Concurrent Programming - Exercises 5

Weak bisimilarity and observable congruence

1. Let

$$\begin{array}{rcl} Buffer & := & put?.get?.Buffer \\ BufferL & := & put?.pass!.BufferL \\ BufferR & := & pass?.get?.BufferR \end{array}$$

   Show $(BufferL|BufferR)\backslash\{pass!, pass?\} \approx (Buffer|Buffer)$.

2. Given the weak bisimilarity $\approx$

$$\approx = \bigcup_{\text{R weak bisimulation}} R$$

   Show that

   (a) $\approx$ is an equivalence.

   (b) $\approx$ is the largest weak bisimulation.

   (c) The weak bisimilarity is coarsest than the strong bisimilarity, i.e., $\sim \subsetneq \approx$.

3. Let

$$\begin{array}{rcl} CMB & := & coin?.coffee!.CMB + coin?.CMB \\ CS & := & pub!.coin!.coffee?.CS \\ UniBad & := & (CMB|CS)\backslash\{coin, cofee\} \end{array}$$

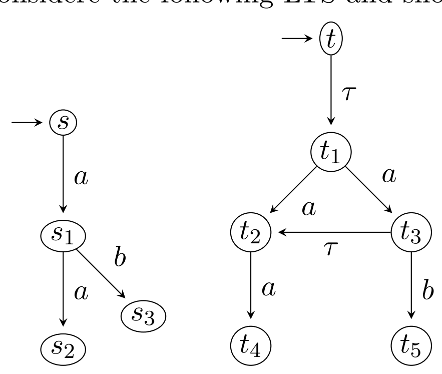
   Is true that $Spec \approx Unibad$ where $Spec := pub!.Spec$?

4. Show that for any $P, Q \in CCS$ and $\alpha \in Act$ the following equivalences hold:

$$\begin{array}{rcl} \alpha.\tau.P & \approx & \alpha.P \\ P + \tau.P & \approx & \tau.P \\ \alpha.(P + \tau.Q) & \approx & \alpha.(P + \tau.Q) + \alpha.Q \end{array}$$

   .

5. Considere the following LTS and show that $s \not\approx t$ using a weak bisimulation game.



6. Consider the following protocol $Protocol := acc?.del!.Protocol$ that corresponds to a comunication channel . Given the implemnetation

$$\begin{aligned}
Send &:= acc?.Sending \\
Sending &:= send!.Wait \\
Wait &:= ack?.Send + error?.Sending \\
Rec &:= trans?.Del \\
Del &:= del!.Ack \\
Ack &:= ack!.Rec \\
Med &:= send?.Med1 \\
Med1 &:= \tau.Err + trans!.Med \\
Err &:= error!.Med
\end{aligned}$$

show that $(Send|Med|Rec)\backslash\{send, error, trans, ack\} \approx Protocol$. Check with Pseuco.Com.

7. Show that $a.0 + 0 \not\approx a.0 + \tau.0$ and conclude that $\approx$ is not a congruence in CCS.

8. Let $\simeq$ be the observable congruence

   - $\tau.a \not\simeq a$
   - $P|\tau.Q \not\simeq \tau.(P|Q)$

9. Consider the following algorithms $MUTEX$ for mutual exclusivity.For each one:

   (a) Write it in CCS . Use $enter_i$ and $exits_i$ for $i = 1, 2$ to indicate the critical region.

   (b) Text with pseuco.com using random traces

   (c) Implement also in CAAL.

   (d) Consider also

   $$MutexSpec \;:=\; enter1.exit1.MutexSpec + enter2.exit2.MutexSpec$$

   Is true that $MUTEX \approx MutexSpec$?

   i) Peterson algorithm.
   For process P_i, $j, i = 1, 2$ and $i \neq j$.

   while true do
       noncricital actions
       $b_i \leftarrow$ **true;**
       $k \leftarrow j$**;**
       while $b_j \wedge k = j$ **do**
           skip;
       critical actions
       $b_i \leftarrow$ **false**

   ii) Hyman algorithm. Variables b_i are Boolean and k is an integer. For processes P_i, $j, i = 1, 2$ and $i \neq j$.

   while true do

noncricital actions
$b_i \leftarrow$ **true;**
while $k \neq i$ **do**
  while b_j **do**
    skip;
  $k \leftarrow i$**;**
critical actions;
$b_i \leftarrow$ **false**;

iii) Pnueli algorithm.

Variables y_i are Boolean and start in $false$ being local. The variable s is shared and has value 0 or 1 starting in 1. For process P_i and $i = 0, 1$:

while true do
  noncricital actions
  $y_i \leftarrow$ **true;**
  $s \leftarrow i$**;**
  while $\neg(y_{1-i} = 0 \vee (s \neq i))$ **do**
    skip;
  critical actions;
  $y_i \leftarrow$ **false**;