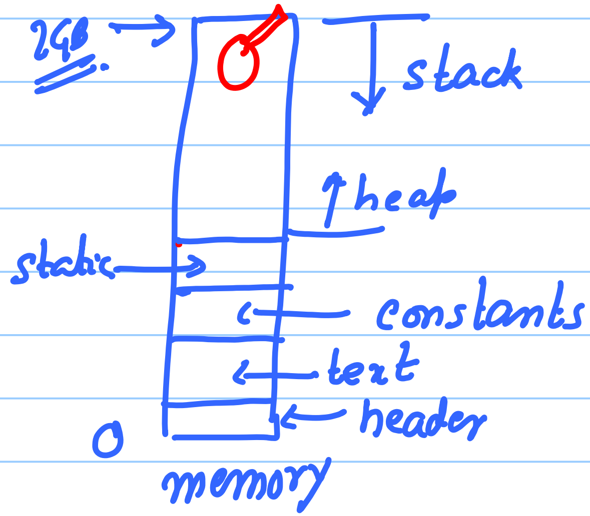
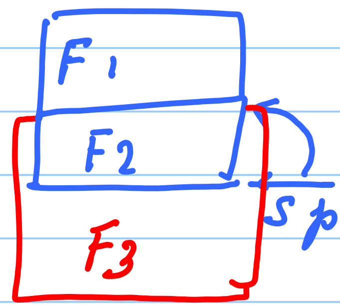
Aug - 8

Note Title 08-08-2012

(I) old PC = PC + 8 + offset

(Brch) old PC = PC + 8 + offset × 4





function pointer

mov [R0] (. . . . .)
LD

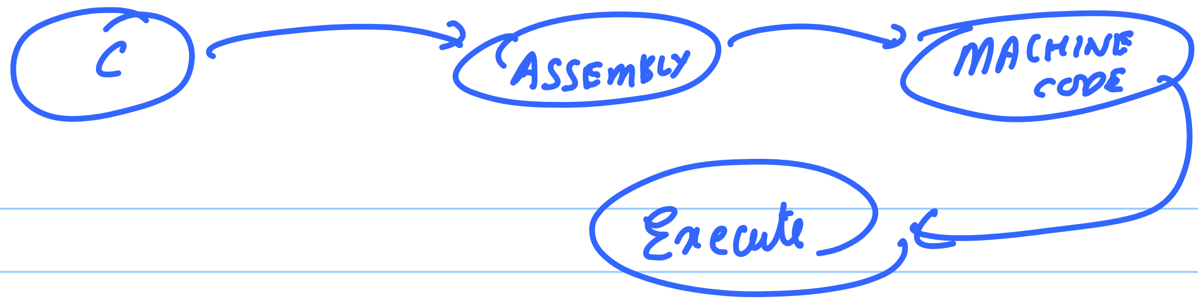
mov LR, PC (LR = PC+8)
mov PC, R0

func

mov PC, LR

ADD R_3, R_1, R_2

MUL R_3, R_1, R_2



✓ 1. (Adder/Multiplier/Divider)

✗ 2. Shifter/Logic

✓ 3. Memory

Adders

$a + b \to {}^{C}S$

Sum $\to a \oplus b$

Carry $\to a \cdot b$

Half adder

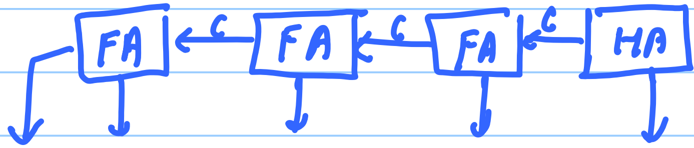
$a + b + c \to {}^{Carry}Sum$

Sum $\to a \oplus b \oplus c$

Carry $\to ab + bc + ca$

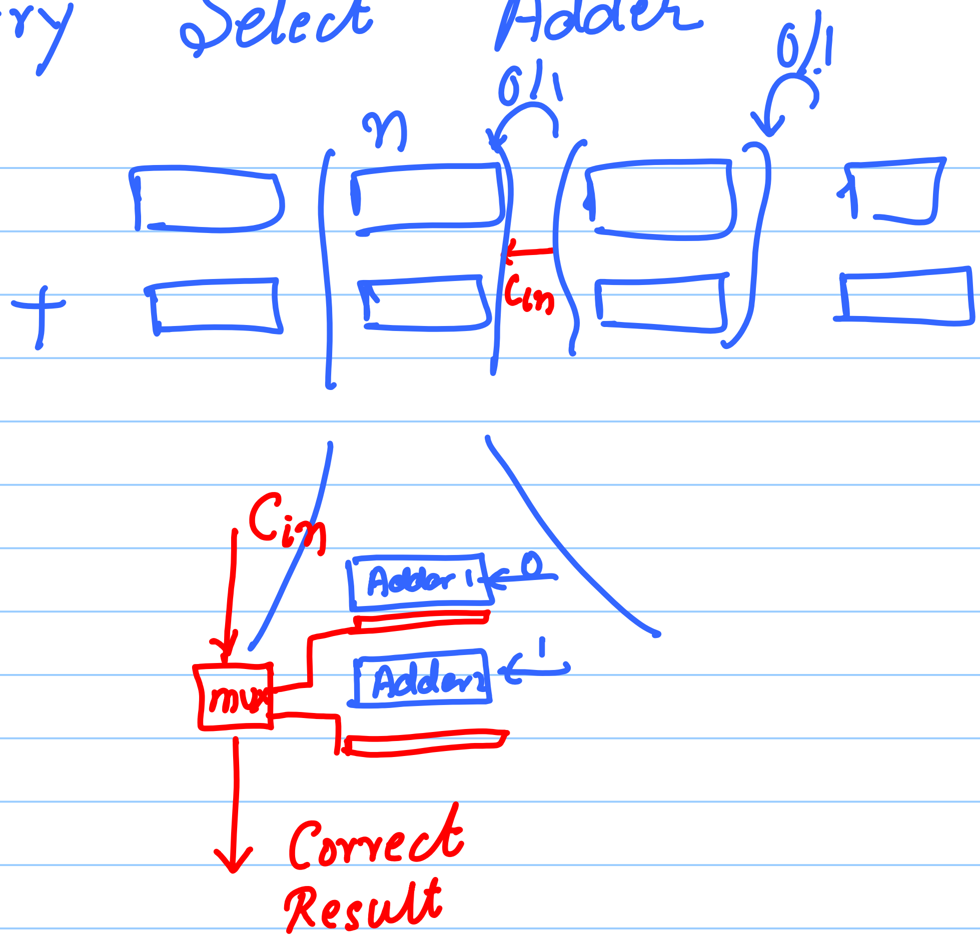
Full Adder

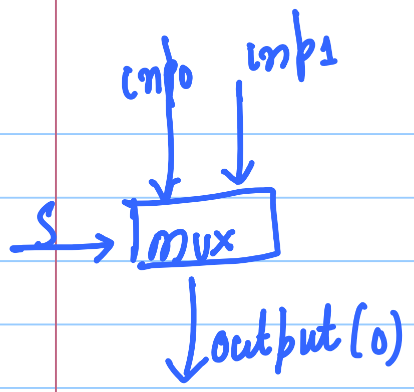
```
    1011
+   1110
--------
   11001
```



Ripple Carry Adder : $O(n)$

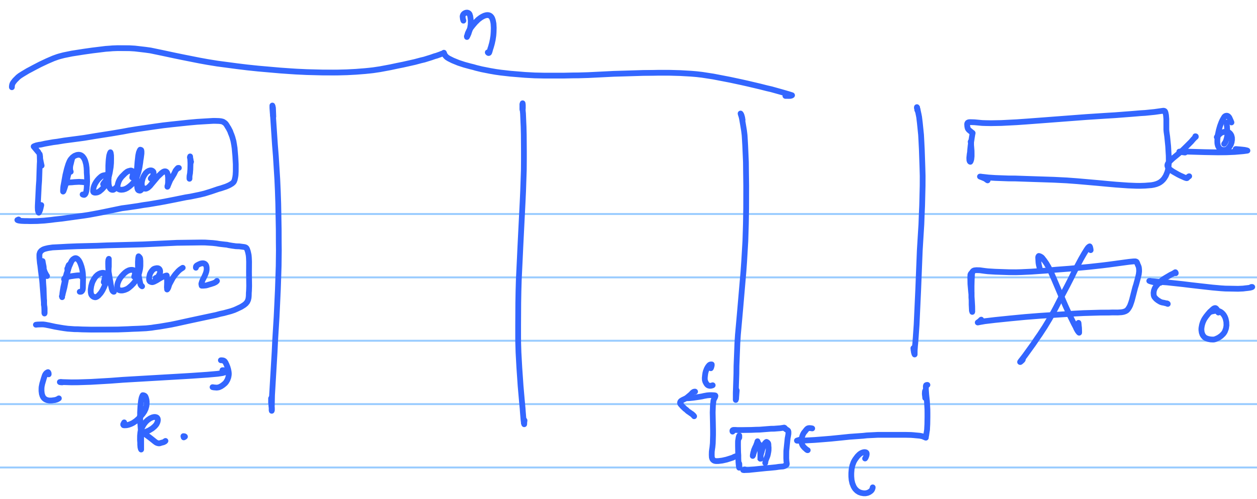
Carry Select Adder





$S=0,\ O = inp_0$

$S=1,\ O = inp_1$



Time per chunk : k

Round 1:

Add each chunk. Produce two results

$Cout_0 \leftarrow res_0$

&

$Cout_1 \leftarrow res_1$

Round 2: Generate C_{in} for each chunk: (n/k)

Total Time: $k + n/k = O(\sqrt{n})$

$= \boxed{2\sqrt{n}}$

$$\frac{\partial (k + n/k)}{\partial k} \Rightarrow 1 - n/k^2 = 0$$

$\Rightarrow n = k^2$

$\Rightarrow k = \sqrt{n}$

Round 2:

C_{in}^{i} (input carry of chunk i)

C_{out}^{j} (output carry of chunk j)

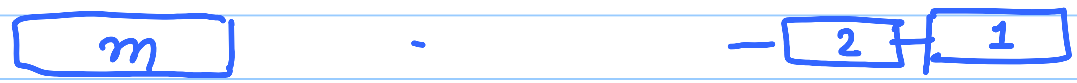
C_{out0}^{i} (output carry of adder 0 - chunk i)

C_{out1}^{i} (output carry of adder 1 → chunk i)

$$C_{in}^{i+1} = f\left(C_{in}^{i},\ C_{out0}^{i},\ C_{out1}^{i}\right)$$

$$= C_{out1}^{i}\, C_{in}^{i} + C_{out0}^{i}\, \overline{C_{in}^{i}}$$

Tighter Carry-Select Adder



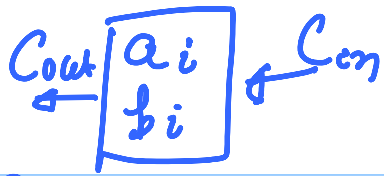
$$\sum_{i=1}^{m} i = n$$

$$\Rightarrow \frac{m(m+1)}{2} = n. \qquad \Rightarrow m^2 - 2n + m = 0$$

$$m = \frac{\sqrt{1+8n} - 1}{2} = -\frac{1}{2} + \sqrt{\frac{1}{4} + 2n}$$

$$\approx \sqrt{2} \cdot \sqrt{n}$$

Carry Lookahead Adder

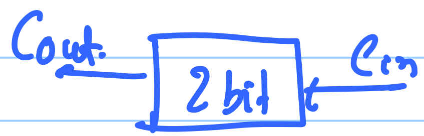


Propagate (P) → $C_{out} = C_{in}$

if: $P = a_i \oplus b_i = 1$

Generate (G) → $a_i \cdot b_i$

$C_{out} = G + P \cdot C_{in}$



$$\begin{array}{c|c} a_2 & a_1 \\ + \; b_2 & b_1 \\ \hline P_2 G_2 & P_1 G_1 \end{array}$$

$G_{12} = G_2 + P_2 G_1$

$P_{12} = P_1 P_2$

3-bit

$$P_{13} = P_1 P_2 P_3$$

$$G_{13} = G_3 + P_3 G_2 + P_3 P_2 G_1$$