kth Symbol in Grammar

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1 0
2 0 1
3 0 1 1 0
4 0 1 1 0 1 0 0 1

complement.

8/4.

if k ≤ mid.
solve (n-1, k)

Since same as prev. row.

if k > mid.
(solve (n-1, k % mid).

(k % mid)

n == 1 && k == 1
return 0;

length = pow(2, n-1).
mid = length/2;

pow

$2^0 = 1$
$2^1 = 2$

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Towers of Hanoi

```
void TOH(int n, int from_rod, int to_rod,
                    int aux_rod)

if (n == 1)
    cout << from_rod << " " << to_rod
                                dest = aux_rod for n-1
***
TOH(n-1, from_rod, aux_rod, to_rod)

cout << from << " " << aux_rod
        _rod

***
TOH(n-1, aux_rod, to_rod, from_rod)

return n;
```

Print subsets

An recursive tree; base condition is leaf node

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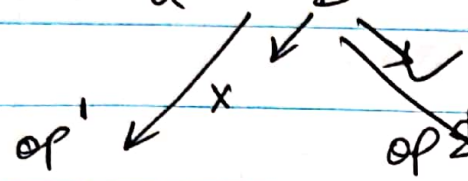
① "a" "b"



"a" " " "ab" " "

↑input

```
if (input.length() == 0) {
    cout << op << endl.
    return;
}
Str op1 = op
Str op2 = op.

op2 += Str[0]

input.erase(input.begin() + 0)

Solve (input, op1)
Solve (input, op2)

return
}
```

Unique Subsets

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① Use a vector of strings and push all subsets in the vector

② Use `set` to get unique subsets

Print all subsets → Print all powersets

Print all Subsequences → Same hi kara do.

Print Powerset / subsequence / all subsets } Write same code

If O/P wanted in lexicographical order; put in vector and sort.

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Powerset
= All subsets of a set.

Print all subsets ≡ Print powersets

Substring	→	(continuous)
Subsequence	→	(Not continuous) Order matters
Subset	→	Order also not matters

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Permutation with spaces

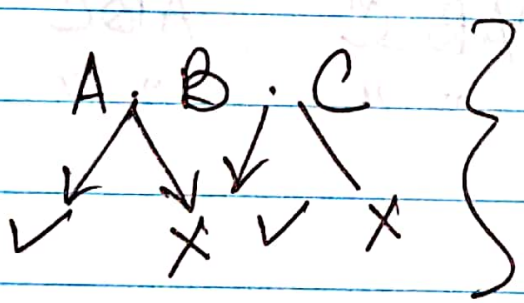
ABC

A _ B _ C

A B . C

A B _ C

ABC



} Choice + Decision.

Recursive Tree

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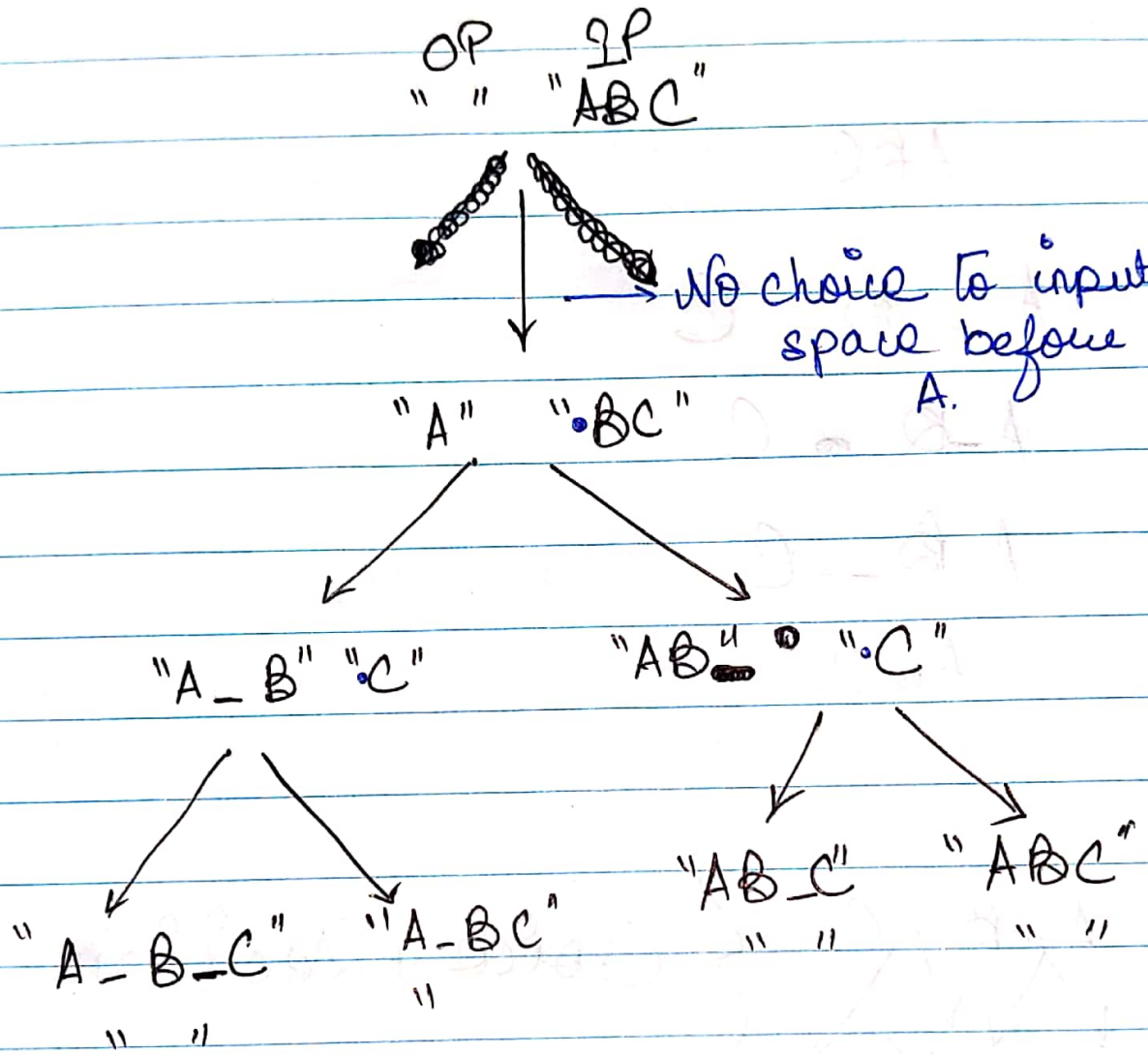
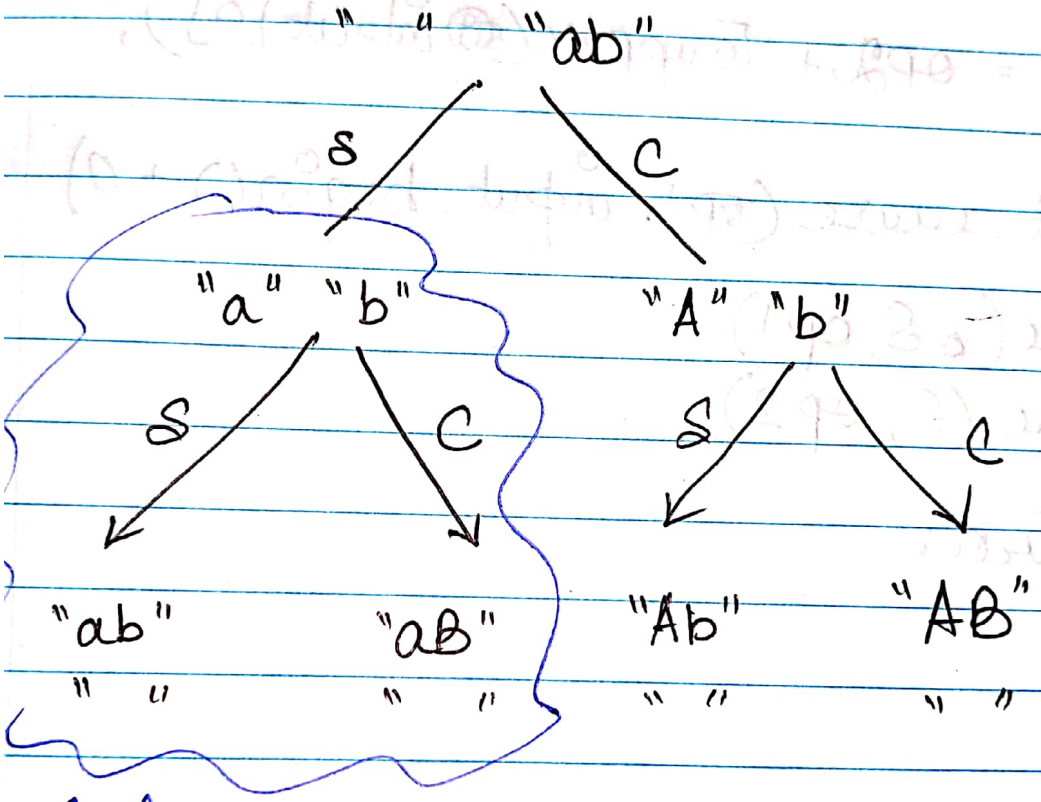


Code for Recursion in Love Babbar 450.

Permutation with case change

IP = ab

OP = ab aB Ab AB.



Code

```
if (input.length() == 0) {
    cout << op << " "
    return;
}
```

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```
string op1 = op;
string op2 = op;

op1 += op1 + input[0];
op2 = op2 + toupper(input[0]);

input.erase(input.begin() + 0)

solve(S, op1)
solve(S, op2)

return;

}
```

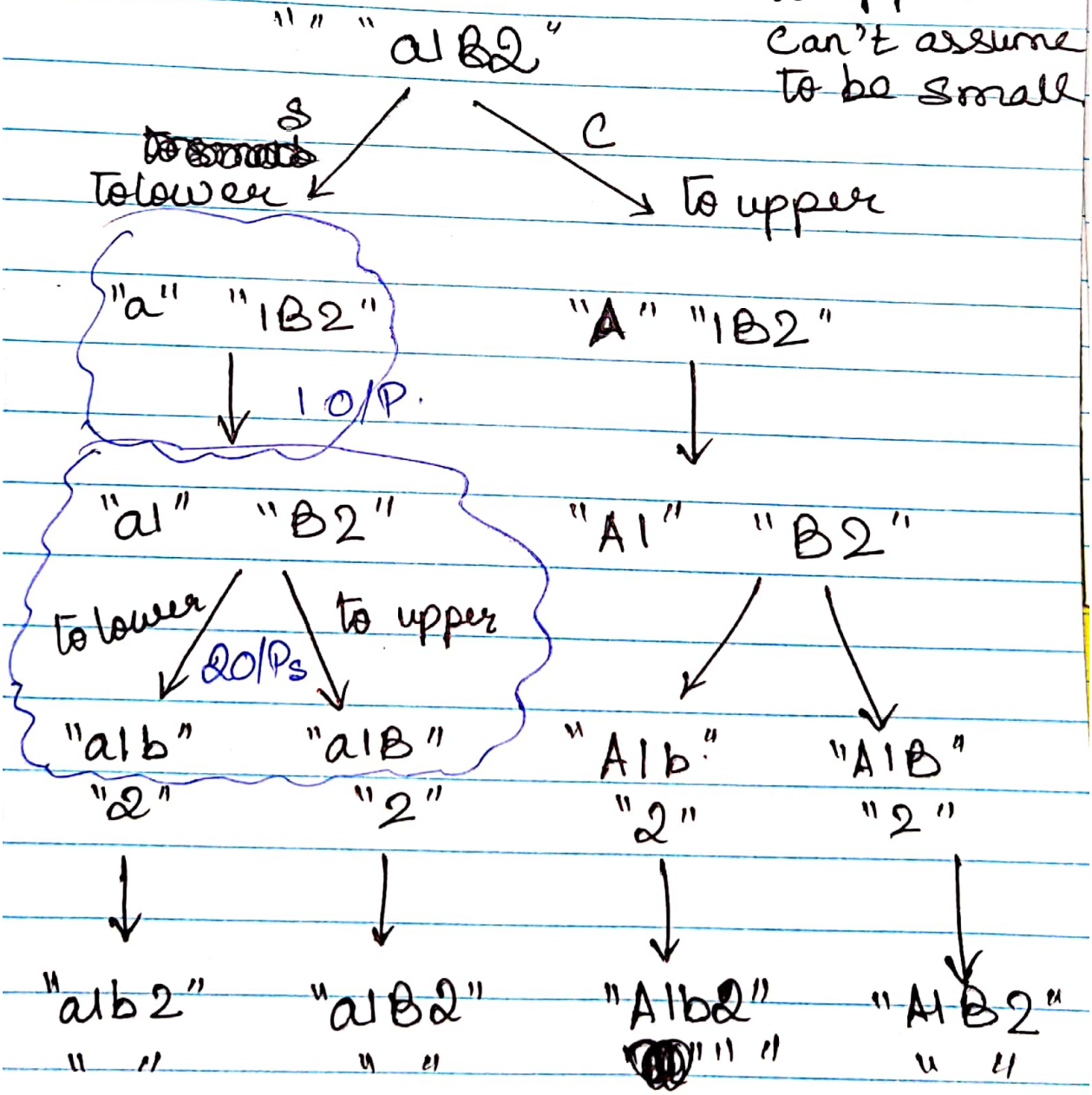
Letter case Permutation (LeetCode)

Only changes from prev.

① Ip input can be small/capital

② digit also included.

(use to lower / to upper
can't assume to be small)



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Generate all Balanced Parenthesis

Given an integer n, representing the number of pairs of parenthesis the task is to generate all combinations of balanced parentheses.

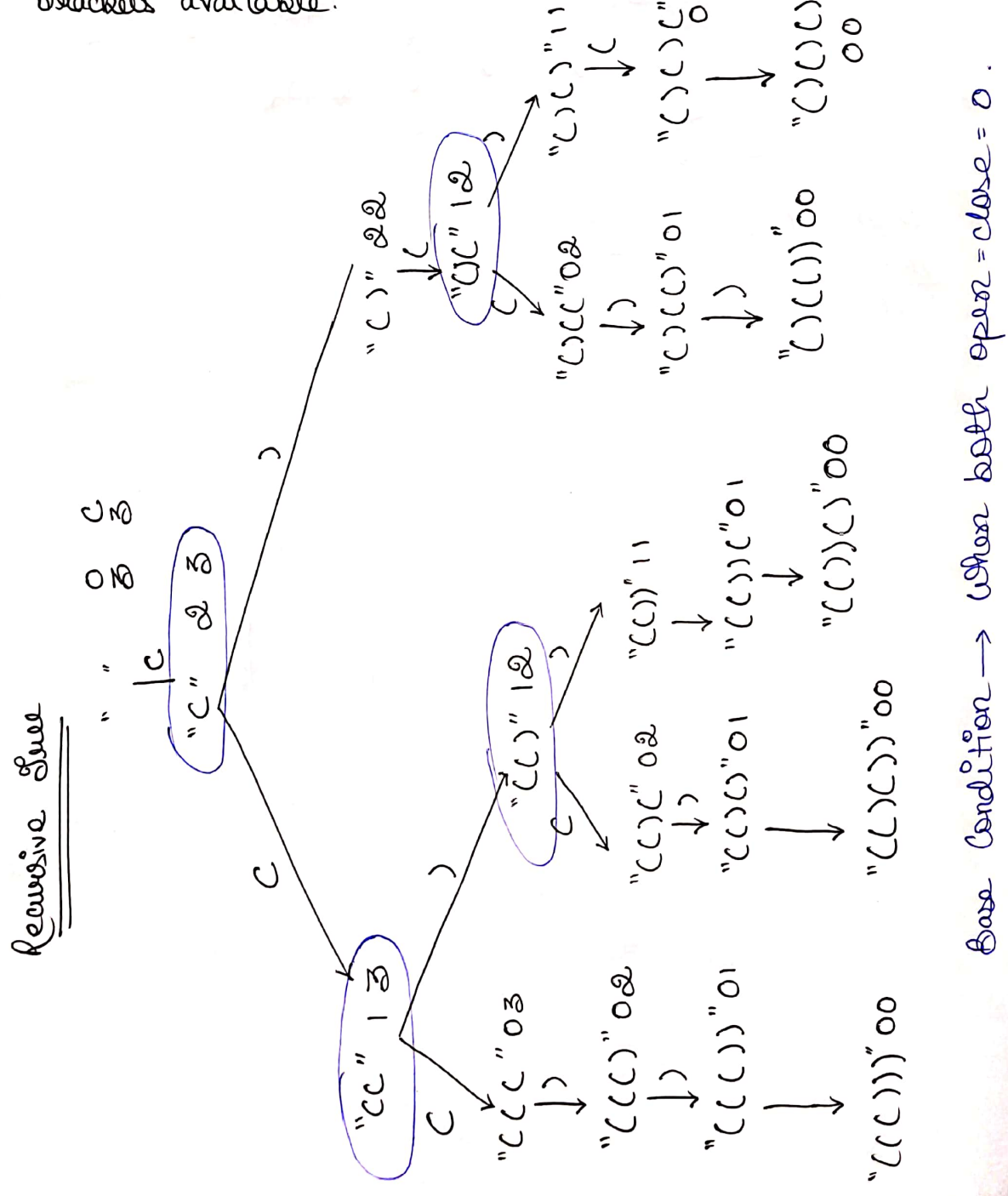
— x —

I/P - 3

O/P - ['((()))', '(()())', '(())()', '()(())'
'()()()']

Create 2 variables that keeps track of no. of open/close brackets available.

Recursive Tree



Choices

① We have choices of "(" always until no. available is 0.

② We have choices of ")" only when no. of close brackets > no. of opening brackets.

Code

```
void util(string op, int open, int close, vector<string>& res){
    if(open == 0 && close == 0){
        res.push_back(op);
        return;
    }
    if (open != 0){
        string op1 = op;
        op1 += "(";
        util(op1, open - 1, close, res);
    }
    if (close > open){
        string op2 = op;
        op2 += ")"
        util (op2, open, close-1, res);
    }
    return;
}

vector<string> AllParenthesis(int n){
    vector<string> res;
    int open = n;
    int close = n
    string op = ""
    util(op, open, close, res);
    return res;
}
```

#Print N-bit binary numbers having more 1's than 0's.

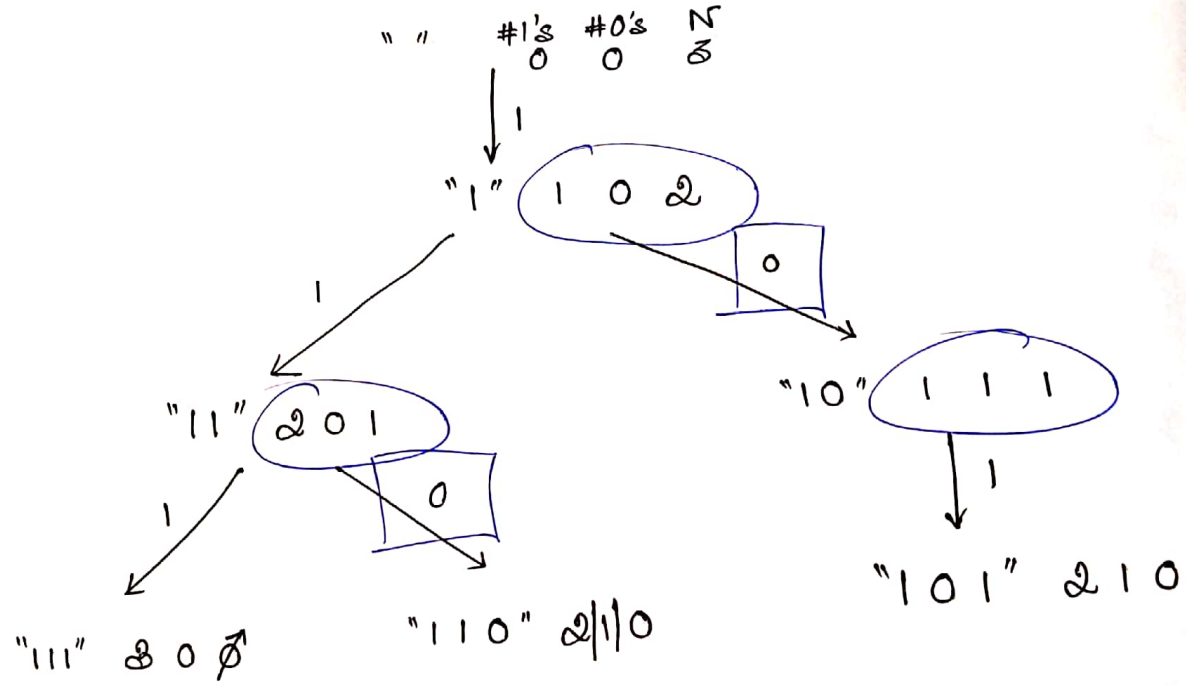
Find all possible N bit binary numbers having more than or equal number of 1's than 0's for any prefix.

—x—

N = 3

O/P => 111 110 101

Recursive Tree



Conclusions

① A "1" is available always.

② We can include a "0" only when

#1s > #0s.

③ Base condition (N=0).

Code

```
void util(int N, int ones, int zeros, string op, vector<string> & res){
    if(N == 0){
        res.push_back(op)
        return;
    }
    string op1 = op;
    op1 += "1";   // Choice of one always available
    util(N-1, ones+1, zeros, op1, res);

    if(ones > zeros){ // Choice of zero only when #1's > #0's
        string op2 = op;
        op2 += "0";
        util(N-1, ones, zeros+1, op2, res);
    }
    return res;
}

vector<string> NBitBinary(int N){
    vector<string> res;
    int ones = 0, zeros = 0;
    string op = "";
    util(N, ones, zeros, op, res);
    return res;
}
```