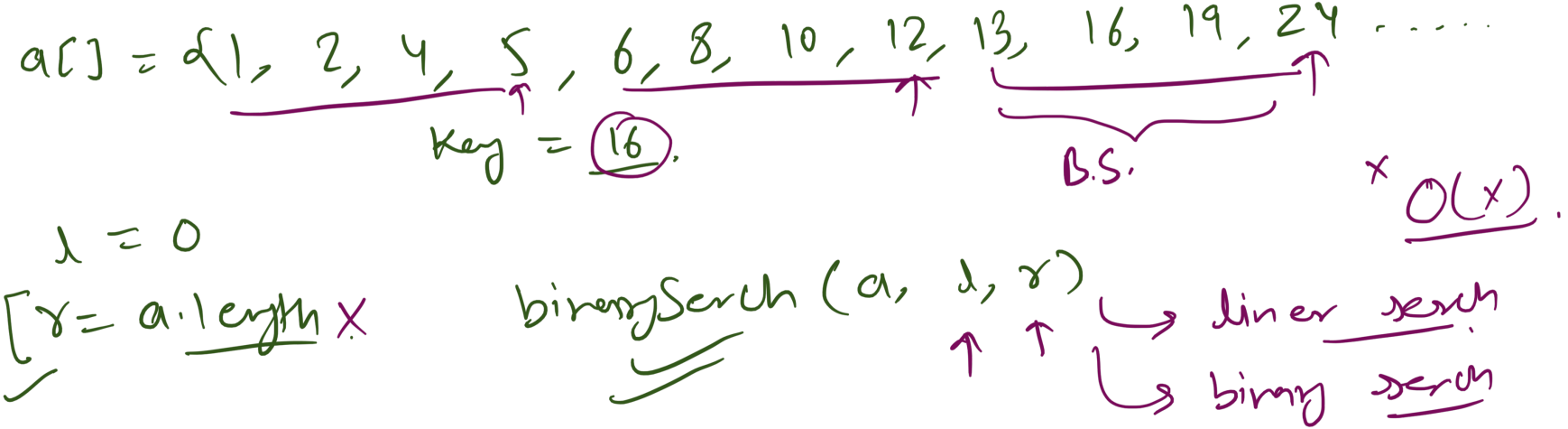
Binary Search Problems - I

Search an element in an Infinite Sorted Array



[4 → length

(10^6) 4, 4 → linear

INFINITE >>>>

if range is kept constant → then solution is still linear in nature.

variable range

(double)

1, 2, 4, 8, 16, 32, 64 ---- 2^{40}, 2^{41}

exponential in nature

a[] = {1, 2, 4, 5, 6, 8, 10, 12, 13, 16, 19, 24 ... 32}

0 1 2 3 4 5 6 7 8 9 10 11 16

Key = 16

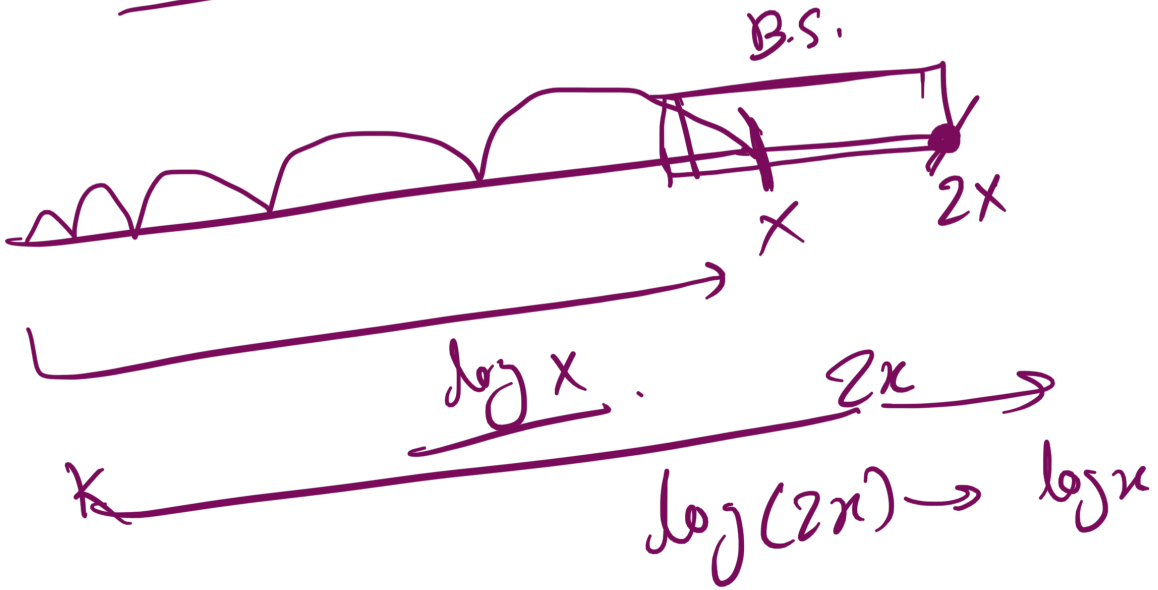
B.S. ✗

$\log x$

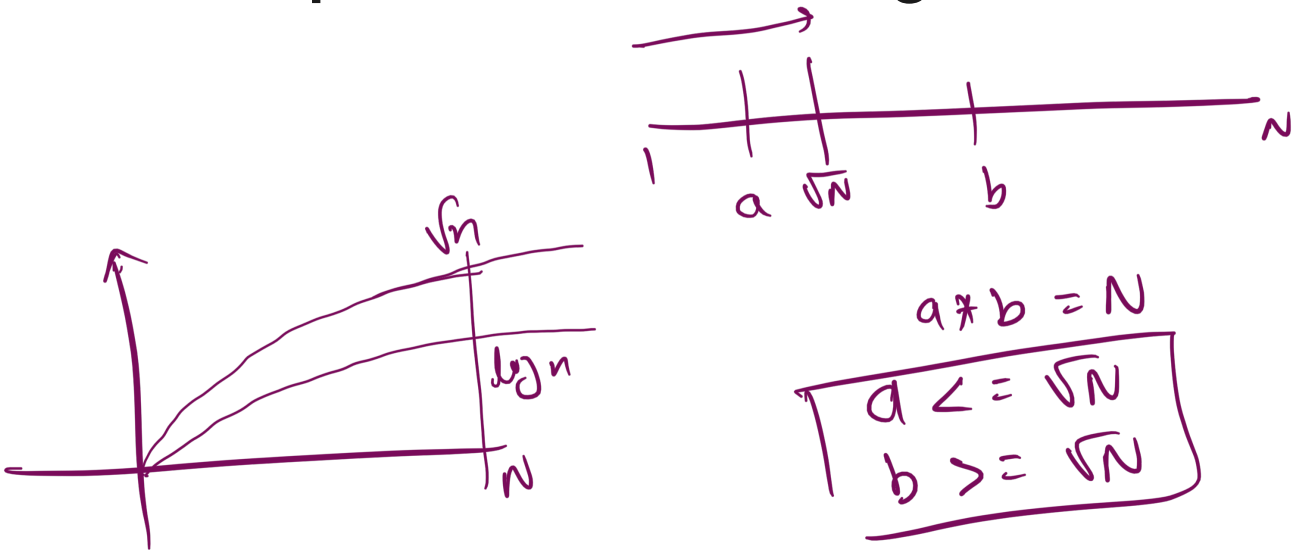
$x \rightarrow$ Position of the element

$\log x + \log x$

$O(\log x)$



Find square root of an Integer



$a * b = N$

$a <= \sqrt{N}$

$b >= \sqrt{N}$

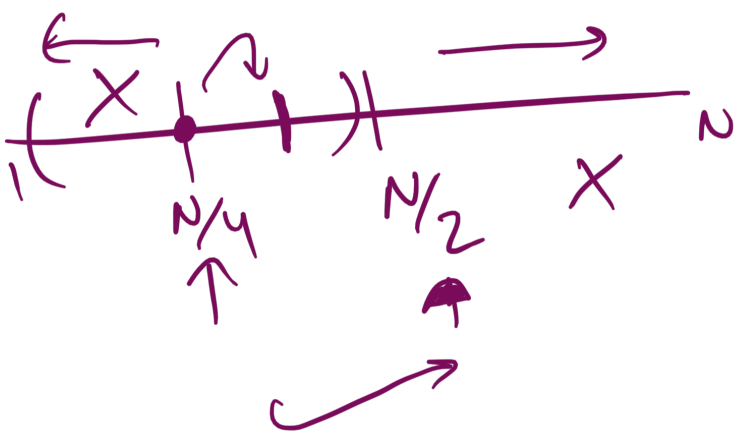
$\log N$

$(\sqrt{78} = 8)$

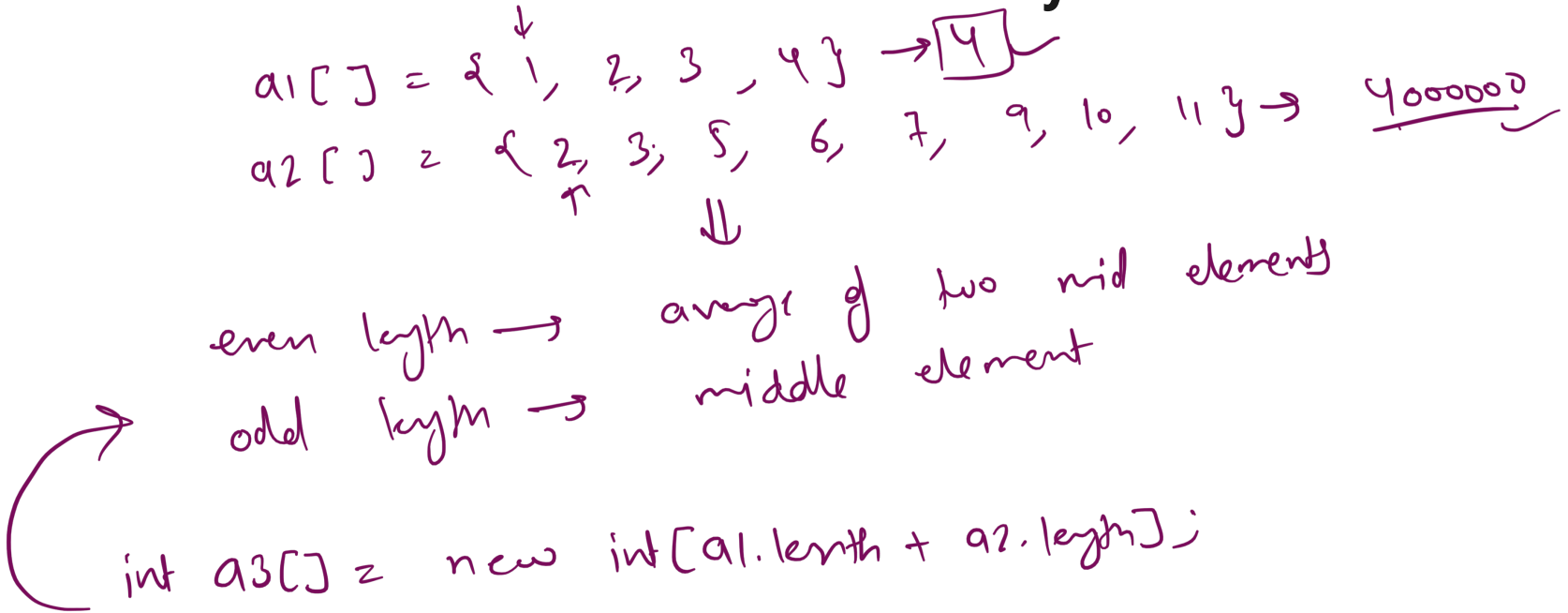
```
int i = 1
for (      ; i*i <= N; i++) {
}

return i-1;
```

Binary search



Find the median of two sorted Arrays



Space → O(N+m) , Time → O(N+m)

↓

O(1) ✓

↓

O(log N) ⇒ O(min(n,m))

Binary Search

mid = x/2 4

x = 4

d = 0/2 4

a1[] = {(1, 2, 3), (4)} → n1

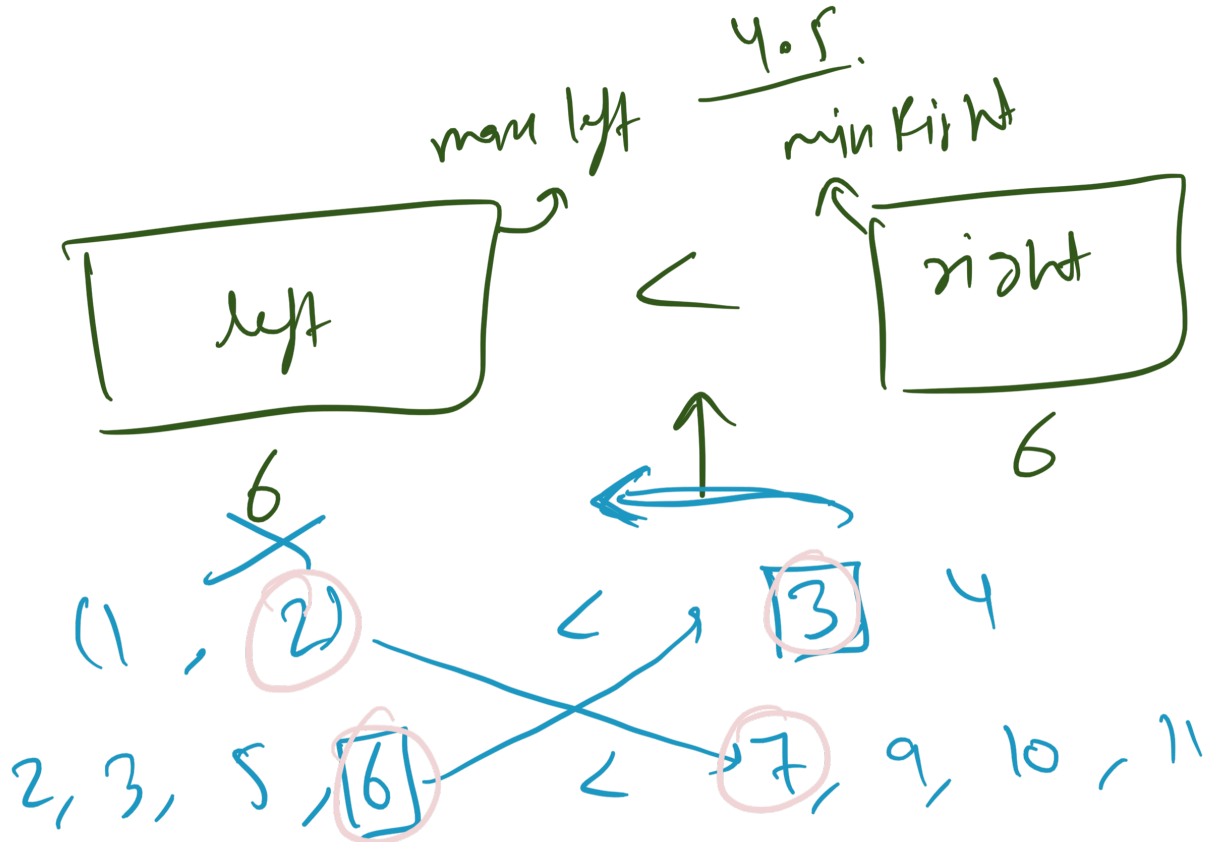
a2[] = {(2, 3, 5) (6, 7, 9, 10, 11)} → n2

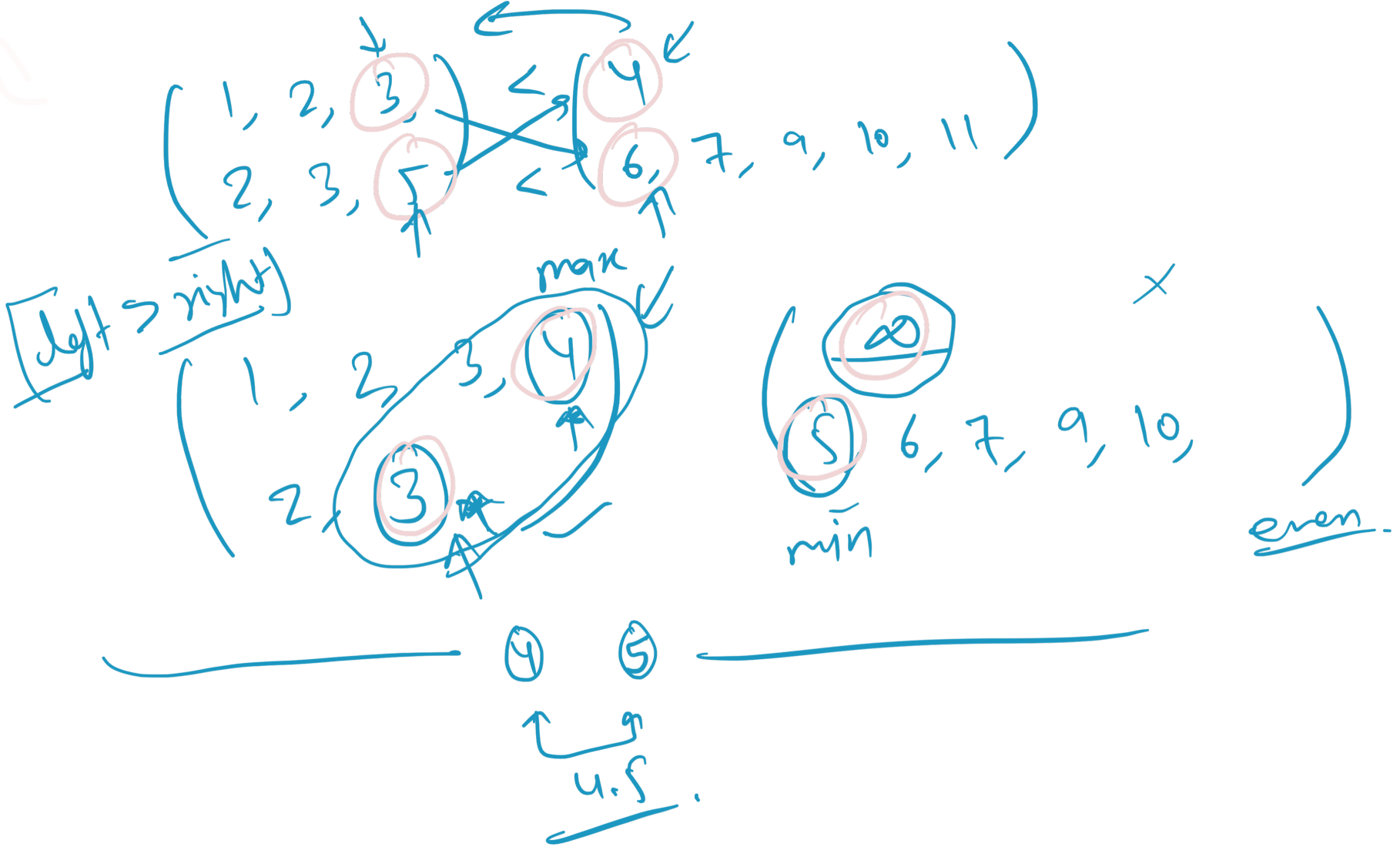
a3[] = {1, 2, 2, 3, 3, 4, 5, 6, 7, 9, 10, 11}

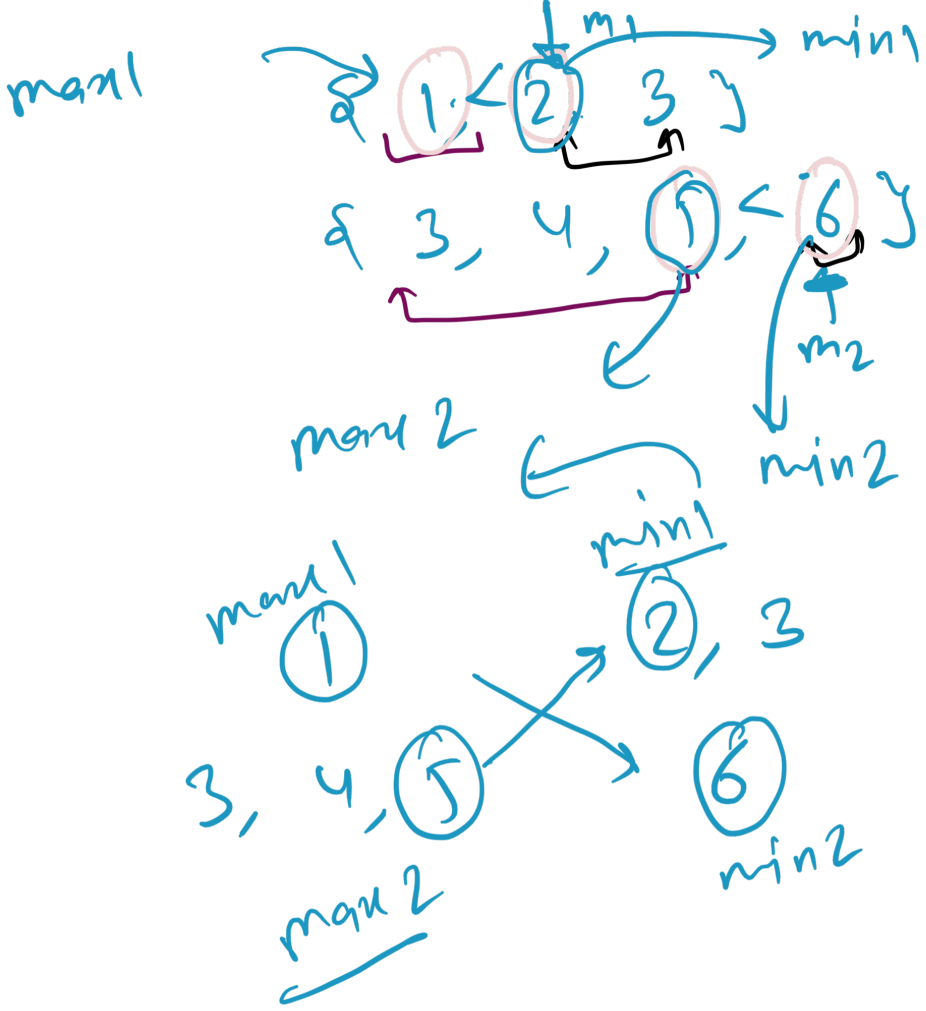
12

n1 <= n2

O(log n1)


4.5
max left
min Right
left
right
6
6
1 , 2
3
4
2, 3, 5, 6
7, 9, 10, 11


1, 2, 3, 4, 6, 7, 9, 10, 11
2, 3, 5
left > right
max
1, 2, 3, 4
2, 3
∞
5, 6, 7, 9, 10,
min
even.
4 5
u.s.


max1
min1
m1
1
2
3
5
3, 4,
6
m2
max 2
min2
l = 0
r = 3
m1 = 1
m2 = 3
m1 = 3
m2 = 4
max1
min1
1
2, 3
3, 4,
5
6
min2
max 2


l = 1
r = 1

$a_1 = \{3, 7, 8, 9\}$ $n_1 = 4$ (m_1 points to 7)

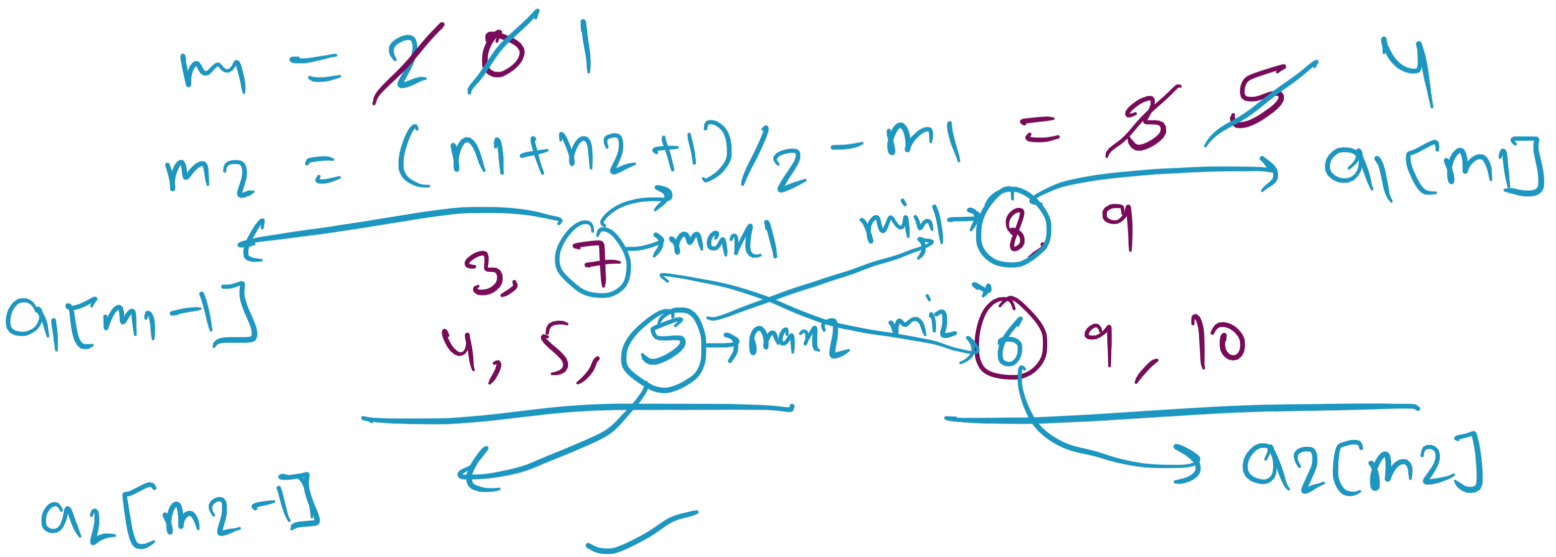
$a_2 = \{4, 5, 5, 6, 9, 10\}$ $n_2 = 6$ (m_2 points to 9)

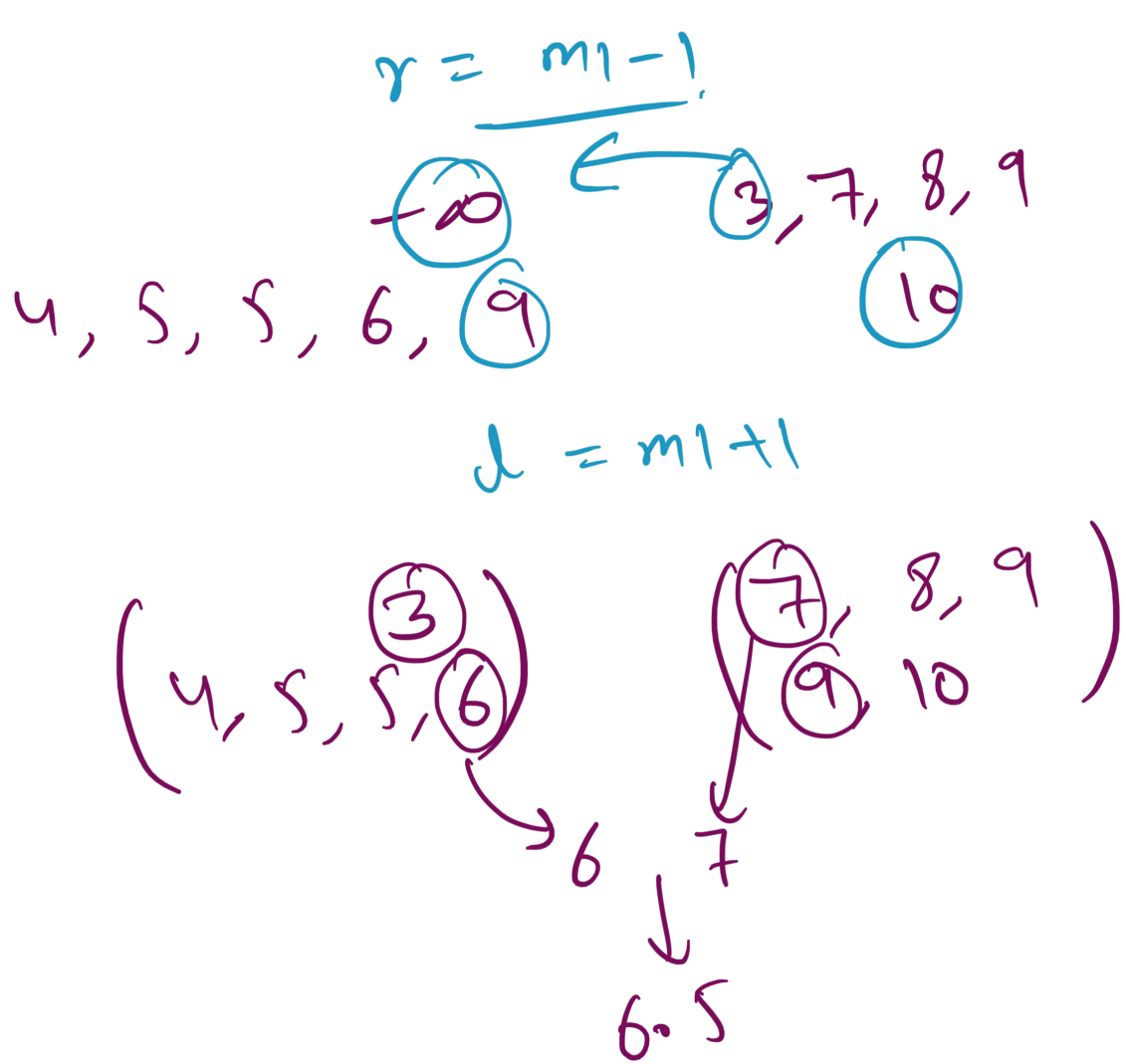
$a_3 = \{3, 4, 5, 5, 6, 7, 8, 9, 9, 10\}$

6.5

$m_1 = ~~2~~ ~~0~~ 1$

$m_2 = (n_1+n_2+1)/2 - m_1 = ~~3~~ ~~5~~ 4$




r = m1 - 1
20
3, 7, 8, 9
4, 5, 5, 6, 9
10
l = m1 + 1
3
4, 5, 5, 6
7, 8, 9
9
10
6
7
6.5

Practice Problems

1. https://www.interviewbit.com/courses/programming/binary-search