

# CLASS - 17

## Binary Search on Answe

4 - 5

Binary Search  
at - ?  
Hashing

$$\begin{array}{r} 0 \\ \times 6 \\ \hline 0 \end{array}$$

A hand-drawn diagram of a ruler with markings from 1 to 9. The first three markings are labeled 1, 2, and 3. The next two markings are grouped together in a box and labeled 67. The final two markings are grouped together in a box and labeled 90.

. 157  
113  
1a)

$$\begin{array}{r} 12134 + 67 \\ \hline = \end{array}$$

+ 90

## optimize Auswege

Binary search reduce

- Search Space

101  
203

$$\begin{array}{r} \cancel{2} \\ 203 + 101 \\ \hline \end{array} = \begin{array}{r} \cancel{3} \\ 304 \\ \hline \end{array} = \underline{\underline{502}}$$

A hand-drawn diagram of a soccer pitch. The field is outlined in red. Several players are represented by black circles with numbers. Red arrows indicate movement paths between players. Key numbers visible include 152, 126, 113, 90, 107, 34, 67, and 113. A small circle with a minus sign is also present.

$$\begin{array}{r} 152 \\ \times 101 \\ \hline 152 \end{array}$$

283

13  
o 1

214

A child's drawing of a person with a large head. The head contains a speech bubble with the numbers 12, 34, 67, 40, and 57. There are also some other scribbles and a red circle with a cross over the bottom right.

—  
67  
88

203

$O^{-1}O_2O_3$

log<sub>2</sub>(204)

火  
ao

threshold  
not possible

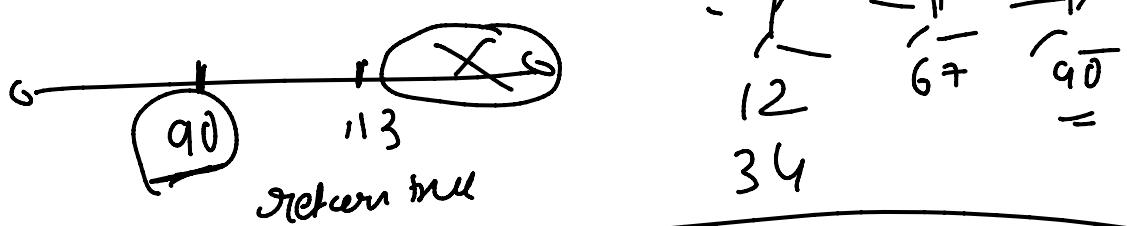
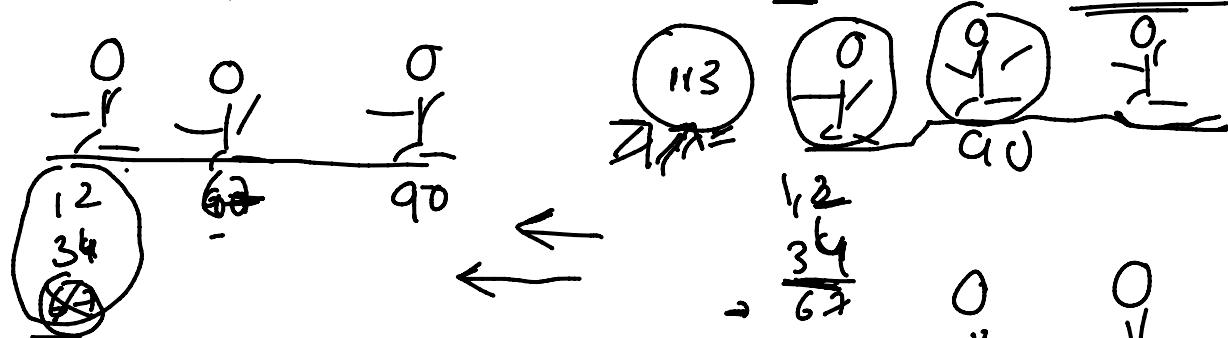
~~not ad~~  
 12  
 34  
 67

113  
 90  
 2 student

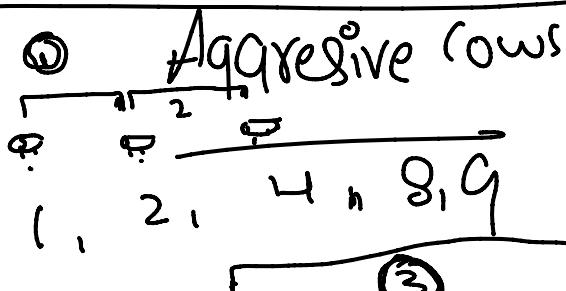
available =

not possible  
return false

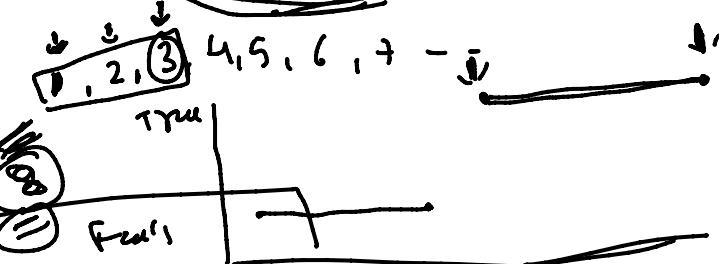
Total books available  $\geq$  Total available Student



min distance  
 binary 2 cows  
 max



- - optimize? distance?



1, 2, 4, 8, 9

1, 2, 4, 5, -1

range = ?

Min Possible ans:

int s = 0;

int e = Shell[n-1] - stalls[0]

$\log_2(10^9)$

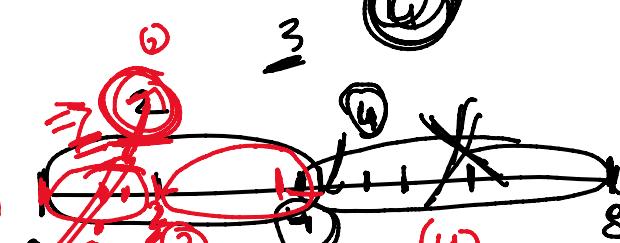
32

+  
0  
-

(6-?)

$$\frac{0+4}{2} = 2$$

$$1+3=4$$



distance (now)?

Threshold

$$2+4=6$$

$$1+3=4$$

$$3+4=7$$

$$4+4=8$$

$$5+4=9$$

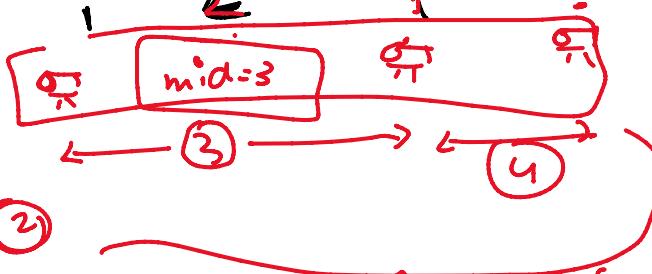
$$6+4=10$$

$$7+4=11$$

$$8+4=12$$

$$9+4=13$$

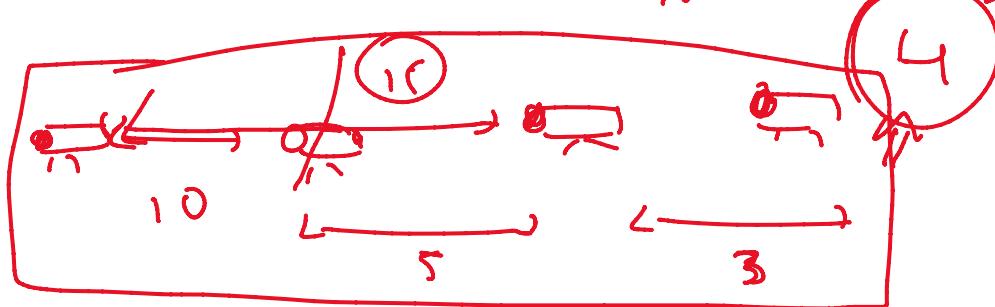
$$10+4=14$$



9

ans = 3

3 available

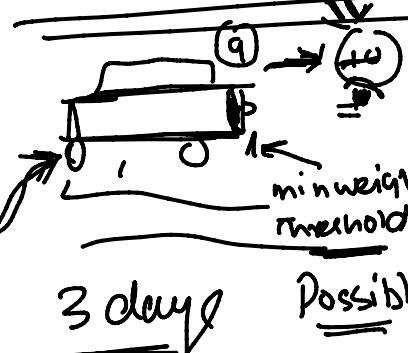
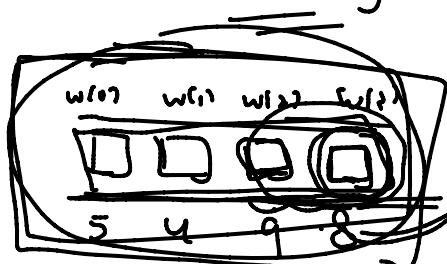


(3)

mid (3)

0...9 L. Sh. 0.1) Package within D days

# Capacity to Ship Packages within D days



1<sup>st</sup> day → 8  
2<sup>nd</sup> day → 9  
3<sup>rd</sup> day → 5+4  
= 9

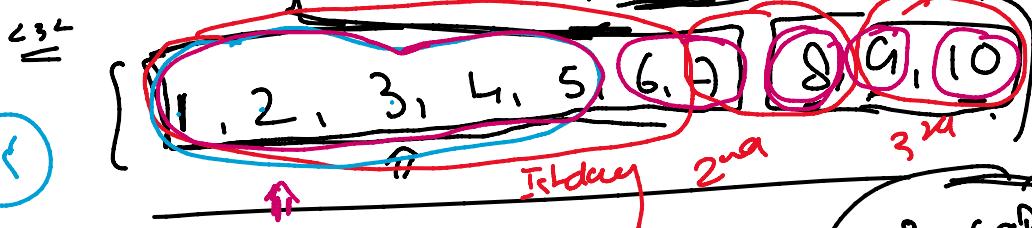
days

W Optimize? ship capacity

Range Min Capacity  $\Rightarrow$  Max Value, 0

26  
10<sup>a</sup>

Max Capacity  $\Rightarrow$  26



5 days

$$1 \text{ day} = \\ 2 \text{ day}$$

$$S = \emptyset \quad Q = 55$$

$$5 \text{ day} \\ \text{deliver} \\ 10 + 21 \\ = 31$$



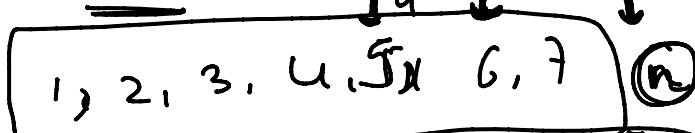
$$6f = 32$$

$$\begin{aligned} 15 + 10 &= 25 \\ 25 + 32 &= 57 \\ 57 &= 21 \end{aligned}$$

Capacity of 21  $\Rightarrow$  3

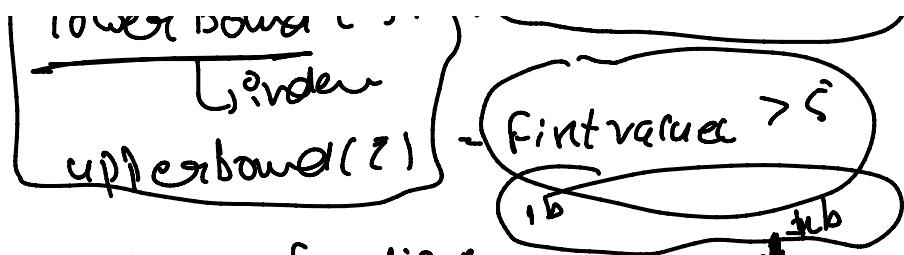
ans = 21

upper bound and lower bound



lower bound (5)  $\Rightarrow$  Fixt value

l<sup>o</sup>wer  $\rightarrow c$



Inbuilt STL Functions:

1, 2, 3, 4, 5, 5, 5, 6, 8, 9

lower\_bound ( start, end, value )

→ pointer return to that element

upper\_bound ( start, end, value )

it ↓      ↓ it1

1, 2, 3, 4, 4, 4, 5

B.S  
10110911

it1 - it

it1 - it = 3

a.

~~3+6=9~~  
~~2~~

1, 2, 3, 4, 4, 5, 5  
0 1 2 3 4 5 6

≥ 5

First element that is  $\geq$  target

$\frac{5+6}{2} = 5$

$\frac{0+6}{2} = 3$

if (a[mid] < target)

s = mid + 1

ans = 4

$\Rightarrow$  target

a[mid]  $\geq$  target

lower bound fix ele  
target

else if (a[mid] == target)

ans = mid

ans = 4

a[mid]  $\geq$  target

Vector<int> v

else if (a[mid] > target)

ans = mid - 1

1, 2, 3, 3, 4, 5, 5, 5  
0, 1, 2, 3, 4, 5, 6, 7

4  $\rightarrow$  lower bound

target = 4

ans = 6

... n - target

$\underline{0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7}$        $\text{if } \underline{\text{mid}} = \text{target}$

$$\frac{3+5}{2} = 4$$

$$\frac{0+5}{2} = 2$$

$\text{int } s=0; \quad \text{int } e=n-1;$

while ( $s <= e$ )

$\geq \text{target}$

$$\text{int mid} = \frac{s+e}{2};$$

if ( $\underline{\text{mid}} \leq \text{target}$ ) // This can't be lower bound  
 $\boxed{s = \text{mid} + 1;}$

upperbound  
 $\rightarrow \text{target}$   
 $\Downarrow$

else  $\Downarrow$        $\text{if } \underline{\text{mid}} > \text{target}$   
 $\boxed{s = \text{mid} - 1;}$        $e = \text{mid};$        $\text{cur} = \text{mid};$   
 $\Downarrow$        $\text{fix it}$

upperbound

while ( $s < e$ )

$\boxed{s = e}$

$$s = \text{mid};$$

$$e = \text{mid};$$

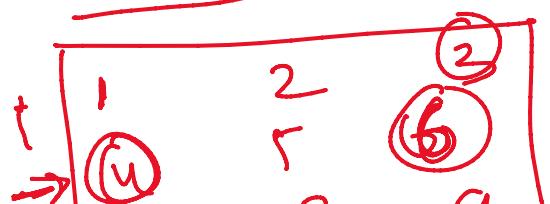
$1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \ 8$

$\boxed{1 \ 2 \ 3 \ 4 \ 5}$

lower  
 $\underline{\text{mid}}$

mid

Sorted



$\underline{e = \text{mid}}$

$$= \boxed{e = \text{mid};}$$

$$\Downarrow \quad \underline{e = \text{mid} - 1}$$

next fix else  $\rightarrow$

