Principles of Knowledge Representation and Reasoning

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Exercise Sheet 14

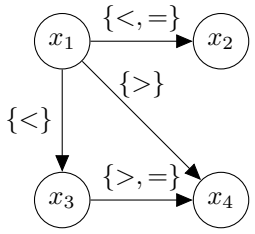
Due: February 13th, 2013

Exercise 14.1 (Point Algebra, 1+1)
Let $B = \{<, =, >\}$ be the point algebra base relations. In the following we interpret them over the set of integers $\mathbb{Z}$. Prove:

(a) The set B is not closed under composition.

(b) Any superset of relations $A' \supseteq B$ that is closed under composition is infinite.

Exercise 14.2 (Path Consistency, 3+1+1)
Consider the following constraint network over the point algebra:



The constraints are thus $x_1 \leq x_2$, $x_1 > x_4$, $x_1 < x_3$, and $x_3 \geq x_4$.

(a) Apply the path consistency algorithm to the network using the composition/converse table.

(b) Provide a solution for the network assuming domain $\mathbb{Q}$.

(c) Is there a non-empty domain for which the network has no solution?

Exercise 14.3 (Direction Relations, 1+4)
Consider the following five *direction relations* for points in the Euclidean plane $\mathbb{R}^2$:

- a I b, if a and b denote the same point.
- a N b, if a is north of b.
- a E b, if a is east of b.
- a S b, if a is south of b.
- a W b, if a is west of b.

We interpret these relations as given in Figure 1; for any two points we assign the most appropriate relation, that is, a point x is considered to be north of point y if it is more to the north than to the east, west, or south. Points that are exactly located on a line in Figure 1 are considered to be N in the upper half-plane and S in the lower half-plane.
From these five relations $\mathcal{A} = \{\mathrm{I}, \mathrm{N}, \mathrm{E}, \mathrm{S}, \mathrm{W}\}$ we obtain a JEPD relation system closed under converse.

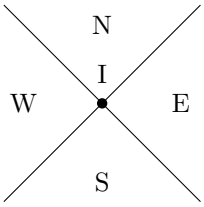


Figure 1: Direction relations in the Euclidean plane.

(a) Provide a formal definition for each of the five relations in $\mathcal{A}$.

(b) Provide a composition table for the five relations of $\mathcal{A}$.