Foundations of Constraint Programming
Tutorial 1 (on October 21st)

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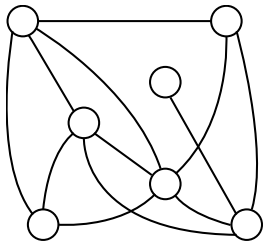
Exercise 1.1:
Consider the task of assigning to each node of a finite graph a color in such a way that no two adjacent nodes have the same color. Such an assignment is called a *coloring* of the graph. Formulate the problem of given only 3-colors as constraint satisfaction problem.

Exercise 1.2:
Consider the depicted graph (to the right), consisting of 7 nodes to which the numbers $1, \ldots, 7$ must be assigned. Each of the nodes has at least one neighbor, whereas the sum of all neighbors of a node must be the sum given in the following table. E.g. if 3 is the assigned node value, then its neighbors must sum up to 14.



node value	1	2	3	4	5	6	7
	=	=	=	=	=	=	=
sum of its neighbors	20	18	14	19	2	7	8

Formulate the riddle as CSP.

Exercise 1.3:
A coloring of a graph involving the minimal number of colors is called the *chromatic number* of the graph. Formulate the problem of finding the chromatic number of a graph as a constrained optimization problem.

Exercise 1.4:
Formulate the following problem as a constrained optimization problem: Place a minimum number of queens on the chess board so that each unoccupied field comes under attack.