Sept 3rd

Note Title 03-09-2011

Performance Equation.

$$P = \frac{\text{Program}}{\text{second}} = \underbrace{\frac{\text{Program}}{\#\text{ instns}}}_{\text{Compiler}} \times \underbrace{\frac{\#\text{ instns}}{\#\text{ cycles}}}_{\text{Organization}} \times \underbrace{\frac{\#\text{ cycles}}{\#\text{ seconds.}}}_{\text{Org. + technology}}$$

$$\frac{\#\text{ instns}}{\#\text{ cycles}} = \text{IPC} \qquad \frac{\#\text{ cycles}}{\#\text{ seconds.}} = f$$

$$P \propto \text{IPC} \times f$$

$f \rightarrow$ technology, design style.

IPC $\rightarrow$ Organization.

$\frac{\#\text{insts}}{\text{Program}}$: Compiler.

Moore's Law: Approximately every two years the number of transistors double.

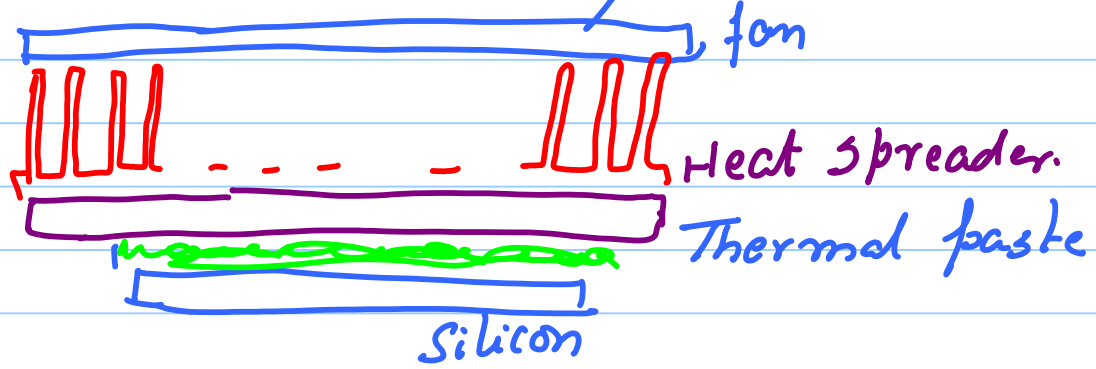
Power Dissipation limits frequency:

$P \propto CV^2f$ $(P \propto f^3)$ (approx.)

Temperature is a very serious problem.
Hence, we cannot increase power

dissipation

High temperature ⇒ exponential decrease in reliability.



Amdahl's Law

Any program's parallel portion (f)

→ serial portion. (1-f)

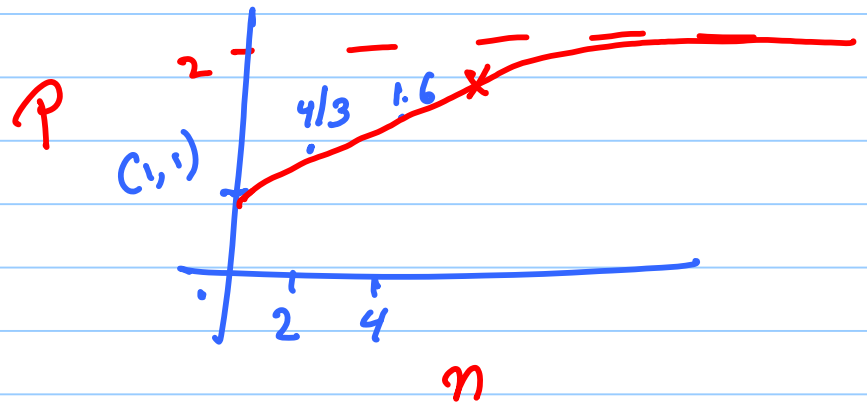
$n \rightarrow$ number of processors.

$$t = 1 - f + f/n$$

$$\phi = \frac{1}{t} = \frac{1}{1 - f + f/n}$$

$$\frac{1}{1 - 1/2 + (1/2)/n}$$

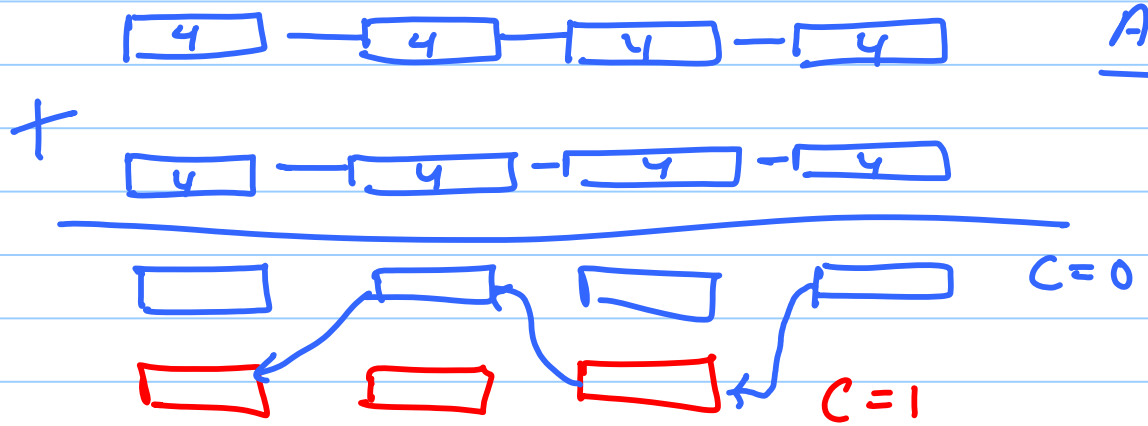
$$f = 1/2$$



Chapter - 3

Addition , Subtraction.

Carry Select Adder



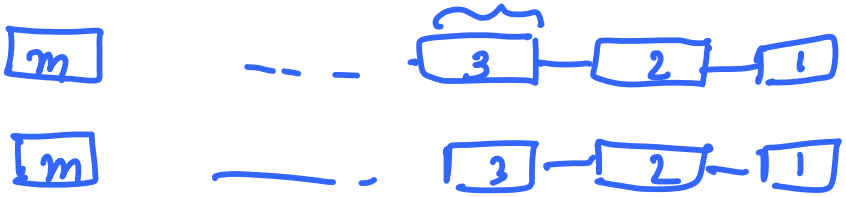
$T = 4 + n/4$

$O(n)$

Change the block size ($\sqrt{n}$)

$T = \sqrt{n} + n/\sqrt{n}$

$= O(\sqrt{n})$



$\sum_{i=1}^{m} i = n = O(m^2)$

$m = O(\sqrt{n})$

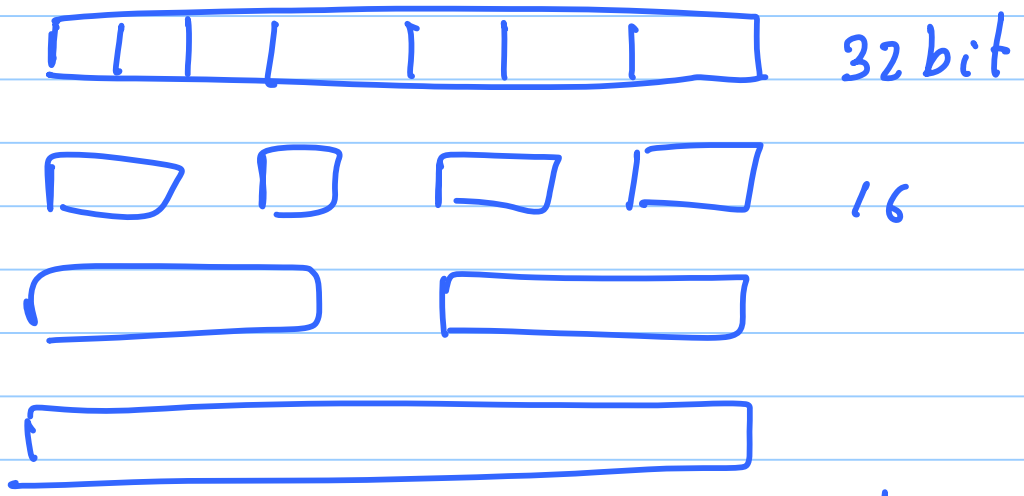
Time: m time units.

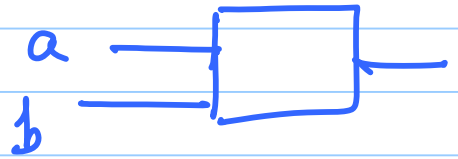
$m = O(\sqrt{n})$

Time. $O(\sqrt{n})$

Carry Lookahead Adder

$O(\log(n))$

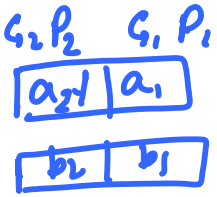




$G = ab$

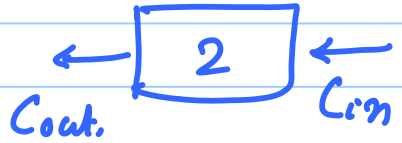
$P = a + b$

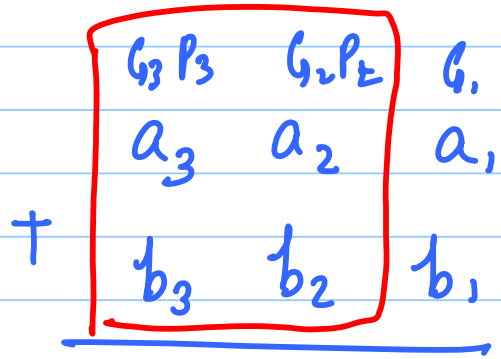
2 bit adder.



$$G = G_2 + G_1 P_2$$

$$P = P_1 P_2$$





$$G = G_3 + G_2 P_3 + G_1 P_2 P_3$$

$$P = P_1 P_2 P_3$$

$$G_{23} = G_3 + G_2 P_3$$

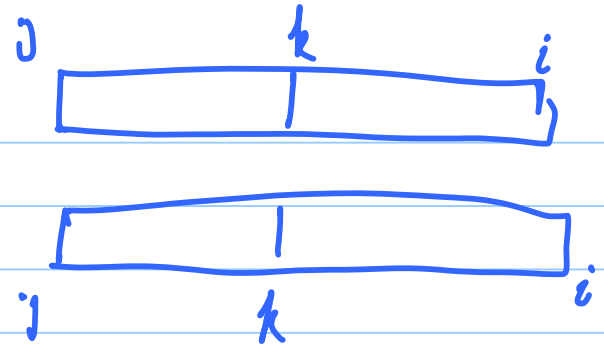
$$P_{23} = P_2 P_3$$

$$P = P_1 P_{23}$$

$$= P_1 P_2 . P_3$$

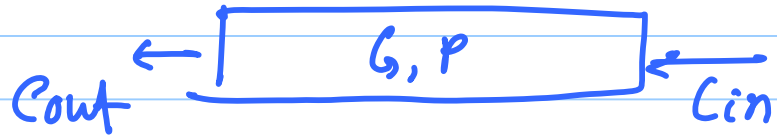
$$G = G_{23} + P_{23} G_1$$

$= G_3 + G_2 P_3 + G_1 P_2 P_3$

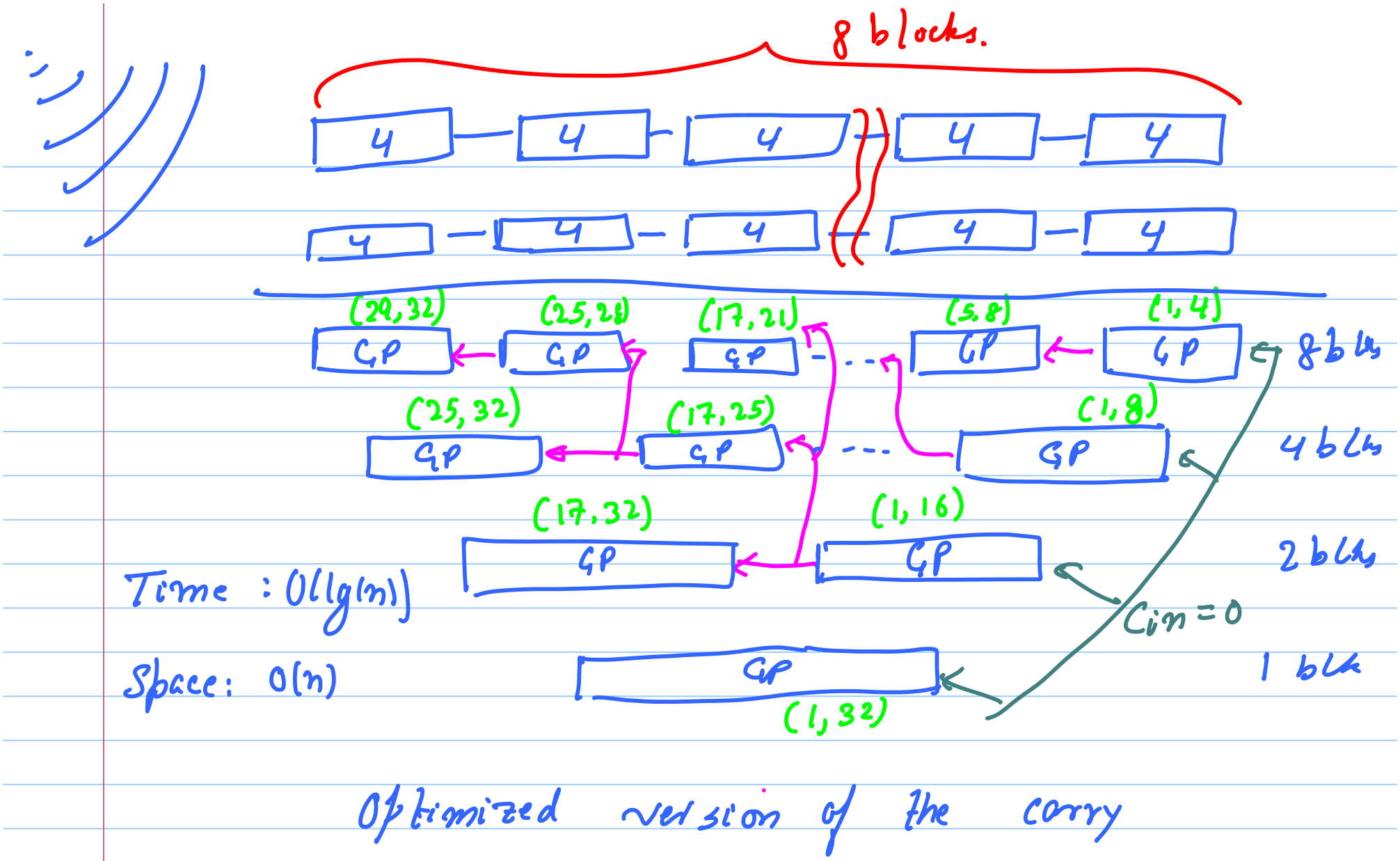


$P_{ij} = P_{ik} \; P_{(k+1)j}$

$G_{ij} = G_{(k+1)j} + G_{ik} \; P_{(k+1)j}$



$Cout = G + P C_{in}$


8 blocks.
4
(29,32)
(25,28)
(17,21)
(5,8)
(1,4)
GP
8 blks
(25,32)
(17,25)
(1,8)
4 blks
(17,32)
(1,16)
2 blks
Cin = 0
1 blk
(1,32)
Time : O(lg(n))
Space: O(n)
Optimized version of the carry

lookahead adder is called Kogge Stone adder.

Wednesday.

How long does it take to add

m n-bit numbers?