knows}(\text{Father}(y), y)$ and $\text{Knows}(x, x)$