Algorithms
CSE 2415

Md. Hasan

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Introduction

Algorithm is a sequence of steps / step-by-step procedure to solve a problem.

Properties of Algorithm:

- Specific input
- Specific output
- Definiteness
- Finiteness
- Effectiveness

Time and Space Complexity

Examples:

```
Algorithm:

int i, j;
for(i = 0; i < n; i++){
    for(j = 0; j < n; j++)
        printf(" \%d ", i+j);
}
```

```
space complexity
cost      repeat      total
 1          1           1
1+1+1    1+(n+1)+n     2n+2
1+1+1  (1+(n+1)+n)+n  2n^2+2n
 1         n^2         n^2

F(n)= 3n^2 + 3n + 1
TC -> O(n^2)
```

```
Space complexity
cost  repeat  total
i= 4     1     4
j= 4     1     4
n= 4     1     4

S(n)= 12
SC -> O(1)
```

```
Algorithm:

int i, j, n, A[i][j], B[i][j], C[i][j];
for(i = 0; i < n; i++){
    for(j = 0; j < n; j++)
        C[i][j] = A[i][j] + B[i][j];
}
```

```
space complexity

cost      repeat       total
  1          1           1
1+1+1    1+(n+1)+n      2n+2
1+1+1   n+n(n+1)+n^2   2n^2+2n
  1         n^2          n^2

F(n)= 3n^2 + 4n + 3
 TC -> O(n^2)
```

```
Space complexity

 cost  repeat  total
 i=4     1       4
 j=4     1       4
 n=4     1       4
A[][]   4*n*n   4n^2
B[][]   4*n*n   4n^2
C[][]   4*n*n   4n^2

S(n)= 12n^2 + 12
 SC -> O(n^2)
```

```
Algorithm:

int i, n;
for(i = 0; i < n; i++)
    printf(" \%d ", 2*i);
```

```
space complexity

cost        repeat      total
  1           1           1
1+1+1  1+(n/2)+1+(n/2)   n+2
  1          n/2         n/2

F(n)= (3n/2) + 3
 TC -> O(n)
```

```
Space complexity

  cost  repeat  total
  i=4     1       4
  n=4     1       4

S(n)= 8
 SC -> O(1)
```

Algorithm:

```
int p=0, i, n;
for(i = 1; i <= p; i++)
    p+=1;
```

Step analysis:

```
i       p
0      0+1
1     0+1+2
2    0+1+2+3
3   0+1+2+3+4
.       .
.       .
.       .
k 0+1+2+3+4+...+k = k*(k+1)/2
```

assume , p>n where step number is k and p = k*(k+1)/2