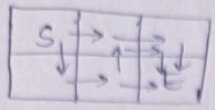
Date :.....

Page No. :.....

Grid Unique path



0 1 2 3

2 4 6 8

low mid high

low mid

$x = 7$

$\frac{0+3}{2} = 1$

$mid = \frac{2+3}{2}$

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

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

0 1 2 3 4

1 4 7 8 10 ; 7

low mid high

low mid

$\frac{3+4}{2} = \frac{6}{2}$

4

ans=0

ans= mid, 3

1 4 7 8 10

mid

0 1 2 3

1 2 4 7

low mid high

4 9

1 2 4 7

Same code for Upper bound

$\frac{3}{2} = 1$ remove '='

Lower Bound and Upper Bound

arr[] = {3, 5, 8, 15, 19, 19, 19}

0 1 2 3 4 5 6 n-1

Q: arr[index]

x = 8 | x = 9 | x = 16 | x = 19

lb = 2 | lb = 3 | lb = 4 | lb = 4

x = 11

arr[] = {1, 2, 3, 3, 7, 8, 9, 9, 9, 11}

low high mid high high

$mid = \frac{0+9}{2} = 4$

ans = 10

$mid = \frac{0+3}{2} = 1$

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

$\boxed{1} >= 1$

Code: // lower bound

```
int low=0;
int high=n-1;
int ans=n;
while(low<=high){
int mid=(low+high)/2;
if (arr[mid] >= x){
    ans = mid;
    high = mid-1;
}
else{
    low = mid+1;
}
}
return ans;
}
```

= O(log n)

// Upper bound.