

Assignment 3 - CSI5109

1. A disk drive is to be shared among two concurrent users. However, they are not allowed to use it at the same time. In the following system, the OS uses a semaphore to ensure that only one user at a time can perform a read followed by a write operation:

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DiskSem[P,V] := P; V; DiskSem[P,V]
User[P, V, R, W] := P; R; W; V; User[P, V, R, W]
System[R1, W1, R2, W2] :=
  hide P, V in
    ( User[P,V,R1,W1] ||| User[P,V,R2,W2] )
    |[P,V]|
    DiskSem[P,V]

```

Using the expansion theorem, prove the following equivalence:

$$\text{System}[R1, W1, R2, W2] \approx \mathbf{i}; R1; \mathbf{i}; W1; \text{System}[R1, W1, R2, W2] \quad [] \quad \mathbf{i}; R2; W2; \mathbf{i}; \text{System}[R1, W1, R2, W2]$$

2. The following “useful” laws are false friends. Give counterexamples:

- a) $A \quad [] \quad (B \quad || \quad C) \approx A \quad [] \quad B \quad || \quad A \quad [] \quad C$
 b) $A \quad || \quad (B \quad [] \quad C) \approx (A \quad || \quad B) \quad [] \quad (A \quad || \quad C)$
 c) $A \quad |[G]| \quad (B \quad |[L]| \quad C) = (A \quad |[G]| \quad B) \quad |[L]| \quad C$
 for sets of gates G and L (hint: such processes only need to contain one action each)

3. A behavior expression B is said to be stable if for no B' , $B \mathbf{-i-} B'$. Show the following:

- a) if $B1 \approx_c B2$ then ($B1$ is stable if and only if $B2$ is stable)
 b) if ($B1 \approx B2$ and $B1$ and $B2$ are stable) then $B1 \approx_c B2$

4. Prove or disprove the following (this can be done mostly by applying known laws seen in class):

- a) $\mathbf{i}; (B1 \quad [] \quad \mathbf{i}; (B2 \quad [] \quad B3)) \quad [] \quad B3 \approx_c \mathbf{i}; (B1 \quad [] \quad \mathbf{i}; (B2 \quad [] \quad B3))$
 b) $\mathbf{a}; (B1 \quad [] \quad B2) \quad [] \quad \mathbf{a}; B2 \approx_c \mathbf{a}; (B1 \quad [] \quad \mathbf{i}; B2)$