Computational Algorithms and Architectures

Homework 2 Solution

Chapter 3 Pipelining and Parallel Processing

Exercise 6.
(a) The broadcast architecture saves pipelining registers.

(b) \( (G_j) \), could be achieved by \( (G_r)_j \). For clarity, retiming is applied first (see p.127).

The 3-parallel architecture is

Exercise 8.
The recursive filter is

(a) Pipeline the MAC into two stages (separate adder and multiplier assumed)
(b) Interleave two independent streams by hardware slowdown (see p.99)

Pipeline the MAC into 4 stages (3-stage multiplier – m1, m2, m3 and one adder)

**Exercise 10.**

Fig 3.24 (a) and (b) have equal clock period, therefore

\[
\frac{C_{charge(a)}v_a}{k(v_a - v_f)^2} = \frac{C_{charge(b)}v_b}{k(v_b - v_f)^2}
\]

\[
v_b(v_a - v_f)^2 = \frac{C_{charge(a)}}{C_{charge(b)}} = \frac{9}{4}
\]

Substitute known values,

\[
v_b = 2.25 \text{ (0.11 is infeasible)}
\]

The power saving is

\[
1 - \frac{v_b^2}{v_a^2} = 68.34\%
\]
Chapter 4 Retiming

Exercise 3.

(a) \( T_w = \frac{7}{4} \)

(b) 7

(c)

Exercise 12.

(a) \( T_{critical} = N \cdot (T_M + T_A) = 75 \)

(b) \( T_{critical} = T_M + T_A = 3 \)

The sampling period is double of the clock period (equivalent to critical path time)