

CS376 : HW 5 : Synchronous Data Flow

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6 A Simply Constrained SDF



The numbers adjacent to the ports indicate the number of tokens produced or consumed by the adjacent actor when it fires.

a Balance equations and solution

The balance equations are ...

$$q_A \times 1 = q_B \times 3 \quad : A \prec B; \quad (1)$$

$$q_B \times 2 = q_C \times 3 \quad : B \prec C; \quad (2)$$

A sufficient condition for a least positive integer solution is to find the least common divisor which is is to have one of the q values be 1 in this case there is no such set of values so 2 by mathematical induction. The least positive integer solution set of q values which conforms to the balance equations is:

$$q_A = 9 \quad (3)$$

$$q_B = 3 \quad (4)$$

$$q_C = 2 \quad (5)$$

b A schedule

The rows are flows and the columns are actors.

$$\Gamma = \begin{bmatrix} 1 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \quad (6)$$

The schedule is

$$\begin{array}{ccccccc}
 A \prec A & \prec A \prec B & \prec A \prec A & \prec A \prec B & \prec C \prec A & \prec A \prec A & \prec B \prec C \\
 \begin{pmatrix} 1 \\ 0 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix} & \begin{pmatrix} 3 \\ 0 \end{pmatrix} \begin{pmatrix} 0 \\ 2 \end{pmatrix} & \begin{pmatrix} 1 \\ 2 \end{pmatrix} \begin{pmatrix} 2 \\ 2 \end{pmatrix} & \begin{pmatrix} 3 \\ 2 \end{pmatrix} \begin{pmatrix} 0 \\ 4 \end{pmatrix} & \begin{pmatrix} 0 \\ 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} & \begin{pmatrix} 2 \\ 1 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \end{pmatrix} & \begin{pmatrix} 0 \\ 3 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \end{pmatrix}
 \end{array}$$

The minimum buffer sizes are:

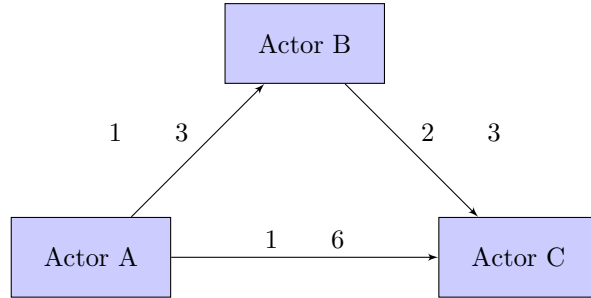
$$b_{AB} = 3 \quad (7)$$

$$b_{BC} = 4 \quad (8)$$

The largest total number of buffers in use at any one time is 5.

7 Determine unbounded execution with bounded buffers

a first

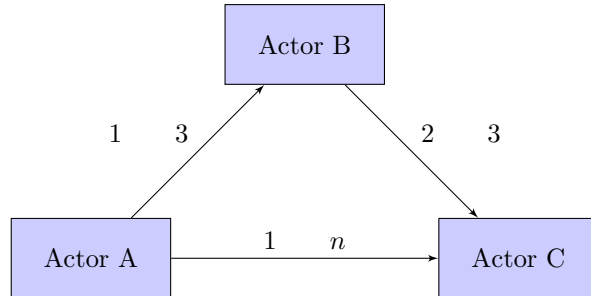


Similar to the previous problem but with an additional flow.

$$\Gamma = \begin{bmatrix} 1 & -3 & 0 \\ 0 & 2 & -3 \\ 1 & 0 & -6 \end{bmatrix} \quad (9)$$

In order for there to be the potential for a solution the matrix must have rank $s - 1 = 3 - 1 = 2$ which can be shown by a zero determinate. The determinate is -3 so no bounded solution exists for unbounded input and no minimum buffer size.

b second



In order for there to be the potential for a solution the matrix must have rank $s - 1 = 3 - 1 = 2$ which can be shown by a zero determinate.

$$\Gamma = \begin{bmatrix} 1 & -3 & 0 \\ 0 & 2 & -3 \\ 1 & 0 & -n \end{bmatrix} \quad (10)$$

The determinate is

$$\det \Gamma = -2 \times n + 3 \times 3 = 9 - 2n \quad (11)$$

Finding those cases when the determinate is zero (and the equations are dependent signifying that the rank is less than 3).

$$0 = 9 - 2n \quad (12)$$

$$n = 9/2 \quad (13)$$

As only integer values of n are allowed then there is no solution. Therefore there is no bounded solution for unbounded input, and no minimum buffer size.