

Solution to Assignment 4:

- Problem 1:

From $L(L-1) \geq 2(n-1) = 2 \times 17 = 34$
it follows $L = 7$ or there are 7 groups with
group size, $k_1=1, k_2=1, k_3=2, k_4=3, k_5=4,$
 $k_6=5, k_7=2.$

The time delay is $L \times 2\Delta_G = 14\Delta_G$

- Problem 2:

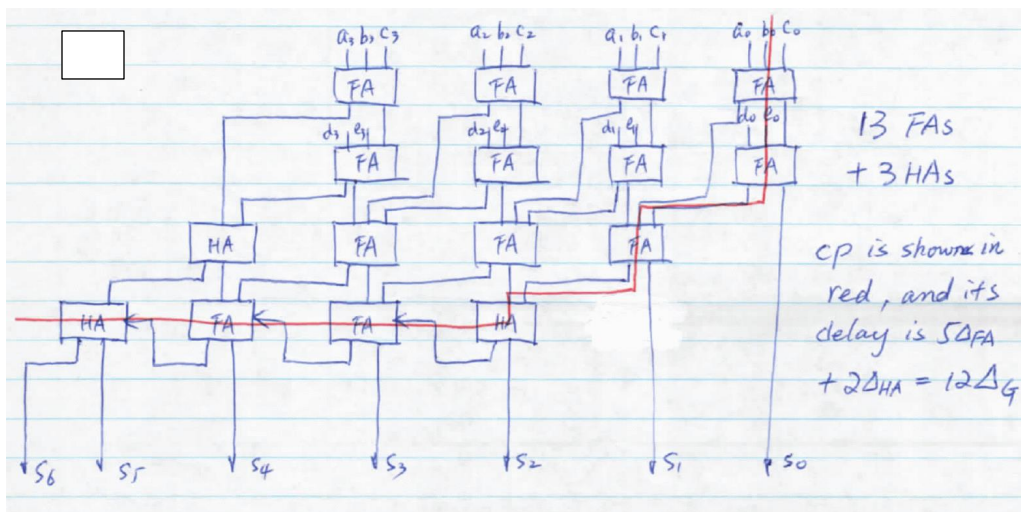
The group size is $k = \sqrt{\frac{n}{2}} = \sqrt{\frac{18}{2}} = 3$.

So the adder contains 6 groups of 3-bit each.

$$T_{\text{carry}} = (4\sqrt{2n} - 7) \Delta_g = 4 \times 6 - 7 = 17 \Delta_g.$$

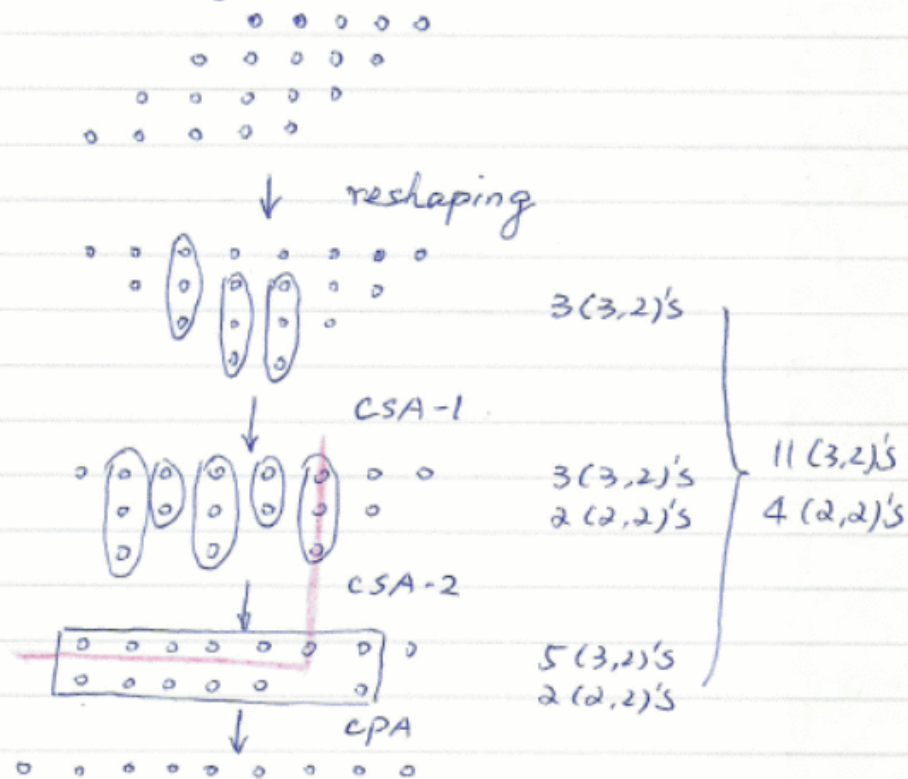
The time delay for the adder should be $18\Delta_G$.

- Problem 3



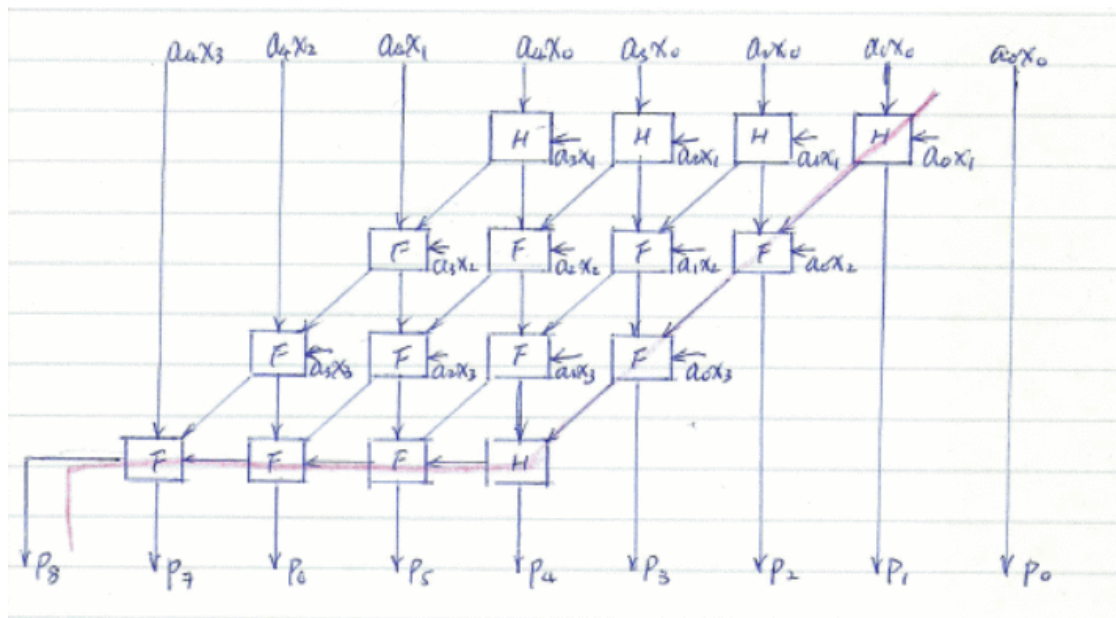
- Problem 4

There are two steps in ~~the~~ multiplication operation.
 The first step generates $1 \times 4 = 20$ partial product bits,
 which uses 20 AND gates.



In total we used ^{20 AND gates,} 11 (3,2)'s and 4 (2,2)'s. ^A The critical path is shown in red and the delay is $\Delta_G + 6 \Delta_{(3,2)} + \Delta_{(2,2)} = 14 \Delta_G$.
 Note that the first Δ_G is for generating the partial product bits.

- Problem 5



Let all the partial products be generated with 20 AND gates. Then from the above diagram, we have.

$$C = 11 \text{ FAs} + 5 \text{ HAs} + 20 \text{ AND}$$

$$T = 5 \Delta_{FA} + 2 \Delta_{HA} + \Delta_G = 13 \Delta_G$$

- Problem 6

- $M = 15 \times 14 \times 13 = 2730$.
- $A = 19_{10} = (4, 5, 6)_{\text{RNS}(15,14,13)}$
 $B = 22_{10} = (7, 8, 9)_{\text{RNS}(15,14,13)}$
 $C = A \times B = (13, 12, 2)_{\text{RNS}(15,14,13)}$
- It requires $3 \times 4 = 12$ bits.