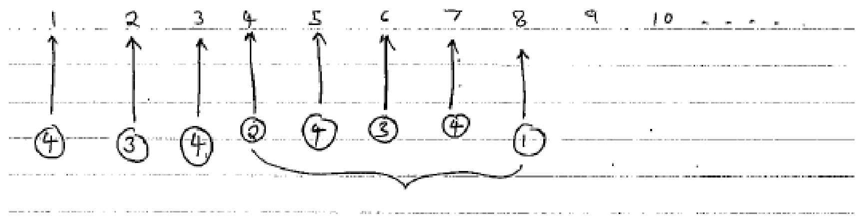
$\boldsymbol{W(n)}$ for Binary Search

Let say array of size 15 has following elements:



Elements	1	2	3	4	5	6	7	8	9	…	15
↓	↓	↓	↓	↓	↓	↓	↓	↓			↓
pass	4	3	4	2	4	3	4	1			

For the lower half:

Pass(es)	Elements
1	1
2	1
3	2
4	4

For a complete array:

Pass	**Total element**	**Array Size (n)**
1	1x1 = 1 = 2^0	2^0
2	1x2 = 2 = 2^1	$2^0 + 2^1$
3	2x3 = 4 = 2^2	$2^0 + 2^1 + 2^2$
4	4x2 = 8 = 2^3	$2^0 + 2^1 + 2^2 + 2^3$
i	2^{i-1}	$2^0 + 2^1 + \cdots + 2^{i-1} = 2^i - 1$

$$2^i - 1 = n$$

$$\log_2(2^i) = n + 1$$

$$i = \log_2(n+1)$$

Test some values:

Array Size (n)	$i = \log_2(n+1) = W(n)$
7	3
15	4
1023	10
1048576	20
15	4
16	4.0875
19	4.3219
29	4.9069
31	5

Let's test some values again:

Array Size (n)	$i = \log_2(n+1) = W(n)$	$i = \lceil \log_2(n+1) \rceil = W(n)$
7	3	3
15	4	4
1023	10	10
1048575	20	20
15	4	4
16	4.0875	5
19	4.3219	5
29	4.9069	5
31	5	5

For simplicity we can use $i = \log_2(n)$.