**NANYANG TECHNOLOGICAL UNIVERSITY**
**School of Electrical & Electronic Engineering**

**IE2108 Data Structures and Algorithms**

**Tutorial No. 08 (Sem 1, AY2022-2023)**

1. Find the index of the element 22 in the following array by applying the binary search algorithm. How many times is the binary search algorithm faster than the linear search in this case?

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 5 | 7 | 8 | 9 | 12 | 14 | 17 | 19 | 22 | 25 | 27 | 28 | 33 | 37 |

2. Write an algorithm for the recursive implementation of binary search.

3. Trace the algorithm in Question 2 when searching for the element 8 in the array given in Question 1.

4. Given an unsorted long array A and a target value b. The task is to find out whether or not b is in A. Is it better to do a linear search to A or first sort A using merge sort and then do a binary search on the sorted array?

5. Answer Question 4 again if you need to perform the search for（n/2) different b values, where n is the length of array A.

6. Explain how the following 2 algorithms compute $x^n$. Compare the time and space complexities of the 2 algorithms.

```
Algorithm 1:

power (x, n) {
   if n == 0
      return 1
   else
      return x * power(x, n-1)
}

Algorithm 2:

power (x, n) {
   if n == 0
      return 1
   else {
      temp = power(x, n/2)
      result = temp * temp
   }

   if n%2 == 1   # if n odd
      result  = result * x

   return result
}
```