CS376 : HW 5 : Synchronous Data Flow

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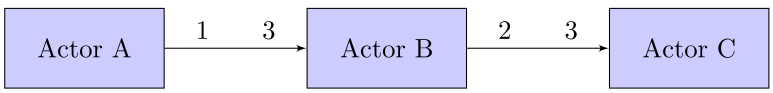
6 A Simply Constrained SDF



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 …

$$q_A \times 1 = q_B \times 3 \qquad : A \prec B; \tag{1}$$
$$q_B \times 2 = q_C \times 3 \qquad : B \prec C; \tag{2}$$

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:

$$q_A = 9 \tag{3}$$
$$q_B = 3 \tag{4}$$
$$q_C = 2 \tag{5}$$

b A schedule

The rows are flows and the colunms are actors.

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

The schedule is

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

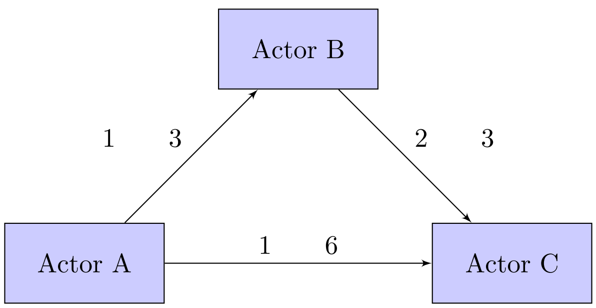
The minimum buffer sizes are:

$$b_{AB} = 3 \tag{7}$$
$$b_{BC} = 4 \tag{8}$$

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

7 Determine unbounded execution with bounded buffers

a first

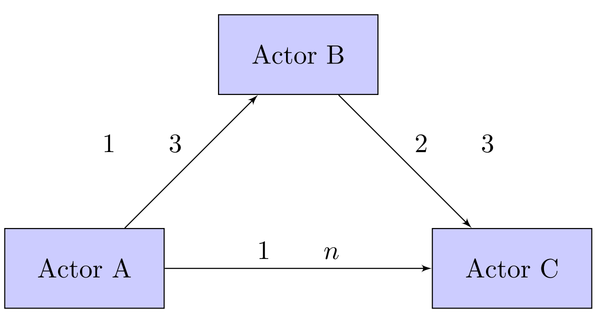


Similar to the previous problem but with an additional flow.

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

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.

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.

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

The determinate is

$$|\Gamma| = -2 \times n + 3 \times 3 = 9 - 2n \tag{11}$$

Finding those cases when the determinate is zero.

$$0 = 9 - 2n \tag{12}$$

$$n = 9/2 \tag{13}$$

As the solution must be an integer there is no solution.