Problem 195: Halves & Doubles

Difficulty: Medium

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Problem Background

Multiplying small numbers isn't too difficult, but multiplying very large numbers can tie your brain in knots as you try to keep track of all the digits in your head. However, there's an ancient method of multiplication that might be somewhat easier to use. Regardless of what numbers you're trying to multiply, it only requires multiplying by 2, dividing by 2, and addition!

Problem Description

The "Halves and Doubles" method of multiplication follows a set of rules:

1. Reduce the first number by half. If there's a remainder (e.g. 5 / 2 = 2 ½), throw away the half.
2. Double the second number.
3. Write down the pair of numbers, keeping them in the same order.
4. Repeat steps 1 through 3 until the first number equals 1.
5. Check the list of numbers you've written. Cross out any pairs where the first number is even.
6. Add together all of the second numbers to get your answer.

For example, if multiplying the numbers 10 and 20 using this method, we start by building a list of pairs of numbers (steps 1 through 4):

10	20
5	40
2	80
1	160

Now we cross out any pairs where the first number is even:

~~10~~	~~20~~
5	**40**
~~2~~	~~80~~
1	**160**

The remaining numbers in the right column get added together for our answer: 40 + 160 = 200 = 10 * 20.

For this problem, your team needs to write a program demonstrating the Halves & Doubles method of multiplication.

Sample Input

The first line of your program's input, **received from the standard input channel**, will contain a positive integer representing the number of test cases. Each test case will include a single line containing two positive integers separated by spaces.

```
3
10 20
11 6
60 200
```

Sample Output

For each test case, your program must print one line for each pair of numbers created while performing this process, starting with the initial pair provided in the input. Numbers should be separated by spaces and be retained in the correct order. If the first number in a pair had a discarded remainder following its division, print an asterisk (*) after that number (before the space). If the first number in a pair is even, print a space and three asterisks (*) after the second number to indicate the row is to be crossed out. Finally, print the result of the multiplication on a separate line after the list of pairs.

```
10 20 ***
5 40
2* 80 ***
1 160
200
11 6
5* 12
2* 24 ***
1 48
66
60 200 ***
30 400 ***
15 800
7* 1600
3* 3200
1* 6400
12000
```