

# Recursion Problems - 2

# In This Lecture

1. Palindrome String
2. Count occurrences of String in another String
3. Print All Subsets of a given String

# Palindrome String

$l > r$   
 $S = a b a, aa, c, racecar$   
 $l = 0$   
 $r = 0$

Problem  $\rightarrow$  subproblem

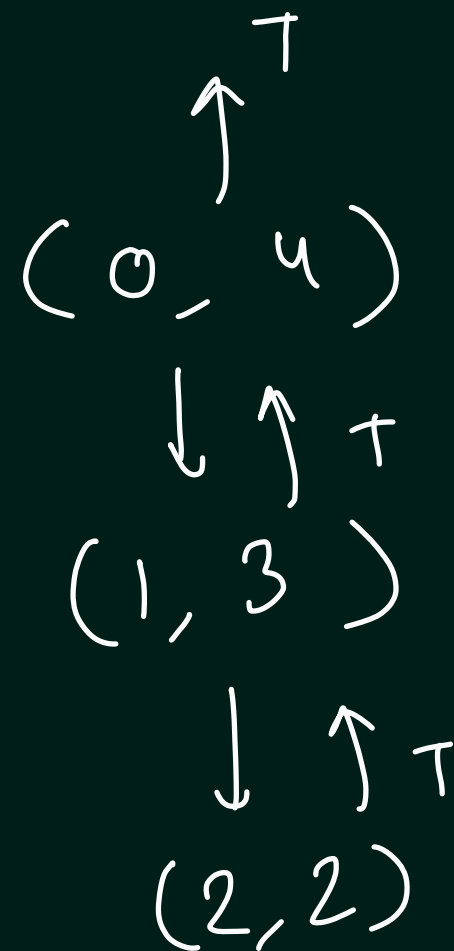
$a b c b a$   
 $r(a c e c a)r$   
 $l = r$

$p(s, l, r)$   
 if  $(l \geq r)$  return true;  
 if (extrem ends match)  
 return  $p(s, l+1, r-1);$

# Palindrome String

$l = 0$   $r = 4 \rightarrow s.length() - 1$   
 $5 - 1 = 4$   
 $[a \quad b \quad (c) \quad b \quad a]$

$(b \quad c \quad b)$



Recursive leaf of

FAITH

# Count substrings in a String

S = a b c b b a b a c  
 0 1 2 3 4 5 6 7 8

$$\begin{array}{r} 6 + 3 = 9 \\ \hline \end{array}$$

(s q)    ↙

t = a b a

Base case

$$[i + t.length > s.length]$$

$$i > s.length - t.length$$

# Count substrings in a String

$s = \text{a(b a b a b)}$   
           0 1 2 3 4 5  
 $t = \text{aba}$   
 $i \rightarrow$   
 $\text{a b a b a b} \rightarrow 0$   
       ↓ ↑ 1  
 $\text{b a b a b} \rightarrow 1$   
       ↓ ↑ 1  
 $\text{a b a b} \rightarrow 2$   
       ↓ ↑ 0  
 $\text{b a b} \rightarrow 3$   
       ↓ ↑ 0  
 $\text{a b} \rightarrow 4$

logic

```

2 usages
static int countOccurrencesHelper(String t, String s, int i) {
    if(i > s.length() - t.length()) {
        return 0;
    }
    int subProblemKaAnswer = countOccurrencesHelper(t, s, i+1);

    boolean doStartingCharsMatch = s.substring(i, i+t.length()).equals(t);

    if(doStartingCharsMatch) return subProblemKaAnswer + 1;
    else return subProblemKaAnswer;
}
    
```

# Print All Subsets of a given String

$S = abc \rightarrow '', a, b, c, ab, ac, bc, abc$

Count  $\rightarrow$  length = n  
 $\rightarrow$  Total  $\rightarrow 2^n$

$(bc) \rightarrow '', b, c, bc$

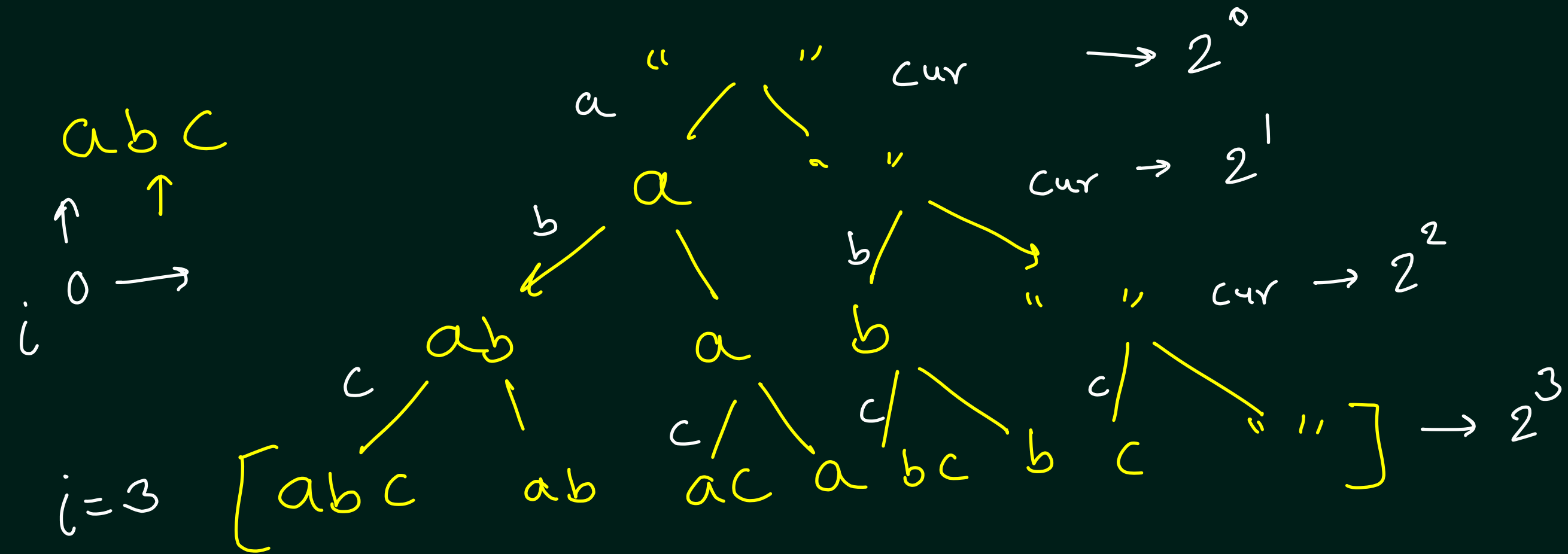
$(a, b, c)$

$\downarrow \uparrow \rightarrow [a * ('', b, c, bc), '', b, c, bc]$

$(bc)$

$[a, ab, ac, abc, '', b, c, bc]$

# Print All Subsets of a given String



$$T(n) = 2T(n-1) + C$$

$$2^0 + 2^1 + 2^2 + \dots + 2^n$$

$$= 2^{n+1}$$

↪  $O(2^n)$