slow.coder's blog

Tiling With Dominoes(DP solution)

By **slow.coder**, history, 21 month(s) ago,

UVa 10918 — Tri Tiling.

In short, You are given the value of **N**, now determine in how many ways you can completely tiled a **3xN** rectangle with **2x1** dominoes. Here is a possible soln: Algorithmist — UVa 10918. My question is, how is the recurrence defined? Here,

```
********     AA*******    AA******    A*******
********  =  BB*******  + B*******  + A*******
********     CC*******    B*******    BB******
  f(n)    =   f(n-2)    +  g(n-1)   +  g(n-1)
```

Isn't it possible as:

```
********     AA*******    AA******    AA******
********  =  BB*******  + BA******  + AA******
********     CC*******    BA******    BB******
  f(n)    =   f(n-2)    +  f(n-2)   +  f(n-2)
```

or like others....(actually I want to know it). How can I define such type of recurrence?

Actually I want to know, what type of thinking should I keep in mind while defining recurrence for **Tiling Block** *problem???*

Thanks in advanced. :)

dynamic programming, **tiling blocks**

-3 slow.coder 21 month(s) ago 12

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slow.coder

21 month(s) ago, # | 0

Auto comment: topic has been updated by ***slow.coder*** *(previous revision, new revision, compare).*

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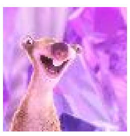
Sa1378

21 month(s) ago, # | ← Rev. 3 0

You don't have to do it in O(N) time...

You can continue to put dominoes and do it in O(N^2)... (I wish I'm not wrong)

For example:

```
A***          AC**
A***  ---->   AC**    f(n-2)
BB**          BB**
```

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```
|
|
v

ACC*        ACCF
ADD*  ---->  ADDF  f(n-4)
BBEE        BBEE

|
|
v

ACCFF*
ADDGG*
BBEEHH

And...
```

NOTE : I want to sleep now and don't have time but I think maybe you can do this in O(N) too...by saving sum of all f(2i) and f(2i+1) in two integers

→ Reply

slow.coder

21 month(s) ago, # ^ | ← Rev. 4 0

@Sa1378

Ok. But why

```
f(n)  =  f(n-2)  +  g(n-1)  +  g(n-1)
```

is the recurrence??? Suppose, I know nothing about the given recurrence in the soln, then how can I feel the idea of recurrence??? Let it is **4xN(, 5xN, 6xN,....., MxN)** then what would be the recurrence relation? How can I develop it step by step?

→ Reply

Kostroma

21 month(s) ago, # | ← Rev. 2 +1

Searching for good tutorials about dynamic programming approach for this problem, I have accidentally found this presentation. The guys claim they can find the number of domino tilings of the $m \times n$ rectangle in polynomial time (it seems like $O((nm)^3)$ algorithm). I haven't had time to understand the full presentation yet, but this fact was quite unexpected to me. Have you guys heard about it before? :)

→ Reply

LLI_E_P_JI_O_K

21 month(s) ago, # ^ | 0

Yes, for example, see acm.timus.ru problem "Aztec treasure" ("Сокровища ацтеков"), here is such problem for 100x100 grid =))

This interesting method firstly was presented to ACM in Petrozavodsk winter camp 2009. Team of Yekaterinburg try to tell us solution, which was described in some big article (40-50 pages in size).

If you want, I can see for some hint or link for you.

→ Reply

birne

21 month(s) ago, # ^ | 0

Can you give me this article, please? I solved this problem several years ago but almost forgot solution.

Proof: http://acm.timus.ru/status.aspx?space=&num=1594&author=64460

→ Reply

21 month(s) ago, # ^ | 0

Ok. I can search it in the evening later... Don't

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Ok, I can search it in the evening later... Don't promise that really have this article now, I'm not sure.

→ Reply

LLI_E_P_JI_O_K

LLI_E_P_JI_O_K

21 month(s) ago, # ^ | 0

time is O((n+m)^3), not O((n*m)^3)

→ Reply

Kostroma

21 month(s) ago, # | 0

As for your question, you can find some clues in this tutorial.

→ Reply

slow.coder

21 month(s) ago, # ^ | ← Rev. 3 0

@**Kostroma**

Truth to tell I have already found the tutorials which you have referred.... Please give your idea if any to understand the psychology of the recurrence of **Tiling Block** problem soln.... :)

→ Reply

draughtsman

21 month(s) ago, # | 0

I found this useful when I was first learning how to solve these types of problems.

→ Reply

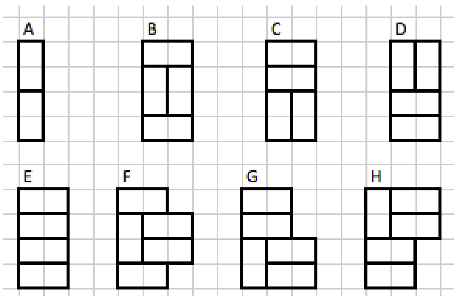
slow.coder

21 month(s) ago, # ^ | ← Rev. 13 0

@Governer

WoW!!! This is an awesome tutorial. Thanks!!!

But, In the first answer I have some confusions:(picture is taken for clearance)




```
A "type F" 4 × n tiling is always configuration F extendedby
a "type B" or "type F" 4×(n−2)  tiling that has its center
left domino removed. So f F(n) is exactly the number of
4×(n−2) "type B" or "type F" tilings, that is, fF(n)=f{B,F}
(n−2). (The type B and F tilings are exactly the ones that
have a center left domino to remove)
```

>>> Here F extended by itself!!! Ok, fine!!!

Now it says,

```
A "type G" tiling is G extended by a tiling of type A, D, or
H, with the upper left domino removed. So fG(n) =f {A, D, H}
(n−2). (A, D, and H are the tiling with an upper left domino)
```

>>> How G could be extended by A (If so then, why not E?), D (Isn't it C?) and H (Isn't it G itself)?

```
A "type H" tiling is H extended by a tiling of type A, C, or
```

```
A "type H" tiling is H extended by a tiling of type A, C, or
G, with the lower left domino removed, so fH(n)=f{A,C,G}(n-2).
(A, C, and G are the tiling types with a lower left domino.)
```

>>> How H could be extended by A (If so then, why not E?), C (Isn't it D?) and G (Isn't it H itself)?

Ok !!! after changing the following things the main result would be same. But the main confusion is here, **".....could be extended by A (If so then, why not E?)"**

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