Foundations of Constraint Programming
Tutorial 2 (on November 4th)

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Exercise 2.1:
Consider the following two CSPs

$$P_1 := \langle x + y \leq z, 4 \leq z < 6; x, y, z \in [2..6] \rangle$$
$$P_2 := \langle a < z, x + y = a, z \geq 5; a \in [4..6], x, y, z \in [2..6] \rangle$$

a) Assume the order $X = a, x, y, z$ between variables. Represent each constraint C of P_1 and P_2 as set of projections $d[Y]$, where $d \in [4..6] \times [2..6]^3$ and Y is the subsequence of X which exactly contains the variables mentioned in C (cf. Slide 3, Lecture 2).

b) Give all solutions to P_1 and P_2.

c) Are P_1 and P_2 equivalent? Are they equivalent with respect to some subsequence of $X = a, x, y, z$?

Exercise 2.2:
Consider the following Boolean constraints (see also Slide 22, Lecture 2):

$$\begin{aligned} i_1 \land o_2 &= y_1 \\ i_2 \land o_1 &= y_2 \\ \neg y_1 &= o_1 \\ \neg y_2 &= o_2 \end{aligned}$$

For the above constraints show two successful derivations using the Boolean constraint propagation rules given on Slides 23-24 (Lecture 2). For each derivation step you should underline the selected constraint and give the used rule. The initial CSPs are:

a) $\langle i_1 \land o_2 = y_1, i_2 \land o_1 = y_2, \neg y_1 = o_1, \neg y_2 = o_2; i_1 = 0, i_2 = 1 \rangle$

b) $\langle i_1 \land o_2 = y_1, i_2 \land o_1 = y_2, \neg y_1 = o_1, \neg y_2 = o_2; o_2 = 1, i_1 = 1 \rangle$

Exercise 2.3:
Consider the CSP from Slide 33, Lecture 2:

$$\langle x \cdot y = z; x \in [1..20], y \in [9..11], z \in [155..161] \rangle$$

Transform this CSP using the three Multiplication Rules from Slide 32 until you reach a fixed point. Give the selected constraint and the used rule for each derivation step.