Exercise Response - 3

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Important Definitions

- $\lesssim$ is the symbol for simulation
- $P \lesssim Q$ implies that if $P \to^{\alpha} P'$ then $\exists Q'$ such that $Q \to^{\alpha} Q'$ and $P' \mathcal{R} Q'$
- $P \lesssim Q$ means Q simulates P, intuitively that Q can do *everything* P can do
- $\sim$ is the symbol for bisimulation
- $P \sim Q$ implies that $P \lesssim Q$ and $Q \lesssim P$
- For all intents and purposes (from an outside perspective), if $P \sim Q$, then P and Q are identical

Knowledge Test

1. Prove that the empty relation is a bisimulation For $\sim$ to be a bisimulation, it must be true that for all $(P, Q) \in$, there must be P', α such that $P \to^{\alpha} P'$, and Q', α such that $Q \to^{\alpha} Q'$. Because $P, Q \notin$, there is actually nothing to prove.

2. Prove that the identity relation id (P id P for all P) is a bisimulation. Assume that we retain the identities of P, but create two copies: R, S. If there exists $Q' \in R$ such that $Q \to^{\mathcal{U}} Q'$, then it stands that there also exists $Q' \in S$ such that $Q \to^{\mathcal{U}} Q'$. Because these two processes have the same identity, then $Q' \in R$ is also a bisimulation of $Q' \in S$.

Now if we add any arbitrary attribute (state? transition?) Z to P, and thus both R and S, then it we can repeat the logic above to prove $R \cup Z \sim S \cup Z$.

Old explanation:

So I can understand this better, I'll rewrite this as * Prove that $P \sim P$, $\forall P$

To prove this, we can simply refer to the definition of bisimilarity, and note that it is innately reflexive in definition, such that $P \sim P$. Therefore, For all P, Q, if $P \sim Q$, then $Q \sim P$. Thus, $P \sim P$ for all P.

3. Prove that $a|a$ and $a.a$ are bisimilar Assume that we act invoke CCS's act rule on both processes. By definition, if $a|a \to^{a} X$, and $a.a \to^{a} Y$, $a|a$ and $a.a$ are bisimilar if $X = Y$ and $X \sim Y$.

In this case, $X = a|0$ which can be reduced to a, and $Y = 0$, so $X = Y$. Repeating this step on X and Y will yield the same results.

Sources and Materials

- https://homes.cs.washington.edu/~djg/msr_russia2012/sangiorgi.pdf
- http://pauillac.inria.fr/~leifer/teaching/mpri-concurrency-2005/c4/cours.pdf