

# Knowledge Representation and Reasoning Project 1

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FMI, AI Master, Year 1

## 1. Resolution

Let us consider the following knowledge base:

- KB {
1. Every DOTA2 player is a gamer.
  2. There are DOTA2 players who are professional.
  3. Some professional DOTA2 players who purchase Divine Rapier lose games.
  4. Anyone who loses games gets angry.

We want to prove that the following Question is logically entailed from our KB by applying the Resolution algorithm:

5. Do some gamers who purchase Divine Rapier get angry?

### 1.1. Representing the KB in FOL (a)

The above written KB can be expressed in FOL in the following way:

- KB {
1.  $\forall x. DOTA2\_Player(x) \supset Gamer(x)$
  2.  $\exists x. DOTA2\_Player(x) \wedge Pro(x)$
  3.  $\exists x. PRO(x) \wedge Buys\_Rapier(x) \wedge Loses\_Games(x)$
  4.  $\forall x. Loses\_Games(x) \supset Gets\_Angry(x)$
  5.  $\exists x. Gamer(x) \wedge Buys\_Rapier(x) \wedge Gets\_Angry(x)$ .

For the sake of simplicity, we can write it in the following way:

- KB {
1.  $\forall x. P_1(x) \supset P_2(x)$
  2.  $\exists x. P_1(x) \wedge P_3(x)$
  3.  $\exists x. P_3(x) \wedge P_4(x) \wedge P_5(x)$
  4.  $\forall x. P_5(x) \supset P_6(x)$
  5.  $\exists x. P_2(x) \wedge P_4(x) \wedge P_6(x)$ .

**1.2. Proving manually that the Question is logically entailed from the KB (b)**

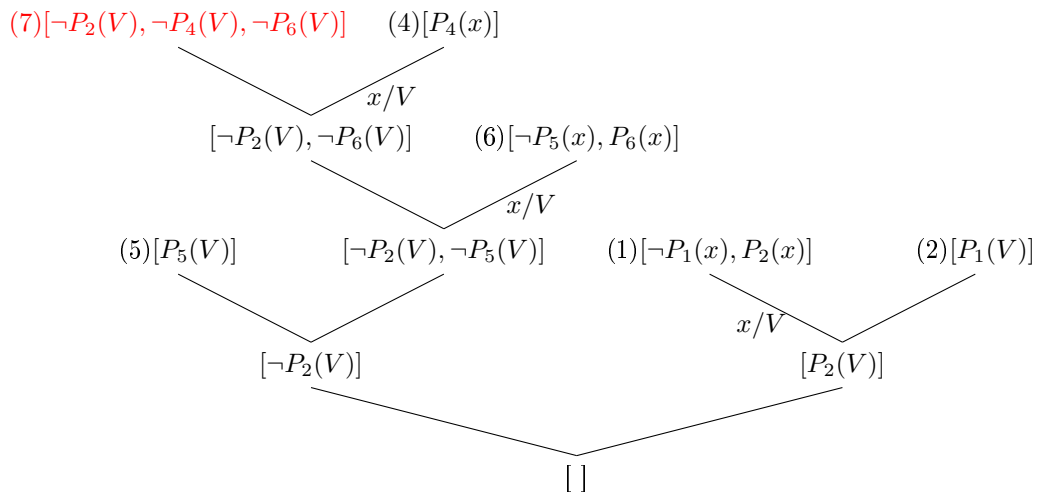
In order to apply the resolution algorithm, we must first transform the KB written in FOL in the conjunctive normal form (CNF), after which the following transformation happens:

$$\text{CNF} \left\{ \begin{array}{l} 1. \neg P_1(x) \vee P_2(x) \\ 2. P_1(V) \\ 3. P_3(V) \\ 4. P_4(V) \\ 5. P_5(V) \\ 6. \neg P_5(x) \vee P_6(x) \\ 7. P_2(V) \wedge P_4(V) \wedge P_6(V), \end{array} \right.$$

where V is a Skolem constant (we now have seven members in the list because we can "divide" into individual items logical sequences like number 2 from the last page:  $P_1(x) \wedge P_3(x)$  becomes 2.  $P_1(x)$  and 3.  $P_3(x)$ ).

Lastly, we need to prove that the negated form of the question that we want to prove is logically entailed from our KB is not satisfiable. After negating, our converted KB looks like this:

$$\text{CNF} \left\{ \begin{array}{l} 1. \neg P_1(x) \vee P_2(x) \\ 2. P_1(V) \\ 3. P_3(V) \\ 4. P_4(V) \\ 5. P_5(V) \\ 6. \neg P_5(x) \vee P_6(x) \\ 7. \neg P_2(V) \vee \neg P_4(V) \vee \neg P_6(V). \end{array} \right.$$



Thus, we have proven that the negated form of sentence 5 is unsatisfiable given our KB. In conclusion, the sentence: "Some gamers who purchase Divine Rapier get angry" is logically entailed from our KB.