Foundations of Artificial Intelligence

Prof. Dr. J. Boedecker, Prof. Dr. W. Burgard, Prof. Dr. F. Hutter, Prof. Dr. B. Nebel
T. Schulte, R. Rajan, S. Adriaensen, K. Sirohi
Summer Term 2021

University of Freiburg
Department of Computer Science

Exercise Sheet 5

Due: Friday, May 28, 2021

Exercise 5.1 (Resolution Method)

Given clause set K:

$$K = \{\{A, B, \neg C\}, \{\neg A, C\}, \{\neg A, \neg B\}, \{A, C\}\},$$

using the resolution method, show whether $K \models (\neg B \rightarrow (A \wedge C))$ holds.

Exercise 5.2 (Modeling, Proofs)

Consider the following knowledge base:

If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is immortal or a mammal, then it is horned. The unicorn is magical if it is horned.

Using this knowledge base, can you prove that the unicorn is (a) mythical, (b) magical or (c) horned? First, formalize the knowledge base with propositional logic. If a statement is valid or unsatisfiable, use resolution for prove. Else, write down one satisfying and one unsatisfying interpretation.

Exercise 5.3 (DPLL)

Use the Davis-Putnam-Logemann-Loveland (DPLL) procedure to check whether the given formulae ϕ_1 and ϕ_2 are satisfiable or not. Write down all steps carried out by the algorithm during the process. If you have to apply a splitting rule, split on variables in alphabetical order, trying *true* first, then *false*. Should the formula be satisfiable, please indicate the satisfying assignment.

(a)

$$\phi_1 = (D \vee C) \wedge (\neg A \vee \neg D \vee B \vee \neg C) \wedge (A \vee C) \wedge (\neg C \vee \neg B) \wedge (\neg C \vee B \vee \neg A \vee D) \wedge (C \vee \neg D \vee B) \wedge (\neg D \vee \neg B \vee \neg A)$$

B → F
C → T
A → F

(b)

$$\phi_2 = (D \vee \neg A \vee B) \wedge (\neg B \vee \neg C \vee A \vee D) \wedge (\neg B \vee \neg A) \wedge (B \vee \neg D) \wedge (A \vee C \vee \neg B) \wedge (\neg D \vee \neg C) \wedge (B \vee D)$$

Note: The exercise sheets may be worked on in groups of up to three students.