CSE 101 2-7-25

- PA4 : ext. 2 days

Algorithm Runtimes

exercise #6

show $f(n) + o(f(n)) = \Theta(f(n))$

Proof. let $h(n) = o(f(n))$. Then

$\lim_{n \to \infty} \frac{h(n)}{f(n)} = 0$. Then

$$\frac{f(n)+h(n)}{f(n)} = 1 + \frac{h(n)}{f(n)} \longrightarrow 1 \text{ as } n \to \infty$$

$\therefore$ $f(n) + h(n) = \Theta(f(n))$. ∎

Ex. $A = (A_1, A_2, \ldots, A_n)$

SelectionSort(A)

1. $n = \text{length}(A)$
2. for $i = 1$ to $n-1$
3. $\quad imin = i$
4. $\quad$ for $j = i+1$ to n
5. $\quad\quad$ if $A_j < A_{imin}$ ←
6. $\quad\quad\quad imin = j$
7. $A_i \leftrightarrow A_{imin}$ (swap)

$A_1 \ldots\ldots A_{i-1}$ | $A_i\ A_{i+1} \ldots\ldots A_n$

sorted | unsorted

$i-1$ smallest elements

basic op : comparison of array elements (line 5)

$$\#\text{comp} = (n-1)+(n-2)+\cdots+1$$

$$= \frac{n(n-1)}{2} = \frac{1}{2}n^2 - \frac{1}{2}n$$

$$= \Theta(n^2)$$

- BFS

let $n = |V(G)|$, $m = |E(G)|$

Initialization: $\Theta(n)$

Queue ops: $\Theta(n)$

inner for loop: cost $= \begin{cases} 2m & \text{undir.} \\ m & \text{dir.} \end{cases}$

$= \Theta(m)$

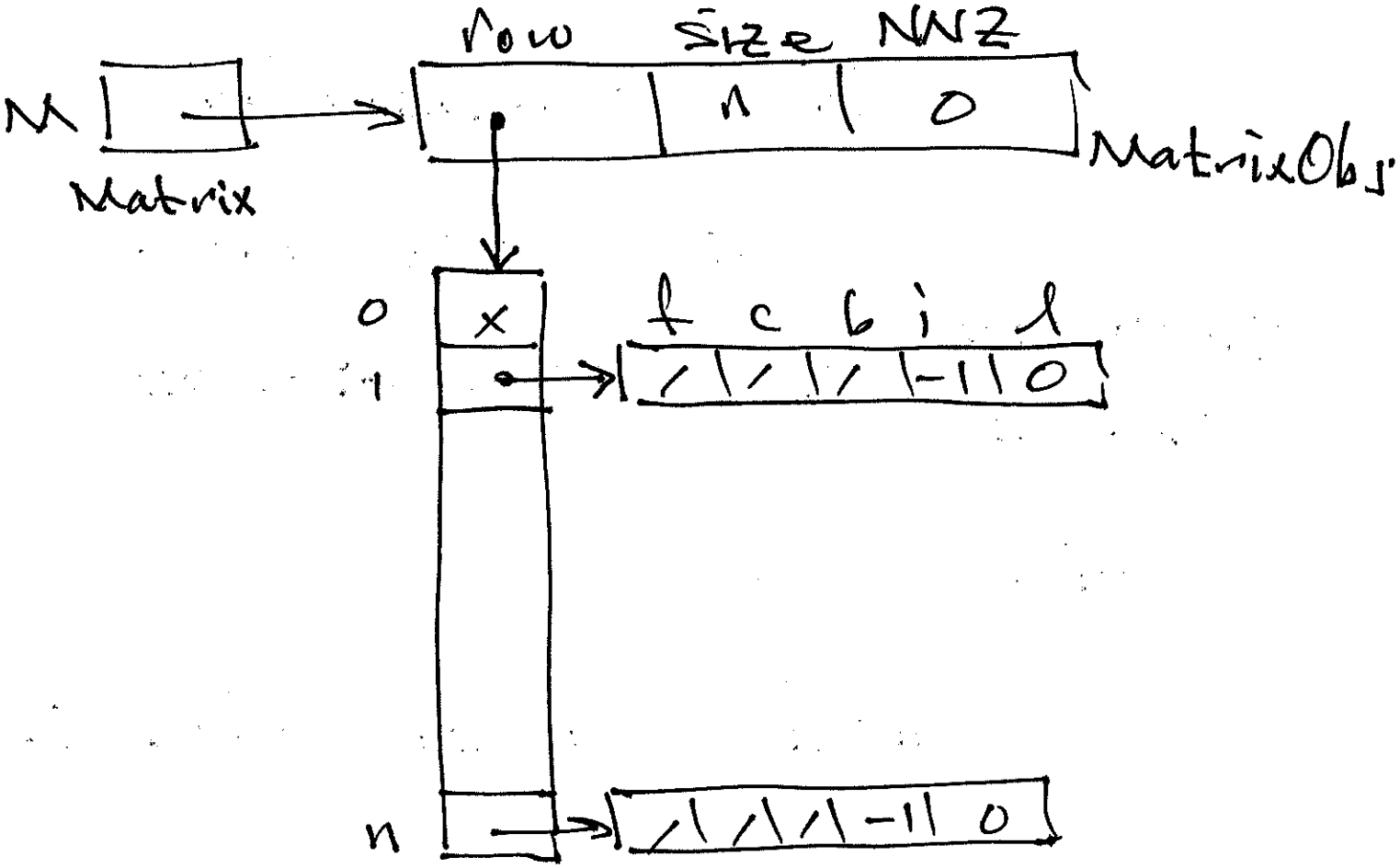
$\therefore$ total cost $= \Theta(n+m)$

- DFS (exercise)

cost $= \Theta(n+m)$

Part 1

Zero state



Matrix ops. Build order

- Constructor
- MakeZero
- destructor
- PrintMatrix
- ChangeEntry ← !!!

changeEntry(i, j, x): $M_{ij} = x$

Cases

1. $M_{ij} = 0$, $x = 0$: do nothing
2. $M_{ij} \neq 0$, $x = 0$: delete
3. $M_{ij} = 0$, $x \neq 0$: insert
4. $M_{ij} \neq 0$, $x \neq 0$: overwrite