Foundations of Constraint Programming

Exam Winter Semester 2013

Examiner: Sebastian Rudolph

11.02.2014, start: .... , duration: 30 minutes

Please write your student registration number on every sheet.

Name: Student registration number:
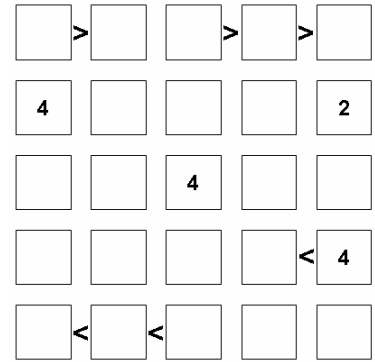
Task	Possible Points	Achieved Points
1	8	
2	8	
3	14	
Sum	30	

Task 1. (8 points)

Futoshiki, or *More or Less*, is a logic puzzle game from Japan. Its name means "inequality". The puzzle is played on a 5 x 5 square grid. The objective is to place the numbers 1 to 5 such that each row, and column contains each of the digits 1 to 5. Some digits are given at the start. In addition, inequality constraints are also initially specified between some of the squares, such that one must be higher or lower than its neighbour. These constraints must be honoured as the grid is filled out.

Formalize the Futoshiki problem on the right as a constraint satisfaction problem. Do **not** solve the problem (at least there will be no points for the solution).

□ >	□	□ >	□ >	□
4	□	□	□	2
□	□	4	□	□
□	□	□	□ <	4
□ <	□ <	□	□	□

Task 2.   (8 points)

Consider the follwoing CSP P with the linear ordering on the variables $y \prec x \prec u \prec z \prec v$:

$$\langle x + y = z, y > u, x < v, u < z; x, y \in [1..3], z \in [2..5], u, v \in [1..4]\rangle$$

a) Draw the graph associated to P.   (2 points)

b) For each node indicate its $\prec$-width.   (1 point)

c) What is the width of the graph?   (2 points)

d) What is the meaning/application of the width of a graph?   (3 points)

Task 3. (14 points)

Consider the following CSP P together with the ordering $y \prec x \prec z$:

$$\langle x > y, y > z, x \neq z; x \in \{1, 2, 3, 4\}, y \in \{1, 2, 3\}, z \in \{1, 2, 3, 4, 5\}\rangle$$

Give a *prop* labeling tree associated with P for the constraint propagation method MAC (Maintaining Arc Consistency).