Exercise 4

Foundations of Constraint Programming

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Exercise 4.1
Consider the following CSP:

\( x < y, x \neq z, y - x = z; x \in [1..4], y \in [1..4], z \in [2..3] \).

Apply the hyper-arc consistency rule (on page 10 of the 4\textsuperscript{th} series of slides) until it is closed under this rule. For each step, indicate the chosen constraint.

Exercise 4.2
Consider the following two CSPs with variables \( x, y, z, w \):

1) \( x \neq y, z = x \cdot y; x \in \{a, b\}, y \in \{b, c\}, z \in \{bb, cc\} \),
   where \( \cdot \) is string concatenation;

2) \( x \neq 10, x = y + 1, all\_different(x, y, z), x + y + z = w; \)
   \( x \in [10\ldots13], y \in [10\ldots12], z \in [10\ldots12], w \in [30\ldots33] \).

Answer the following questions, justifying your answer:

(a) Are these CSPs consistent?
(b) Are they node consistent?
(c) Are they arc consistent?
(d) Are they directional arc consistent wrt some linear ordering \( \prec \)? If so give the linear ordering.
(e) Are they hyper-arc consistent?

Note: all\_different constraint imposes the condition under which the specified variables are pairwise different.