Constraint Satisfaction Problems

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Exercise Sheet 1

Due: 29.10.2014

Exercise 1.1 (2+2 points)

(a) Solve the following Sudoku (http://sudoku.zeit.de/):

			2	4				
9		5			7		4	
8		7		5				2
		3			9	1	5	
7				6		8		3
				8				9
	6		8				3	
3	9	1		7	2	5		
					3			

(b) Explain briefly the methods you used to solved this puzzle.

Exercise 1.2 (2 points)
Let $R_{x,y} = \{(1,2),(1,3),(2,3)\}$ and $S_{z,y} = \{(1,3),(1,4),(2,1),(3,1)\}$.
Calculate the following relations:

(a) $R_{x,y} \bowtie S_{z,y}$

(b) $\sigma_{x=1}(R_{x,y} \bowtie S_{z,y})$

(c) $\pi_y(S_{z,y})$

(d) $R_{x,y} \circ S_{z,y}^{-1}$

Exercise 1.3 (4 points)
Let X be a non-empty set, and let R, S, T be binary relations on X. Prove or disprove (provide a counterexample) the following statements:

(a) $R \circ (S \cap T) = (R \circ S) \cap (R \circ T)$

(b) $(X^2 \setminus R)^{-1} = X^2 \setminus R^{-1}$

(c) $(R \circ S)^{-1} = R^{-1} \circ S^{-1}$

(d) $(R \circ S) \cap T^{-1} \neq \emptyset$ if and only if $(S \circ T) \cap R^{-1} \neq \emptyset$