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# Binary Exponent

# Calculate $x^m$

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Simple Algorithm is as Below:

Algorithm Power(x,m)

1. ans=1
2. for i=1 to m
3.     ans=ans\*x
4. return ans

Number of Multiplication it takes =  $m-1$

Complexity =  $O(m)$

# Binary Exponent

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## Algorithm BINEXPONENT( $x, m$ )

- It calculates  $x^m$

1. let  $ans = 1$
2. Repeat step 9
3. divide  $m$  by 2 giving quotient  $q$  & remainder  $r$
4. if  $r = 1$
5.     then  $ans = ans * x$
6. if  $q = 0$
7.     return  $ans$
8. let  $m = q$
9. let  $x = x * x$
10. exit

# Time Complexity

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- Binary exponent takes maximum of  $2 * \text{floor}(\lg m) + 1$  multiplication instead of  $m-1$  for simple power algorithm.
- It's Complexity is  $O(\lg m)$  compare to  $O(m)$  for simple power algorithm.