Problem 1. Coin Change Problem

Given a value N, If we want to make change for N cents, and we have infinite supply of each of $S = \{S1, S2, .., Sm\}$ valued coins, how many ways can we make the change?

The order of coins doesn't matter.

Solution: Steps for creating memoization matrix.

1. > Exclude the new coin
2. > Include the new coin
3. > Add the number of ways (1)+(2)

base condition

coins \ Total	0	1	2	3	4	5
0	1	0	0	0	0	0
1	1	1	1	1	1	1
2	1	1	2	2	3	3
3	1	1	2	3	4	5
4	1	1	2	3	5	6
5	1	1	2	3	5	7

→ this cell represents the number of ways to make a total of 3 by using coins of denominations of 0, 1, 2.

Ques. What is new coin?

Ans: consider case of cell T[2][5].

(1) Exclude case: {0, 1} → total of 5.
∴ No of ways is 1 i.e T[1][5]

(2) Include case: {0, 1, 2} → total of 5
2 + 3 = 5
{0, 1, 2} problem drills down to total 3 using {0, 1, 2}

(3) i.e T[2][3] = 2
And now Add i.e 2+1 = 3 ways.

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#- If $r > c$, then just copy the value from above cell.

Code 1:

```
public int dynamicCoin(int[] c, int amount)
{
    int res[][] = new int[c.length+1][amount+1];

    for(int i=0; i<=c.length; i++){
        res[i][0] = 1;

    for(int i=1; i<=amount; i++)
        res[0][i] = 0;

    for(int i=1; i<=v.length; i++){

        for(int j=1; j<=amount; j++) {

            if(c[i-1] <= j){

                res[i][j] = res[i-1][j] + res[i][j-c[i-1]];
            }
            else{

                res[i][j] = res[i-1][j];
            }
        }
    }
    return res[c.length][amount];
}
```

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// Simple apna code

```
public int coinchange(int[] c, int amt)
{
  int[][] res = new int[c.length+1][amt+1];

  for(int i=0 ; i< c.length+1 ; i++)
  {
    for(int j=0; j< amt+1 ; j++)
    {
        if (i==0)
       {   if (j==0)
             res[i][j] =1;
          else
             res[i][j]=0;
       }

     else if ( i>=j){

        res[i][j] = res[i-1][j] ;
     }
    else
     {
        res[i][j] = res[i-1][j]+ res[i][j-i];
     }
    }
  }
  return res[c.length][amt];
}
```

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