

Operating System

Exercise 4

1. Assume that the page size is 2^n B.

So that : page num = $\frac{\text{virtual address space}}{\text{page size}}$

$$= \frac{256 \cdot 2^{20}}{2^n} = 2^{28-n}. \text{ Page table size} =$$

$$\text{Page num} * \text{page table entry size} = 2^{28-n} \cdot 4$$

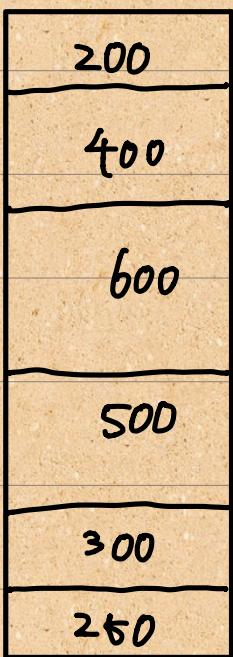
\because We want to put entire page table into one

$$\text{page, so: } 2^{30-n} \leq 2^n \Leftrightarrow n \geq 15.$$

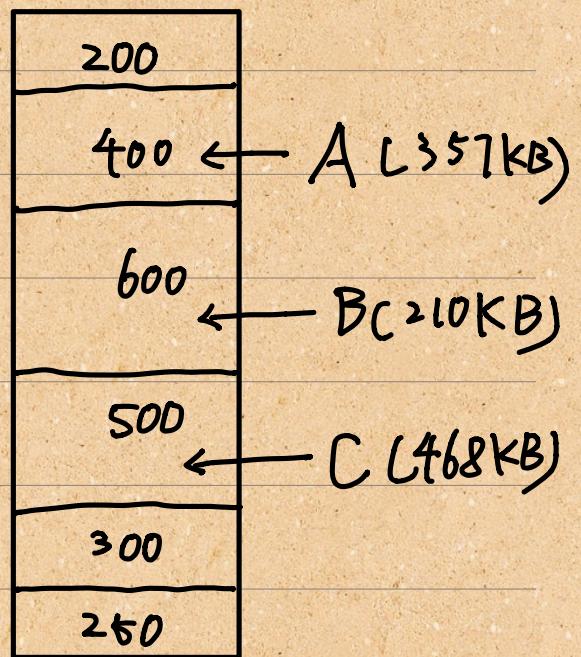
$$\Rightarrow \text{Minimum page size} = 2^{15} = 32\text{ kB}$$

2.

Let four process with size of 357 kB,
210 kB, 468 kB, 491 kB be A, B, C, D.



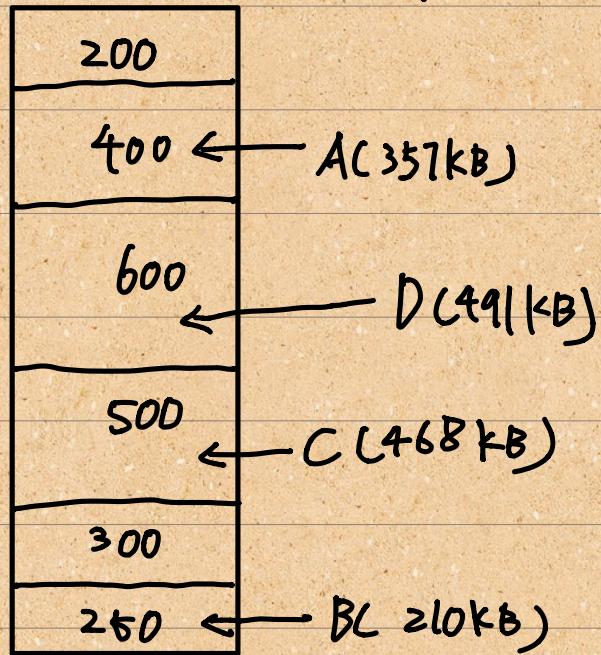
(1)



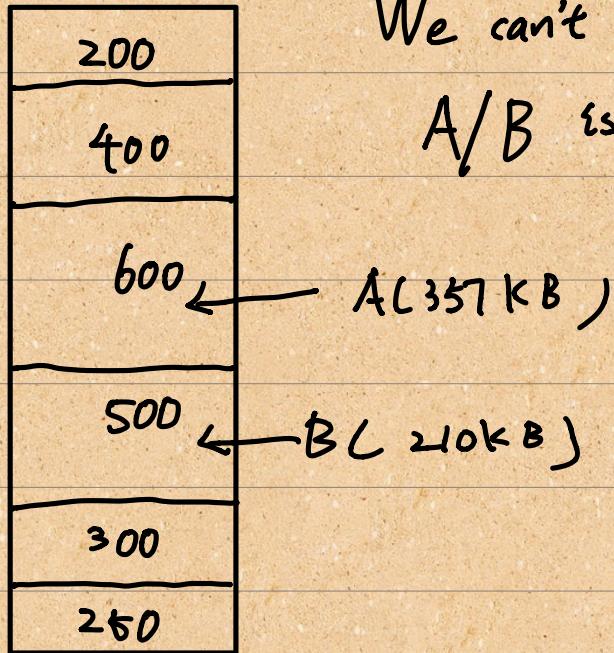
Memory partition

We can't allocate D until
B/C is finished.

(2)



(3)



We can't allocate C-D until
A/B is finished.

3.(1) For the fact that memory is byte addressable,
and we have: Page num = $\frac{2^{64}}{2^{20}} = 2^{44}$.

\therefore Page table size = $2^{44} \cdot 4 = 2^{46}$ B.

So that we can't use a single-level scheme.

If we use n-level paging scheme, let
nth outer page table num = $2^{\frac{44}{n}}$ and inner page table

num = $2^{\frac{44}{n}}$, we have the page table size:

$2^{\frac{44}{n}} \cdot 4 = 2^{\frac{44}{n}+2}$ B, which can be put into

one page. $\Rightarrow 2^{\frac{44}{n}+2} \leq 2^{20} \Leftrightarrow \frac{44}{n} \leq 18$

So we need 3-level page table.

(2) virtual address:

2nd outer	outer	inner	offset
P ₁	P ₂	P ₃	d

physical address:

frame number	offset
f	d

4. (1) Total number of page faults: 6

Hit ratio: 40% Miss ratio: 60%

(2). Total number of page faults: 6

Hit ratio: 40% Miss ratio: 60%

(3). Total number of page faults: 5

Hit ratio: 50% Miss ratio: 50%

5.

For the fact that if TLB hits,

page number	offset
P ₁	d

logical address

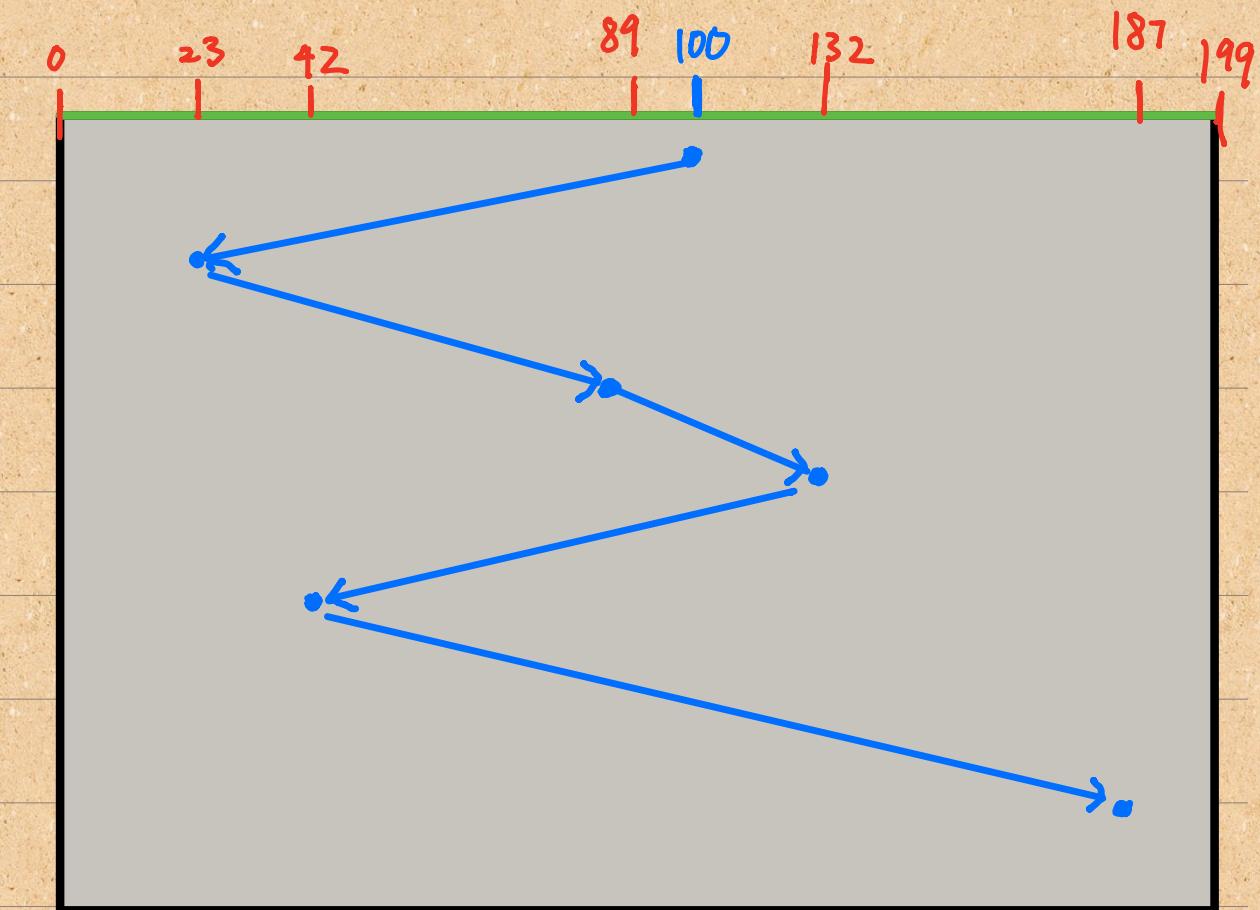
then we don't need to access page table, we can get frame

number directly from TLB. So the effective

access time is:

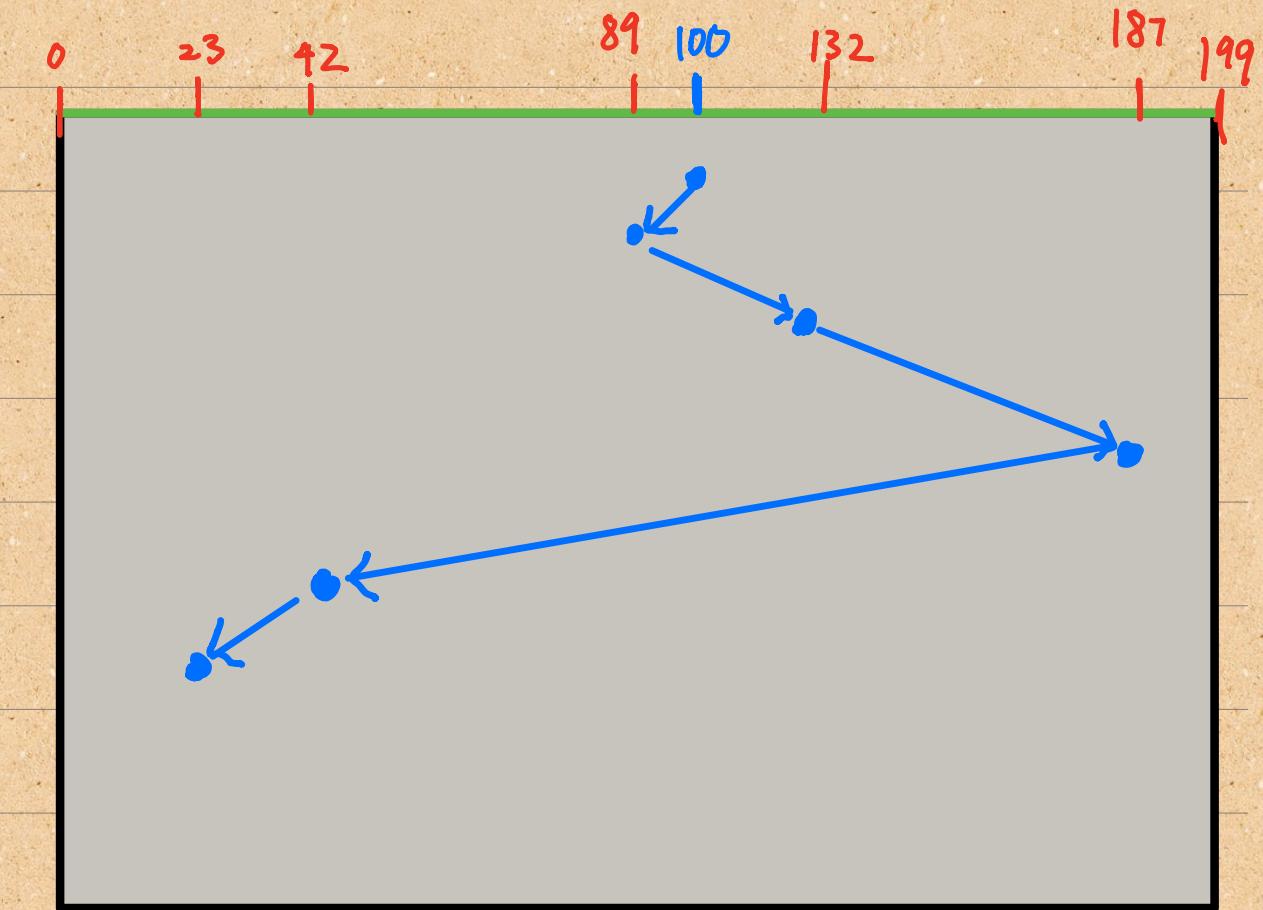
$$\begin{aligned} EAT &= (1+\varepsilon)\alpha + (3+\varepsilon)(1-\alpha) \\ &= (100+20) \cdot 0.8 + (300+20) \cdot 0.2 \\ &= 160 \text{ ns} \end{aligned}$$

6. (1) FCFS.



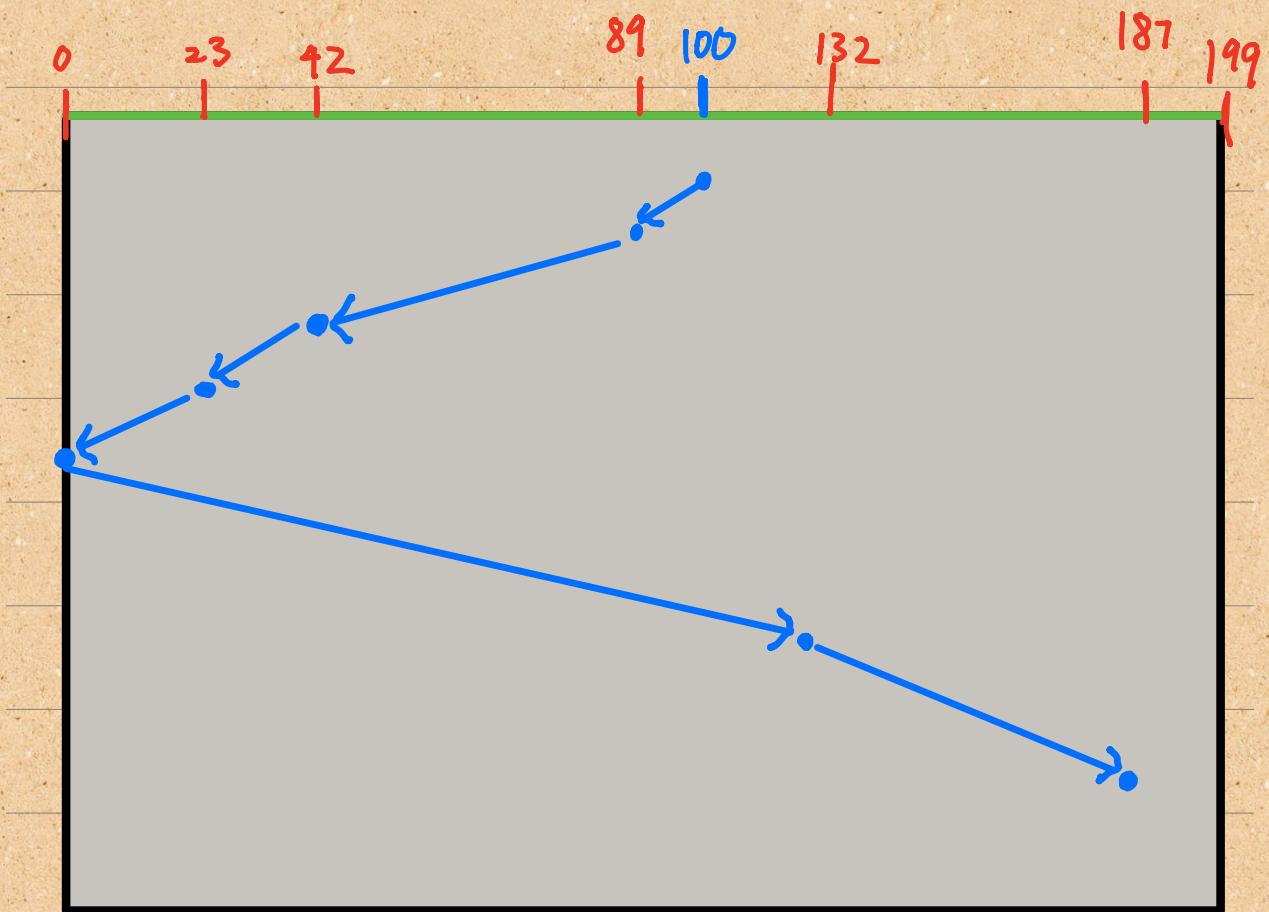
Total head movement: 421

(2) SSTF



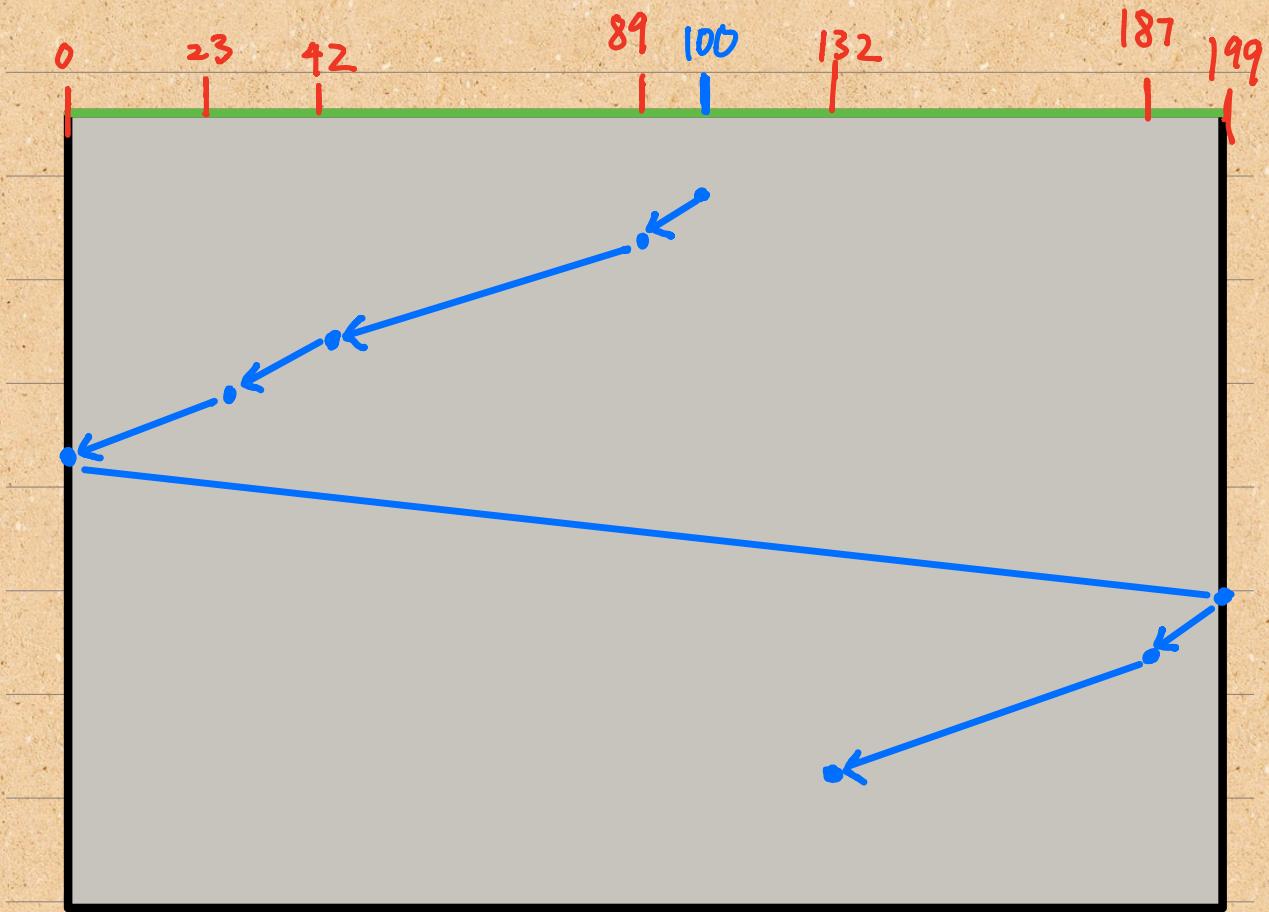
Total head movement: 273

(3) SCAN



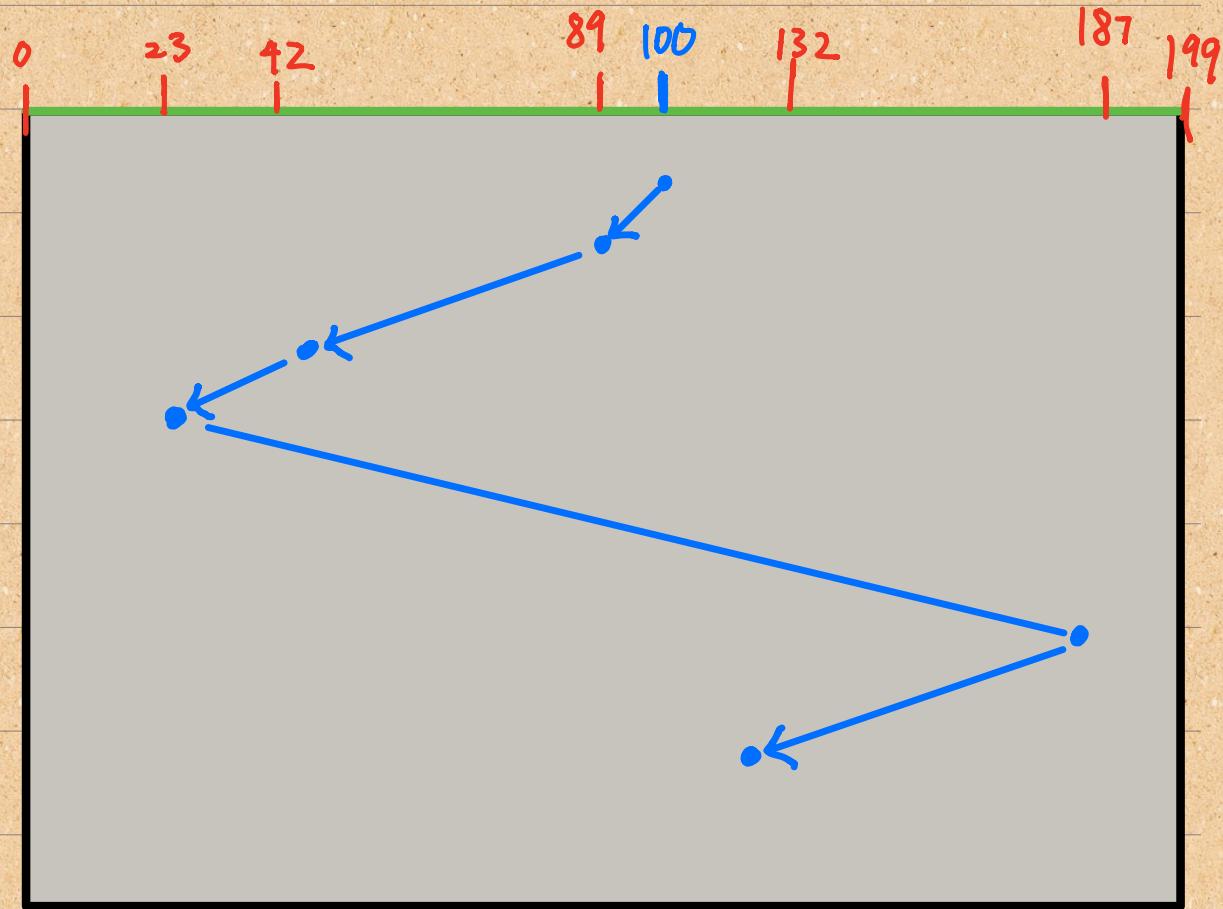
Total head movement: 287

(4) C-SCAN



Total head movement: 366

(5) C-LOOK.



Total head movement: 296