SIXTH ANNUAL JUILFS CONTEST
SPRING 2014

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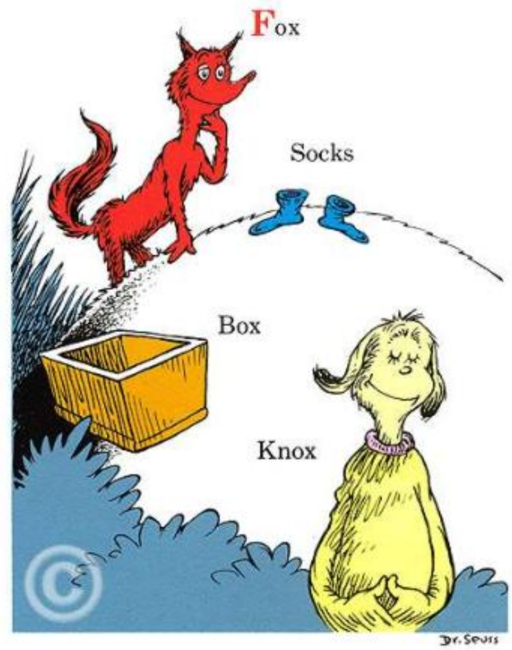
A. Knox on fox in socks in box
(5 points)

Knox has a box and Fox has a box. They each have a box for their socks. But …



The boxes have to be in a different place since they cannot share the space, else their socks get all mixed up.

So, they need a program that will take a pair of rectangles on the plane, and say if they share any space ("overlap"). A rectangle is described by a pair of points (x1, y1) and (x2, y2). These are the upper left and lower right corners of the rectangle. Two rectangles will be described by 4 such pairs, and the program needs to determine if this pair overlap.

The input will be a number n, $1 \le n \le 20$, followed by n pairs of rectangles. Each rectangle will be on one line, so there will be 2n lines following the first line. A line for a rectangle will be 4 integers

```
x1 y1 x2 y2
```

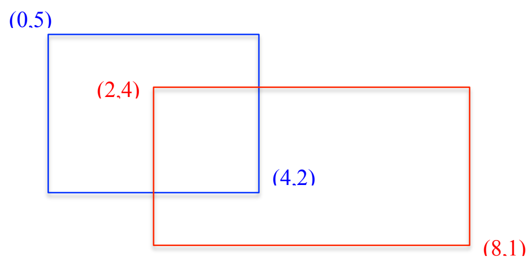
describing the two points.

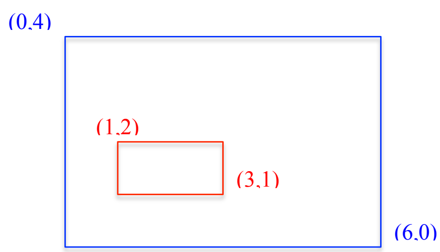
For example, the input

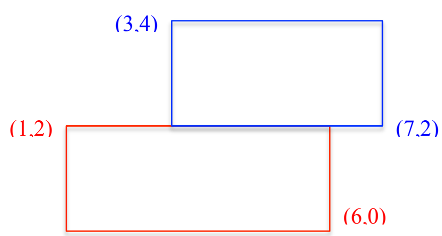
```
3
0 5 4 2
2 4 8 1
0 4 6 0
1 2 3 1
3 4 7 2
1 2 6 0
```

describes the three pairs of rectangles pictured below. The desired output is

```
OVERLAP
OVERLAP
NO OVERLAP
```


(0,5)
(2,4)
(4,2)
(8,1)


(0,4)
(1,2)
(3,1)
(6,0)


(3,4)
(1,2)
(7,2)
(6,0)

B. COUNT THE CATS IN HATS (5 points)

The Cat in the Hat has made a terrible mess of things! He was trying to help the Sneetches clean out a peculiar machine when he raised his hat, which had under it Little Cat A. He asked Little Cat A to help, and after two minutes, the Little Cat raised his hat, revealing another Little Cat, with more Little Cats in its hat!

Each Little Cat releases a another Little Cat after two minutes and then releases another Little Cat every minute thereafter. Little Cat A is always considered to have been released at in minute 1. So in minute 1, there is 1 Little Cat. In minute 2, there is still 1 Little Cat. In minute 3, Little Cat A releases Little Cat B and there are 2 Little Cats. In minute 4, Little Cat A releases Little Cat C and there are 3 Little Cats. In minute 5, Little Cat A releases Little Cat D, Little Cat B releases Little Cat E, and there are 5 Little Cats. And so on and so forth.

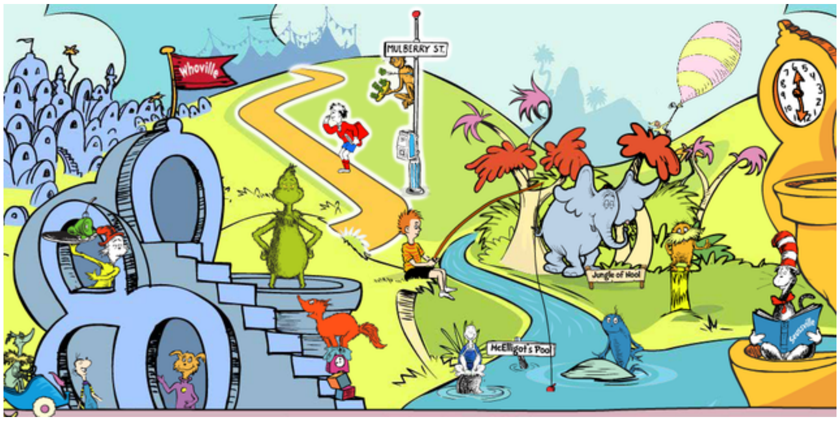
During certain minutes the Cat in the Hat manages to catch a Little Cat and stuff it back into his hat. If the Cat in the Hat catches a Little Cat during minute 5, then there would be 4 rather than 5 Little Cats out and about at that minute. You may assume that the Cat in the Hat always catches a newly released Little Cat. Thus in the next minute there would be 7 Little Cats.

== input ==
The first line of input will contain a single integer, T, followed by T test cases. Each test case will consist of a normal start with a line contain two space separated integers, 1 <= M <= 30 and 1 <= N <= M. M represents the number of minutes that pass and N represents the number of Little Cats that the Cat in the Hat catches and puts back in his hat. The next line will contain N space separated integers representing each minute that Cat in the Hat catches a Little Cat.

== output ==
For each test case print the number of Little Cats out and about after N minutes have passed. The output will be greater than or equal to 0 and less than 2^31.

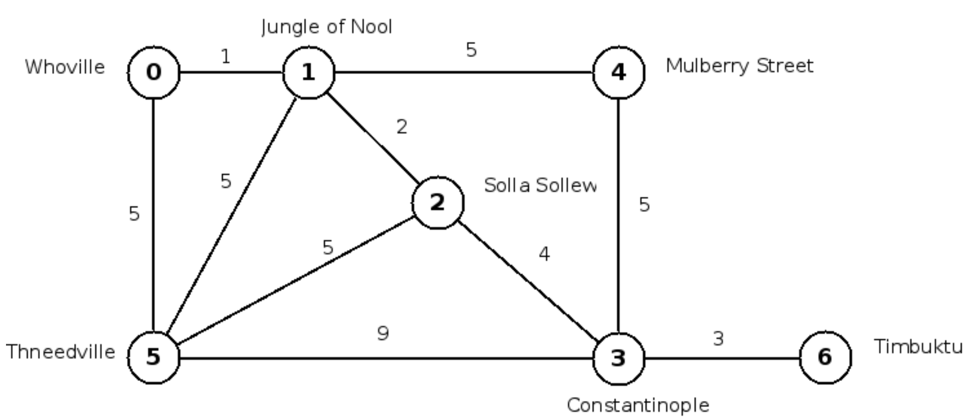
Sample Input	Sample Output
3 6 1 5 10 3 3 6 9 1 1 1	7 28 0

C. SNEETCH VISITING (7 points)

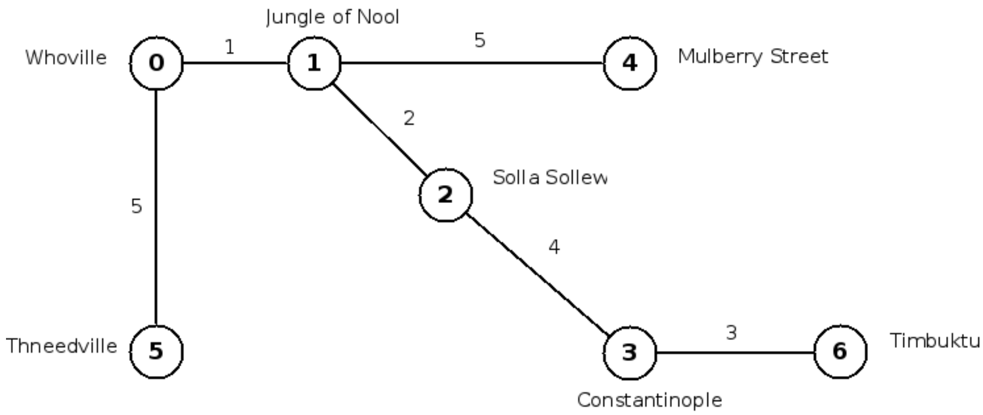


The Sneetches live in several different towns. It is hard for them to visit each other, because currently there is no way for a Sneetch to get from one town to another except through the perilous Truffula forest. They would like to build a network of roads connecting the towns. Since Sneetch concrete is expensive, they would like to do this in a way that minimizes the total amount of road mileage while ensuring that each town is connected to every other town.

For example, in this situation:



One optimal network of streets would be:



The input consists of a line with a single number $0 < n < 100$ indicating the number of problems. Each problem begins with a line containing a single number $0 < m < 1000$ indicating the number of Sneetch towns. This is followed by m-1 lines of data. Each line of data shows the distances between the towns and all of the preceding towns. There is no line for the first town.

For each problem, you should output a single number on a line by itself which indicates the total distance of the minimal road network connecting all the towns.

In our example, the towns can be represented by this adjacency matrix:

	Whoville	Jungle of Nool	Solla Sollew	Constantinople	Mulberry St.	Thneedville	Timbuktu
Whoville	0	1	0	0	0	5	0
Jungle of Nool	1	0	2	0	5	5	0
Solla Sollew	0	2	0	4	0	5	0
Constantinople	0	0	4	0	5	9	3
Mulberry St.	0	5	0	5	0	0	0
Thneedville	5	5	5	9	0	0	0
Timbuktu	0	0	0	3	0	0	0

Thus, the section of input for this example would be:
7
1
0 2
0 0 4
0 5 0 5
5 5 5 9 0

0 0 0 3 0 0

The output would be:
20

Sample Input	Sample Output
4 4 2 1 3 3 1 2 5 2 2 2 2 1 2 2 2 1 1 6 10 1 5 5 1 4 2 5 1 4 5 2 4 1 3 7 1 0 2 0 0 4 0 5 0 5 5 5 5 9 0 0 0 0 3 0 0	4 5 7 20

D. Encryption (6 points)

The first line of input, N, will be an integer indicating how many phrases are to encrypted or decrypted. 2N lines will follow. Each pair of lines will comprise an integer shift amount S, indicating the amount by which to shift the phrase, followed by a string phrase P, the phrase which is to be encrypted or decrypted.

To help the Lorax save the Truffula trees and keep his plans hidden from the prying eyes of the Once-ler, you must encrypt the Lorax's messages. You must take each character of each input phrase and shift it by the shift amount. For example, a shift amount of "–3" and an input character of "d" would mean an output character of "a". Note that spaces are allowed, and that the space character " " is considered the 27th letter, and thus an input character of "y" with a shift amount of 17 would mean an output character of "o".

Sample Input

```
3
-3
very sad backward glance
26
vomfttaxibufwfsauibuanfbouaxfmmajakvtuadpvmeouahvftt
7
gluppity glupp
```

Sample Output

```
sbovxpyaxzy htyoaxdiyk b
unless whatever that meant well i just couldnt guess
nsawwp egnsaww
```

Comments

The only allowable characters will be the lowercase latin alphabet, and the space character. The space character will be considered the 27th letter, and thus your alphabet will be as such: "abcdefghijklmnopqrstuvwxyz ", noting the extra space after the z. The shift amount S can be any integer from –26 to 26 inclusive.

E. TOO MANY THINGS!
(4 points)

Once you start to collect things, your house will fill up with them very quickly. They are able to replicate themselves in a very strange way. Each day, there is a new generation of things. And over night, all things that are at most four days old make a copy of themselves. This is even worse than the famous Fibonacci growth rate!

Their total numbers can be expressed as a sequence

1, 1, 2, 4, 8, 15, 29, 56,…

That is, on day 0 and day 1 there is just 1 thing. On day 2 there are 2, on day 3 there are 8, on day 4 there are 15. In general, to calculate the number of things on day k, add up the number of things on days k-4, k-3, k-2, and k-1. This can be expressed as a recurrence for NT[k], the number of things on day k:

NT[k] = 1 if k<2
NT[2] = 2
NT[3] = 4
NT[k] = NT[k-4] + NT[k-3] + NT[k-2] + NT[k-1] if k>3

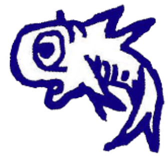
Your job is to write a program that will calculate a series of NT values. The input will be an integer n (0<n<20), being the number of test cases. Following this will be n integer values, each on a separate line. Each integer will represent a number of days k (0≤k<68). For each number k, the program should write down the corresponding NT[k], the number of things after k days.

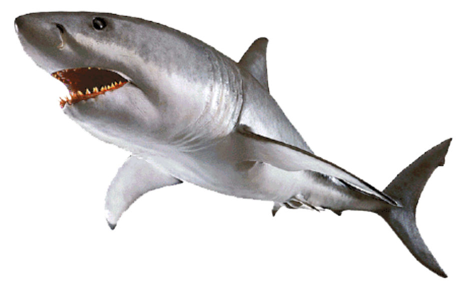
Sample Input	Sample Output
3 3 7 50	4 56 100808458960497

F. SHARKBAIT (7 points)

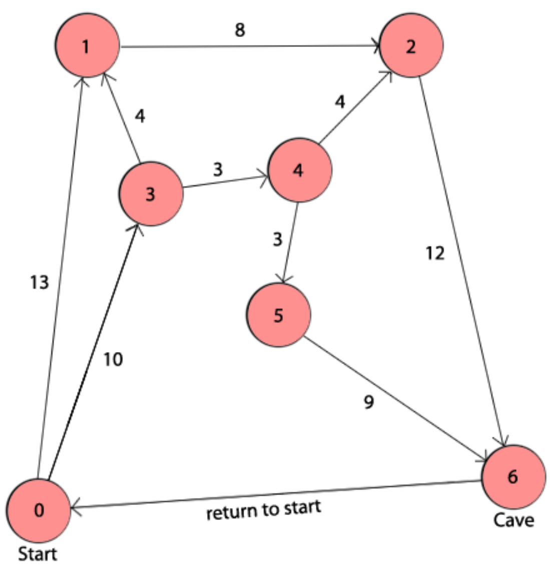
The greatest sport in all the sea,
(Which gamblerfish bet on constantly)
Is the deadly game of Sharkbait,
In which brave fish test their true fate.

One fish, two fish, red fish, blue fish,
Blue Fish is now I.O.U. Fish,
Becuase he placed a bet too high,
Worth the Palace of Versailles.





The game of Sharkbait begins with a blow of the referee's conch shell. At once, all participating fish set out from the starting point in search of a deadly shark. Once a shark is found, the player must race to the Cave with the shark in tow. The Cave is a tunnel which is too small for a shark to enter, and leads back to the start point. Fish have 1 hour of game time to lure and evade as many sharks as possible.



The only way Blue Fish can repay his large sum of debt is by joining the ranks of the well-paid athletes in the Pacific Sharkbait League (PSL). Blue Fish wants to use the power of computation to improve his chances of survival. He knows he must always swim with the current if he wants to survive. To this end, has studied the PSL Arena's currents and the patterns of shark behavior in the area.

Blue Fish has consructed the following directed graph to model the arena. Each vertex represents a hotspot area where sharks convene. Each directed edge represents the direction of the current between two hotspots. Blue Fish's strategy for Sharkbait is to repeatedly take the shortest start-to-finish path which crosses a hotspot.

Write a program for Blue Fish which outputs the length of the shortest path from the from the Start to the Cave. Input will be given in the form of a line specifying a number (m) of vertices, then m lines describing adjacencies for each vertex. Each of these lines is composed of one or more pairs of vertex number followed by edge weight. For example, the line describing the adjacencies of vertex 0 in this graph should be 1 13 3 10.

<table>
<tr><th>Sample Input</th><th>Sample Output</th></tr>
<tr><td>6
1 13 3 10
2 8
6 12
1 4 4 3
2 4 5 3
6 9</td><td>25</td></tr>
</table>