Automated Reasoning
Written test
12 February 2010 (I Session)

1 Exercise 1 (10)

Decide, using DPLL, whether the following set of clauses are satisfiable, and if
they are, provide a model

1. $\neg a \vee \neg b \vee x$, $\neg x \vee a$, $\neg x \vee b$, $\neg x \vee z$, $\neg b \vee z$, $\neg z \vee x \vee b$

2. $p \vee q$, $\neg p \vee \neg q$, $p \vee s$, $\neg p \vee \neg s$, $q \vee s$, $\neg q \vee \neg s$

2 Exercise 2 (20)

Prove the unsatisfiability of the following set of ordered clauses by Linear Ordered Resolution

1. $\neg D(x) \vee P(x)$

2. $\neg L(x, y) \vee \neg C(y) \vee D(x)$

3. $L(x, y) \vee D(x)$

4. $C(a)$

5. $\neg P(x)$

Use the last clause as top clause.

3 Exercise 3 (18)

Given the constraint network $\mathcal{N}$:

- Variables: {X,Y,Z,W}, Domain $D_x = D_y = D_z = \{0,1\}$ and $D_w = \{0,1,2\}$

- Constraints: $X > Y$, $X < W$, $X < Z$, $Y = Z$

describe an execution of AC-3. Is the resulting network arc consistent ? Is the
resulting network consistent ? Motivate your answers.

4 Exercise 4 (20)

Given the soft graph coloring problem below, apply the Branch and Bound algorithm to find an optimal solution. Use ordering $d = \{x_1, x_2, x_3, x_4\}$.

- Variables: $\{x_1, x_2, x_3, x_4\}$, Domain $D_i = \{0, 1\}$

- Constraints: $R_{12}, R_{13}, R_{23}, R_{24}$

- $F_{ij} : \{< (1,1), -1 >, < (0,1), 0 >, < (1,0), 0 >, < (0,0), -2 >\}$

5 Exercise 5 (32)

Given a combinatorial auction and the following set of bids:

- $B_1 = \langle \{1, 2, 3\}, 5 \rangle$, $B_2 = \langle \{1, 4, 6\}, 4 \rangle$, $B_3 = \langle \{4, 5\}, 1 \rangle$, $B_4 = \langle \{2, 5\}, 3 \rangle$

Answer to the following questions:

1. Provide a cost network formalisation of the winner determination problem, specifying the variables, their domain and the constraints (hard and soft).

2. Is the resulting cost network acyclic ? Motivate your answer

3. Solve the cost network with a solution technique of your choice.