Chapter 3. Pipelining and Parallel Processing

Exercise Solution

Exercise 10. As required, filter(a) and filter(b) have equal clock period, therefore:

$$\frac{C_{charge(a)} \cdot v_a}{k(v_a - v_t)^2} = \frac{C_{charge(b)} \cdot v_b}{k(v_b - v_t)^2} \tag{3.1}$$

From the filter structure we know $T_{critical}$=$9T_a$ for filter (a), $T_{critical}$=$4T_a$ for filter (b),

$$\frac{v_b \cdot (v_a - v_t)^2}{v_a \cdot (v_b - v_t)^2} = \frac{C_{charge(a)}}{C_{charge}(b)} = \frac{9}{4} \tag{3.2}$$

Substitute the values of $v_a = 4$ and $v_t = 0.5$, we have:

$$\begin{aligned} 36(v_b)^2 - 85v_b + 9 &= 0 \qquad (3.3) \\ v_{b1} &= 2.25Volt \\ v_{b2} &= 0.11Volt - -discard \end{aligned}$$

Compared to filter(a), the ratio of power saved by filter(b) is

$$1 - \frac{(v_b)^2}{(v_a)^2} = 1 - \frac{2.25^2}{4^2} = 68.34\% \tag{3.4}$$

Chapter 4. Retiming

Exercise Solution

Exercise 4.

$$T_\infty = 2T \tag{4.1}$$

$$T_{critical} = 7T \tag{4.2}$$

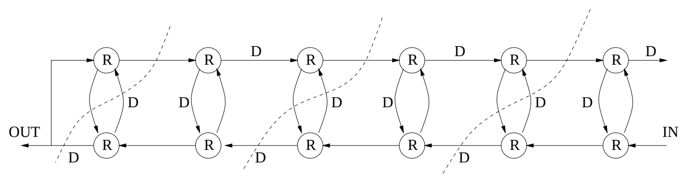
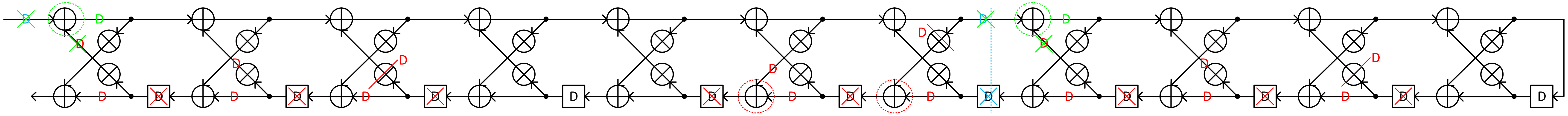
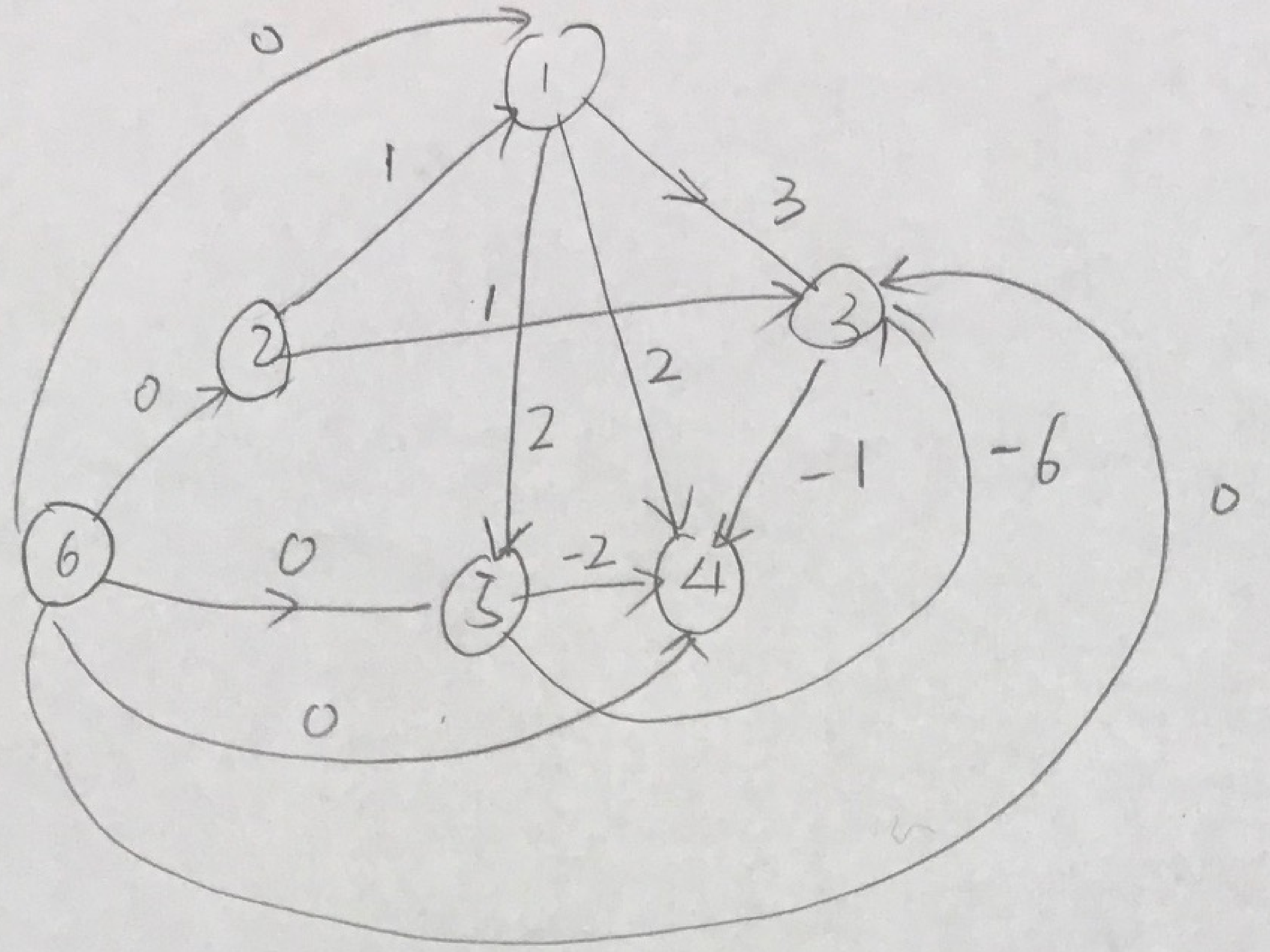


Fig. 4.1 Retimed data flow graph for Exercise 4.



Retimed architecture of the filter in Fig. 4.7(a) of the text book achieving 7.u.t as the critical path
(Note that the red, blue, and green colors are used to differentiate separate cutset retiming)

Problem 9 (b) chapter 4.



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

$$R^{(4)} = \begin{bmatrix} \infty & \infty & 3 & 2 & 2 & \infty \\ 1 & \infty & 1 & 0 & 3 & \infty \\ \infty & \infty & \infty & -1 & \infty & \infty \\ \infty & \infty & \infty & \infty & \infty & \infty \\ \infty & \infty & -6 & -7 & \infty & \infty \\ 0 & 0 & 0 & -1 & 0 & 0 \end{bmatrix} = R^{(5)} \quad R^{(6)} = \begin{bmatrix} \infty & \infty & -4 & -5 & 2 & \infty \\ 1 & \infty & -3 & -4 & 3 & \infty \\ \infty & \infty & \infty & -1 & \infty & \infty \\ \infty & \infty & \infty & \infty & \infty & \infty \\ \infty & \infty & -6 & -7 & \infty & \infty \\ 0 & 0 & -6 & -7 & 0 & 0 \end{bmatrix} = R^{(7)}$$

none of the entries in the diagonals of the matrices are negati

$\Rightarrow$ a solution is $r_1 = 0$, $r_2 = 0$, $r_3 = -6$, $r_4 = -7$, $r_5 = 0$,