Call-by-Need is Clairvoyant Call-by-Value: Erratum

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In Section 5, we stated that "$\times$ is the Cartesian product of lattices". This works for most things, but for our proof that common subexpression elimination is an improvement we need the following property to hold:

$$(k, f) \leq (0, k \triangleright f)$$

which is not true in general. The issue is that the ordering we have defined is simply the product ordering, which is not good enough. Instead, we should define the ordering like this:

$$(k, f) \leq (k', f') \Leftrightarrow k \geq k' \wedge \forall v. k \triangleright f(v) \leq k' \triangleright f'(v)$$

taking the cost expended earlier in the evaluation into account. This is still a lattice, with least-upper bounds calculated as follows:

$$\bigsqcup_{i \in I} (k_i, f_i) = (\min_{i \in I} k_i, \lambda v. \bigsqcup_{i \in I} (k_i - \min_{j \in I} k_j) \triangleright f_i(v))$$

The proofs of soundness, adequacy and compositionality should all still go through with only minor changes required. However, now when it comes to the proof of common subexpression elimination, our reasoning must be a little more subtle. We need to justify the following step in the proof:

$$\begin{aligned} & (1 + k \triangleright f((1, v))) \sqcup (1 \triangleright f(\bot)) \\ \geq & \\ & 1 \triangleright f((k + 1, v)) \end{aligned}$$

This will follow from the property that $k \triangleright f((l, v)) \sqcup f(\bot) \geq f((l + k, v))$, which can be proved by induction on the context that produced f.