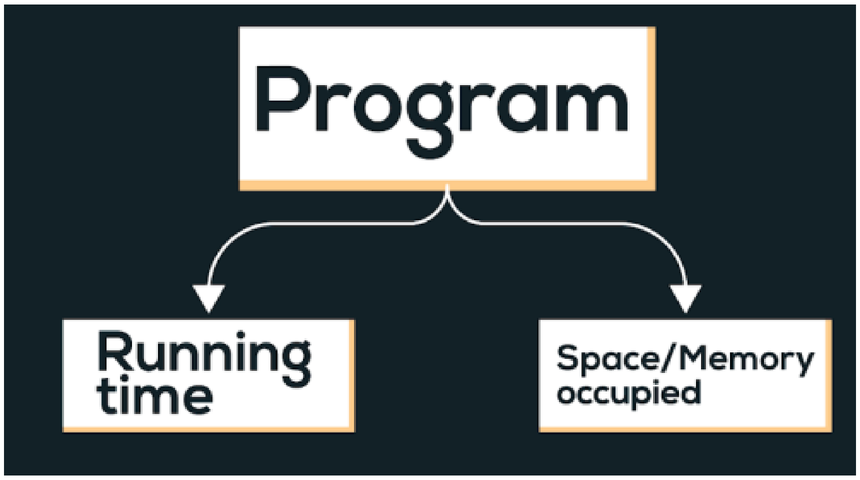
Java - Introduction to Programming
Lecture 8

Time & Space Complexity

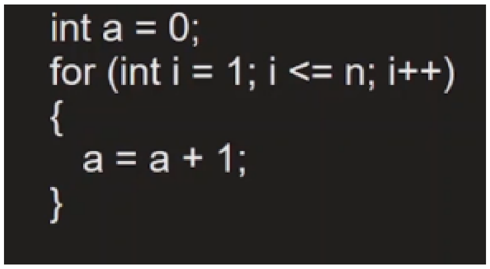


Time complexity of an algorithm quantifies the amount of time taken by an algorithm to run as a function of the length of the input.

Types of notations

1. O-notation: It is used to denote asymptotic upper bound. For a given function g(n), we denote it by O(g(n)). Pronounced as “big-oh of g of n”. It is also known as worst case time complexity as it denotes the upper bound in which the algorithm terminates.
2. Ω-notation: It is used to denote asymptotic lower bound. For a given function g(n), we denote it by Ω(g(n)). Pronounced as “big-omega of g of n”. It is also known as best case time complexity as it denotes the lower bound in which the algorithm terminates.
3. ϴ-notation: It is used to denote the average time of a program.

Examples :



```
int a = 0;
for (int i = 1; i <= n; i++)
{
   a = a + 1;
}
```

Linear Time Complexity. O(n)

Comparison of functions on the basis of time complexity

It follows the following order in case of time complexity:

$O(n^n) > O(n!) > O(n^3) > O(n^2) > O(n.\log(n)) > O(n.\log(\log(n))) > O(n) > O(\mathrm{sqrt}(n)) > O(\log(n)) > O(1)$

Note: Reverse is the order for better performance of a code with corresponding time complexity, i.e. a program with less time complexity is more efficient.

Space Complexity

Space complexity of an algorithm quantifies the amount of ~~time~~ Space taken by a program to run as a function of length of the input. It is directly proportional to the largest memory your program acquires at any instance during run time.

For example: *int* consumes 4 bytes of memory.