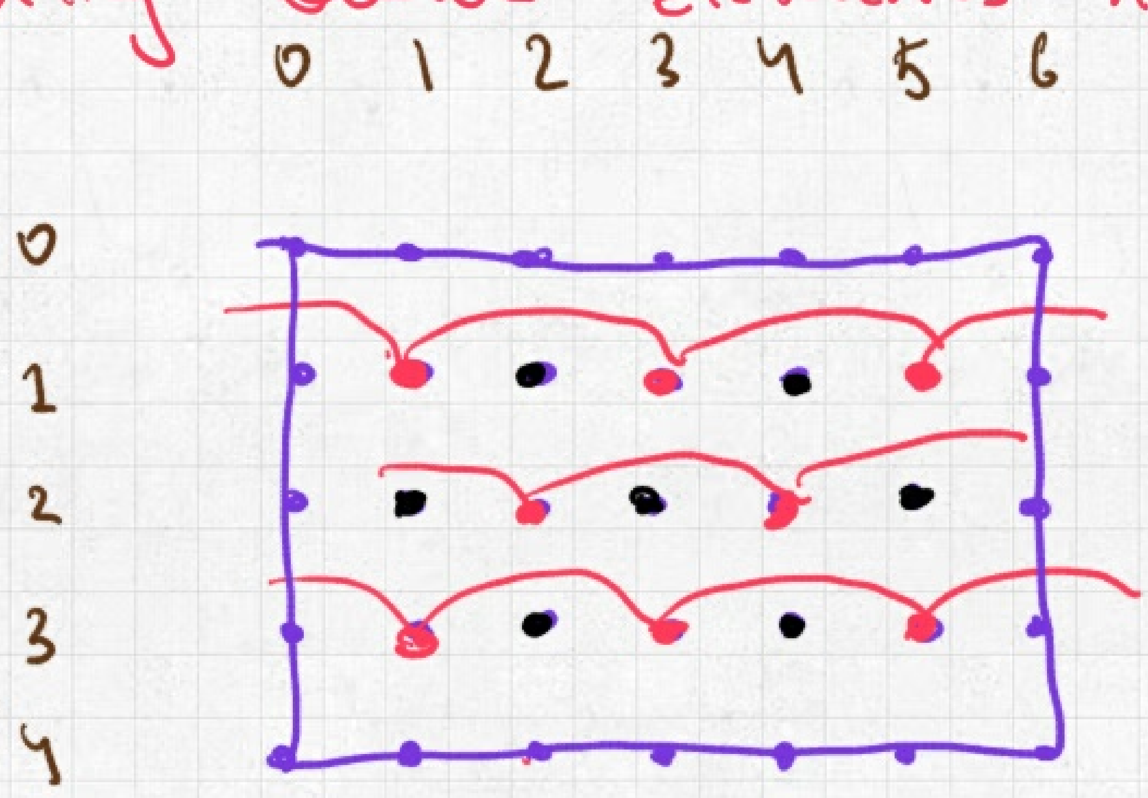
Treating border elements in dmaps, how to focus on



$(i+j)\%2 == 0 \rightarrow$ Red

otherwise $\rightarrow$ Black

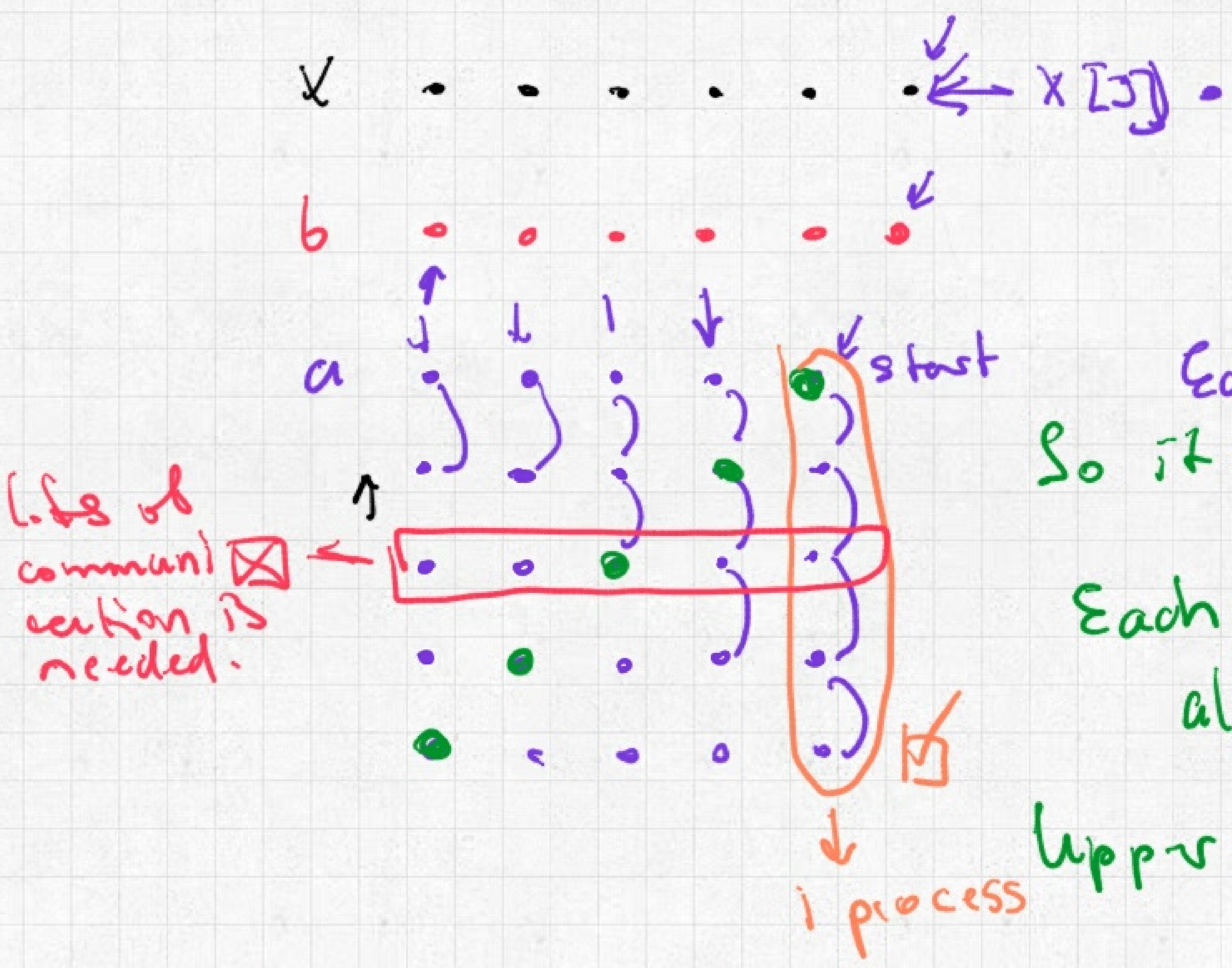
1+2	2+2	3+1	1+2	2+1	3+2
1+3	2+4	3+3	1+4	2+3	3+4
1+5		3+5		2+5	

1

2

3

Can split it into 4 loops



$b[i] \mathrel{-}= x[j] \cdot a[i][j]$

Column dependent

Each b

So it partitioned by first dimension

Each process gets a column of a.
almost no communication is needed

Upper loop can be

If partitioned by row (second dimension) then
lots of communication is needed!

read + write = pass (from/to disk)

Are two passes always sufficient for sorting?

When not enough memory ~~→~~ more than two passes are required!

Answer depends on the available memory!

$T_s = 12$

$T_p \to 2 + \frac{10}{2} = 2 + 5 = 7$ $\boxed{\frac{12}{7}}$ $\frac{12}{2+\frac{10}{10}} \to \frac{12}{3} \to 4x$

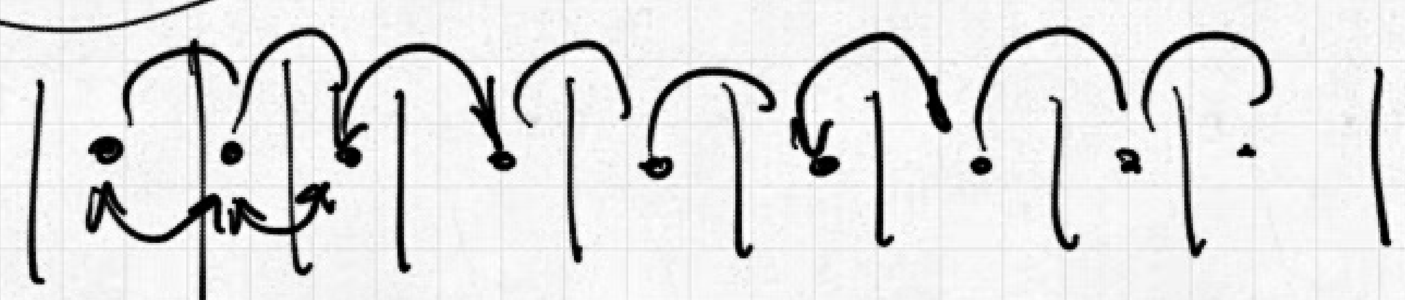
Smallest number → 10 or 10 + 2 ?

$m \times n \cdot 2$ Computes $\qquad 5mn$ – Overall

$2mn$ Reads $\qquad m \cdot \frac{n}{p} + \boxed{(p-1)50}$

mn Writes

Parallel Execution.



$(p-1)$ Communications → 50 units of tim

$$\frac{5n}{\frac{n}{p} + (p-1)50}$$

$$\frac{5 \cdot 10000}{\frac{10000}{p} + (p-1) \cdot 50}$$

$$\frac{10000}{5000 \cdot + 100}$$

$100 + \cdot 5000$

$m \cdot \frac{n}{p} + (p-1) \cdot 50$ vs $5mn$

Fixed size speedup.

1. - p processors.

$$S_{FS} = \frac{T_S(N_0)}{T_p(N_0)}$$

$$T_S(N) = 10^6 + 10^3 N + 24N^2$$

$$T_p(N) = 15 \cdot 10^5 + 1050\,N/p + 24N^2/p$$

$$\frac{1000000 + 1000N + 24N^2}{1500000 + 1050\frac{N}{p} + 24N^2/p}$$

1) $\frac{N}{p} = N_0 \quad \frac{N}{p} = 1000 \qquad N =$

$$T_S(p1000) = \frac{1000000 + 1000000p + 24000000p^2}{1500000 + 1050000 + 24000000p}$$

$$\frac{1 + p + 24p^2}{1.5 + 1.05 + 24p} = \frac{1 + p + 24p^2}{2.55 + 24p}$$

Unbounded when $p \to \infty$

2) $T_p = T_S(N_0)$?

$$S_{FT} = \frac{T_S(N_p)}{T_p(N_p)} \qquad T_p(N_p) = T_S(N_0) = 26 \cdot 10^6$$

$$26 \cdot 10^6 = 1500000 + 1050\frac{N_p}{p} + 24\frac{N_p^2}{}$$

$$20 \quad 1500000 - 26 \cdot 10^6 + 1050\frac{N_p}{p} + 24N^2/p$$

Now just need to find roots of this equation huh.

$E = \frac{T_s}{T_p \cdot N} \cdot 100\%$ $\frac{5}{2 \cdot 10} \cdot 100\%$ $\frac{5}{20} \approx$ very low!

Pram total Complexity t, m total operations

Processors $\# = p$

then $t + \frac{(m-t)}{p}$ theorem! Global sum

Example: $p = \lfloor \frac{n}{\log n} \rfloor$ $m = n-1$

$$\lceil \log n \rceil + \frac{n-1-\lceil \log n \rceil}{\lfloor n / \log n \rfloor} = \Theta(\log n)$$

$\text{Cost} = \lfloor n / \log n \rfloor \times \Theta(\log n) = \Theta(n)$ - optimal

Same but for prefix sum: