← Notes

▲ Dynamic Programming for Beginners. Part 2 (1-D)
12   Dynamic Programming

Now that we are introduced to the concept of Dynamic Programming (DP) , let us start doing some real analysis . In this note I am going to conclude 1-D DP

Let us start of with a problem :

Q. Given a number , find the different number of ways to write this number as the sum of { 1 , 2 , 3 } (say) . --> Say , the given number is 5 . We can represent it as,

```
5 - 1+1+1+1+1
    1+1+1+2
    1+1+2+1
    1+2+1+1
    2+1+1+1
    1+1+3
    1+3+1
    3+1+1
    2+2+1
    2+1+2
    1+2+2
    2+3
    3+2
```

The answer is 13 .

Now think for a while how you can solve this problem using DP !!!!!

Sub - problems : Let for n ,

```
n = 1 ,  the answer is 1 .
n = 2 ,  the answer is 2 . ( 1+1 , 2 )
n = 3,  the answer is 4. ( 1+1+1 , 1+2 , 2+1  , 3 )
```

and so on . Let us consider a array D to store all our values

```
D[k] = 0 , k<1
D[1]=1 , D[2]=2, D[3]=4
```

We just got our base cases!!!

Recurrences : Consider the recurrence ,

```
n = x1 + x2 + ... + xn
```

If $xn = 1$, then the rest of the term must add up to $n-1$.

In our given problem , the relation would be ,

```
Dn = Dn-1 + Dn-2 + Dn-3
```

Now we are done . Try to implement the above details .

Short answer (:)) ,

```
for( int i = 4 ; i<=n ; ++i )
D[i] = D[i-1] + D[i-2] + D[i-3]

For n=5 , D[5]=13 (check)
```

This problem is a variation of the classical "Coin Change" problem .(See O(n) implementation using 1-D array)

http://www.geeksforgeeks.org/dynamic-programming-set-7-coin-change/

So , we can see that problems involving simple recurrences can be solved using DP with linear time complexity .

Try solving these problems using 1-D DP :

http://poj.org/problem?id=2663

http://www.spoj.com/problems/ACODE

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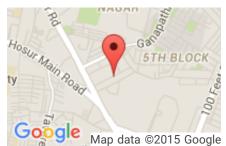Terms of Service

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