

Foundations of Artificial Intelligence

Prof. Dr. B. Nebel, Prof. Dr. W. Burgard
C. Plagemann, P. Pfaff, D. Zhang, R. Mattmüller
Summer Term 2007

University of Freiburg
Department of Computer Science

Exercise Sheet 6

Due: Friday, June 8, 2007

Exercise 6.1 (Modeling in First-Order Logic)

Represent the following sentences in first-order logic, using a consistent vocabulary.

- (a) Some students attend an AI exercise group.
- (b) Every student who attends an AI exercise group passes the AI exam.
- (c) There is exactly one AI exercise group held in English.

Exercise 6.2 (Davis-Putnam Procedure)

Use the Davis-Putnam procedure to compute models for the following clause sets or to prove that no model exists. Whenever possible, apply the *pure symbol heuristic* (i.e. assignment of the corresponding value to variables always occurring with the same polarity) and *unit propagation*. At each step, indicate which rule you have applied.

- (a) $\{\{P, \neg Q\}, \{\neg P, Q\}, \{Q, \neg R\}, \{S\}, \{\neg S, \neg Q, \neg R\}, \{S, R\}\}$
- (b) $\{\{P, Q, S, T\}, \{P, S, \neg T\}, \{Q, \neg S, T\}, \{P, \neg S, \neg T\}, \{P, \neg Q\}, \{\neg R, \neg P\}, \{R\}\}$

Exercise 6.3 (Programming Assignment: Davis-Putnam Procedure)

Implement the Davis-Putnam procedure in one of the languages **Java**, **C** or **C++**¹, first as presented in the lecture (i.e. with *unit propagation* and *splitting*), afterwards extended by sophistications of your own choice.

Compare the running times of the variants of the Davis-Putnam procedure you implemented on the basis of the benchmark formulae from the lecture website². The formulae are encoded in the DIMACS input format³. The output of your program should conform to the DIMACS output format⁴. If the input formula is satisfiable your program should output a satisfying valuation.

Submit an archive file containing all source files you wrote (no binaries, but with a Makefile or similar, where necessary) to your tutors by e-mail. Document the code and point out which variants of the Davis-Putnam procedure you have implemented. Give a table showing the running times on the benchmark problems. Note that the difficulty of the benchmark formulae varies considerably and that you need not solve all problems.

The exercise sheets may and should be worked on in groups of three (3) students. Please write all your names and the number of your exercise group on your solution.

¹Other programming languages can be agreed upon with your tutor.

²<http://www.informatik.uni-freiburg.de/~ki/teaching/ss07/gki/exercises.html>

³<http://www.satlib.org/Benchmarks/SAT/satformat.ps>, Abschnitt 2.1

⁴<http://www.satlib.org/Benchmarks/SAT/satformat.ps>, Abschnitt 2.4