Recursion - III

Permutation

To print all the permutations of a string.

Idea: for each character s[i] in the given string, we add a character in the ans string and then solve solve s.substr(0,i) + s.substr(i+1)

Sample Input:

ABC

Sample Output:

ABC

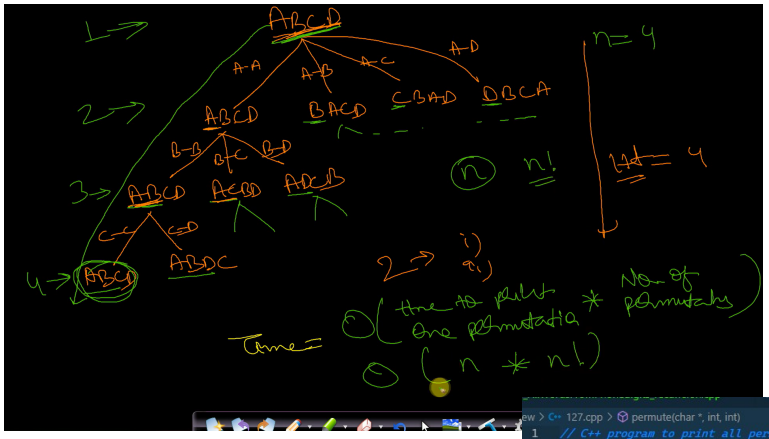
ACB

BAC

BCA

CAB

CBA



Time Complexity: $O(N*2^n)$

Space Complexity: $O(2^n)$

```cpp
// C++ program to print all permutations with duplicates allowed
#include <bits/stdc++.h>
using namespace std;

/* Function to swap values at two pointers */
void swap(char *x, char *y)
{
    char temp;
    temp = *x;
    *x = *y;
    *y = temp;
}

/* Function to print permutations of string
This function takes three parameters:
1. String
2. Starting index of the string //left
3. Ending index of the string. //right */

// for swapping we g=have used a pointer at string as initially it will point at index 0
void permute(char *a, int l, int r) {
    if (l == r)
        cout<<a<<endl;
    else{
        for (int i = l; i <= r; i++) {
            swap((a+l), (a+i)); //combination
            permute(a, l+1, r);
            swap((a+l), (a+i)); //backtrack
        }
    }
}

/* Driver program to test above functions */
int main()
{
    char str[] = "ABC";
    int n = strlen(str);
    permute(str, 0, n-1);
    return 0;
}
```

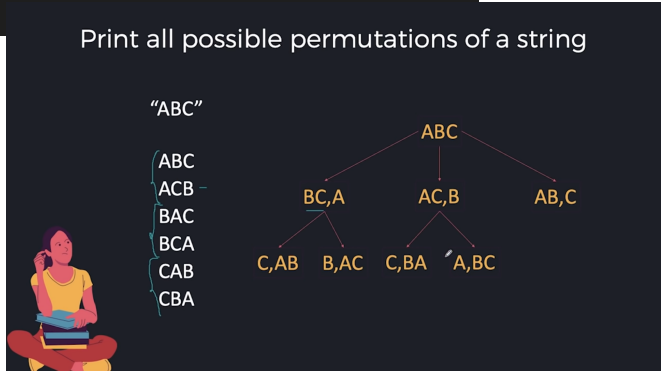
```cpp
void permutation(string s, string ans) {

    if (s.length() == 0) {
        cout << ans << endl;
        return;
    }

    for (int i = 0; i < s.length(); i++) {
        char ch = s[i];
        string ros = s.substr(0, i) + s.substr(i + 1);

        permutation(ros, ans + ch);
    }
}
```

permutation(s, “”) will give the required answer



CountPaths

Find the number of ways to reach e from s.

Idea:

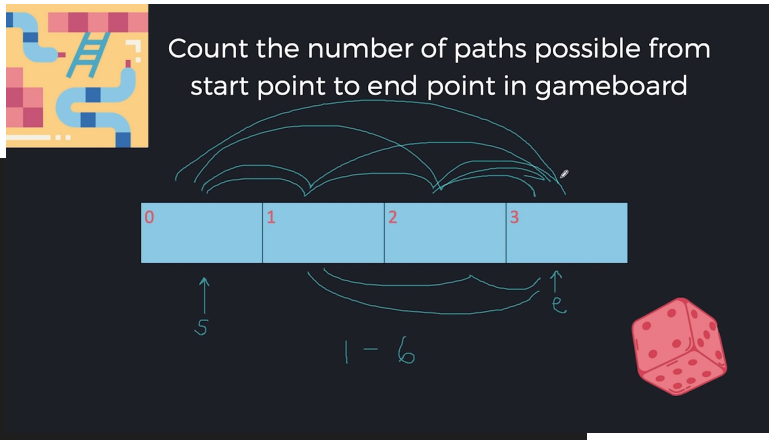
We have 6 ways to go forward (1,2,3,4,5,6).

At the starting point s,

Current answer = countPath(s+1,e) + countPath(s+2,e) + countPath(s+3,e) + countPath(s+4,e) + countPath(s+5,e) + countPath(s+6,e)

Time Complexity: $O(2^n)$

Space Complexity: $O(2^n)$




```
int countPath(int s, int e) {
    if (s == e) {
        return 1;
    }
    if (s > e) {
        return 0;
    }
    int count = 0;
    for (int i = 1; i <= 6; i++) {
        count += countPath(s + i, e);
    }
    return count;
}
```

CountPathMaze

Given a 2D grid, find the number of ways to reach (n-1, n-1).

You can go to (i,j) from (i-1,j) and (i,j-1).

Time Complexity: $O(2^n)$

Space Complexity: $O(2^n)$

```java
int countPathMaze(int n, int i, int j) {
    if (i == n - 1 && j == n - 1) {
        return 1;
    }
    if (i >= n || j >= n) {
        return 0;
    }

    return countPathMaze(n, i + 1, j) +
           countPathMaze(n, i, j + 1);
}
```

Count the number of paths possible in a maze