

Foundations of Artificial Intelligence

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Exercise Sheet 9

Due: May 5, 2021

Exercise 9.1 (3 marks)

In the lecture, we have shown that the resolution method can be used for reasoning by a reduction to testing unsatisfiability. In this way, use the resolution method to show that $\psi = (A \wedge D)$ follows logically from $\varphi = \{\{A, C\}, \{A, D\}, \{\neg A, D, E\}, \{\neg A, \neg E\}, \{B, \neg C\}, \{\neg B, \neg C, \neg E\}, \{\neg B, \neg D, E\}\}$, i.e., $\varphi \models \psi$. Compare the number of required resolution steps to the size (number of rows) of a truth table that verifies the same statement.

Exercise 9.2 (2 marks)

Perform DPLL on the clause set $\{\{A, \neg B\}, \{\neg A, B\}, \{B, \neg D\}, \{C\}, \{\neg C, \neg B, \neg D\}, \{C, D\}\}$, always picking the variable occurring in the highest number of clauses and always considering the assignment $v \mapsto \mathbf{T}$ first.

Exercise 9.3 (1 mark)

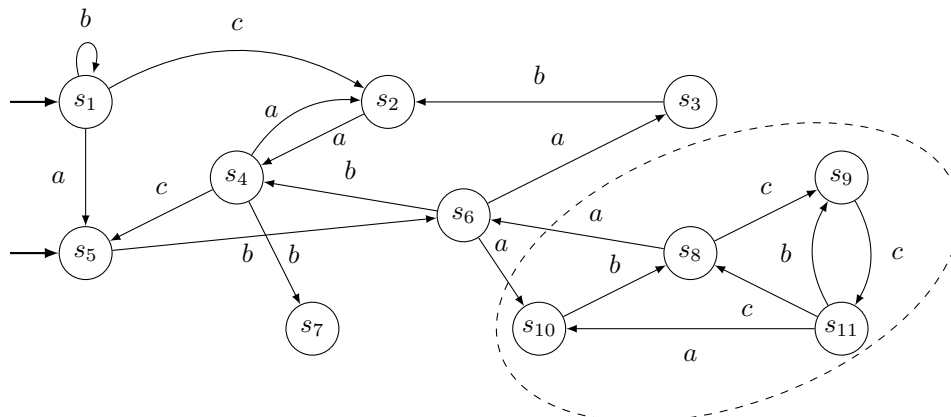
A *Dual-Horn formula* is a propositional formula in CNF where each clause contains *at most one negative literal*. Is the time complexity of DPLL on Dual-Horn formulas polynomial? Justify your answer.

Exercise 9.4 (1+1 mark)

- (a) If we would investigate the phase transition for SAT with a fixed clause size of 10, would it be more to the left (i.e. < 4.3 clauses per variable) or more to the right (i.e. > 4.3 clauses per variable) compared to the phase transition for 3-SAT (fixed clause size of 3)? Justify your answer.
- (b) Considering the phase transition for 3-SAT and your answer to (a), why do you think the formulas from Goldberg (1979) are in general easy to solve?

Exercise 9.5 (2 marks)

List all reasons why the following graph G with cost function $cost = \{a \mapsto \frac{1}{3}, b \mapsto -1.32, c \mapsto 0\}$ is not a valid state space:



Submission rules:

Upload a single PDF file (ending .pdf). If you want to submit handwritten parts, include their scans in the single PDF. Put the names of all group members on top of the first page. Use page numbers or put your names on each page. Make sure your PDF has size A4 (fits the page size if printed on A4).