Algorithm HW 2

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1. partition algorithm pseudocode is below.
The subarray size $n = r-p+1$

PARTITION (A, P, r)

① $x = A[r]$ → const time
② $i = p-1$ → const time
③ for $j = p$ to $r-1$ → for loop $O(n)$ for loop
④ if $A[j] \le x$ → const time
⑤ $i = i+1$ → const time
⑥ exchange $A[i]$ with $A[j]$ → const time
⑦ exchange $A[i+1]$ with $A[r]$ → const time
⑧ return $i+1$ → const time

Time complex $=$ ① $+$ ② $+$ ③ $\times$ (④ $+$ ⑤ $+$ ⑥) $+$ ⑦ $+$ ⑧

$= n_1\Theta(1) + n_2\Theta(n)$

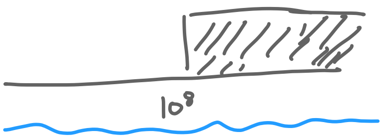
We can discard multiplicative constant and low degree.
So. PARTITION procedure of quick sort on a subarray of size n is $\Theta(n)$

2. chebyshev's inequality is

$$P[|X-\mu| \ge k] \le \frac{\sigma^2}{k^2} \iff P[\mu - k\sigma < x < \mu + k\sigma] \ge 1 - \frac{1}{k^2}$$

μ(number of Quicksort): $2N \ln N = 27631021.12 = 2.76 \times 10^7$

σ(standard deviation) : $0.65N = 6.5 \times 10^5$



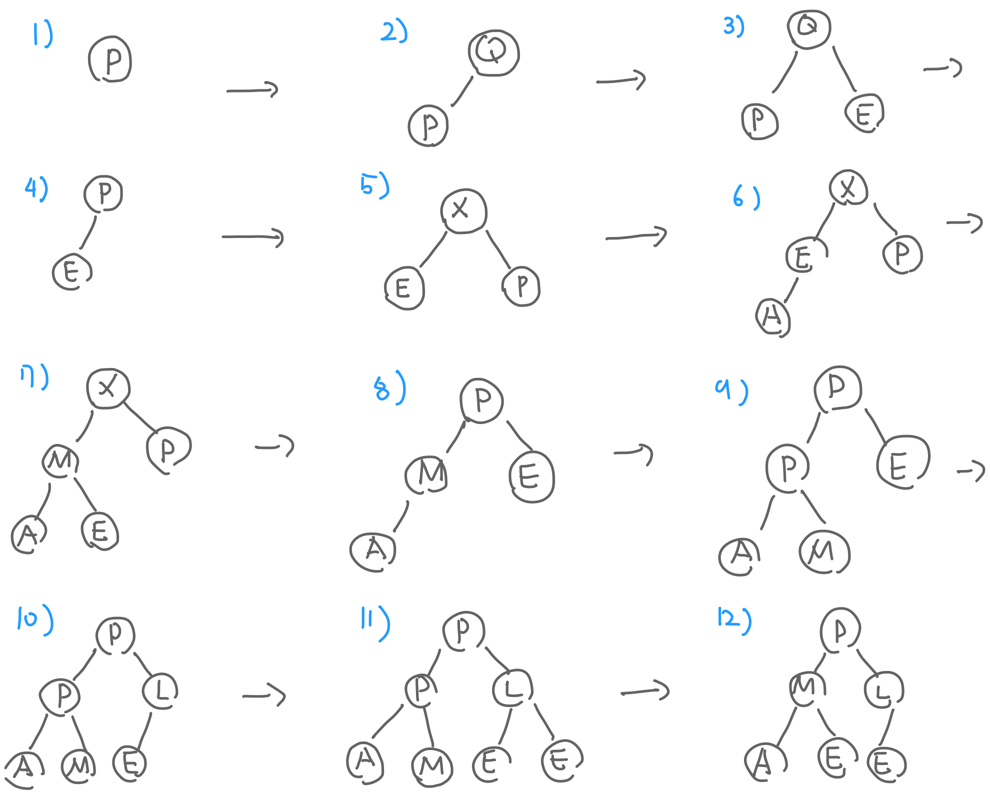
$$\Rightarrow \quad P[|x - 2.76 \times 10^7| \ge \overbrace{7.24 \times 10^7}^{k}]$$

$$= \left(P[x \ge 10^8] \text{ and } P[x \le -4.48 \times 10^7]\right) \le \frac{\sigma^2}{k^2}$$

$P[x \le -4.48 \times 10^7] = 0$,

So $P[x \ge 10^8] \le \dfrac{(6.5 \times 10^5)^2}{(7.24 \times 10^7)^2} \fallingdotseq 8.06 \times 10^{-5}$

3. First I draw tree and draw priority queue.



Let's draw priority queue by reference tree. (Priority queue doesn't use index 0.)
↳ (I used array. Linked list also okay)

1)

0	1	2	3	4	5	6	7	8
·	P							

→ 2)

0	1	2	3	4	5	6	7	8
·	Q	P						

→ 3)

0	1	2	3	4	5	6	7	8
·	Q	P	E					

→ 4)

0	1	2	3	4	5	6	7	8
·	P	E						

→ 5)

0	1	2	3	4	5	6	7	8
·	X	E	P					

→ 6)

0	1	2	3	4	5	6	7	8
·	X	E	P	A				

→ 7)

0	1	2	3	4	5	6	7	8
·	X	M	P	A	E			

→ 8)

0	1	2	3	4	5	6	7	8
·	P	M	E	A				

→ 9)

0	1	2	3	4	5	6	7	8
·	P	P	E	A	M			

→ 10)

0	1	2	3	4	5	6	7	8
·	P	P	L	A	M	E		

→ 11)

0	1	2	3	4	5	6	7	8
·	P	P	L	A	M	E	E	

→ 12)

0	1	2	3	4	5	6	7	8
·	P	M	L	A	E	E		

→