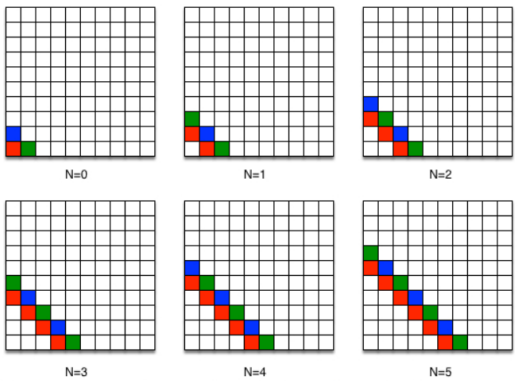
Algorithms

TOTAL POINTS 4

1. The following two questions refer to this figure: 1 point



The diagrams shown above are the result of executing an algorithm with one parameter N, a non-negative integer, that colors boxes on a 10 by 10 grid. The patterns for values of N from 0 to 5 are given above.

Determine the algorithm that was used to draw these patterns and

1. Write it down.
2. Execute it for N = 6, and write down your result.

Which of the following diagrams is the result?

The image shows six squares each of which is a grid comprised of 100 smaller squares. The upper left one has a red square in the bottom square of the first column on the left, a blue square in the second square from the bottom in the first column on the left, and a green square in the bottom square in the second column from the left. It is labeled N=0.

The middle top square shows red squares in the second square from the bottom in the first column on the left and the bottom square of the second column from the left. It shows green squares in the third square from the bottom in the first column on the left and the bottom square of the third column from the left. It shows a blue square in the second square from the bottom in the second column from the left. It is labeled N=1.

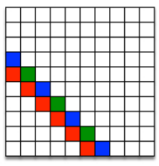
The right top square shows red squares in the third square from the bottom of the first column on the left, the second square from the bottom in the second column from the left, and the bottom square in the third column from the left. It shows blue squares in the fourth square from the bottom in the first column on the left and the second square from the bottom in the third column from the left. It shows green squares in the third square from the bottom in the second column from the left and the bottom square in the fourth column from the left. It is labeled N=2.

The left bottom square shows red squares in the fourth square from the bottom, in the first column on the left, the third square from the bottom in the second column from the left, the second square from the bottom in the third column from the left, and the bottom square in the fourth column from the left. It shows green squares in the fifth square from the bottom in the far left column, the third square from the bottom in the third column from the left, and the bottom square in the fifth column from the left. It shows blue squares in the fourth square from the bottom in the second column from the left and the second square from the bottom in the fourth column from the left. It is labeled N=3.

The left middle square shows red squares in the fifth square from the bottom in the far left column, the fourth square from the bottom in the second column from the left, the third square from the bottom in the third column from the left, the second square from the bottom in the fourth column from the left, and the bottom square in the fifth column from the left. It also shows blue squares in the sixth square from the bottom in the far left column, in the fourth square from the bottom in the third column from the left, and in the second square from the bottom in the fifth column from the left. It shows green squares in the fifth square from the bottom in the second column from the left, the third square from the bottom in the fourth column from the left, and the bottom square in the sixth column from the left. It is labeled N=4.

The right bottom square shows red squares in the sixth square from the bottom in the far left column, the fifth square from the bottom in the second column from the left, the fourth square from the bottom in the third column from the left, the third square from the bottom in the fourth column from the left, the second square from the bottom in the fifth column from the left, and the bottom square in the sixth column from the left. It shows green squares in the seventh square from the bottom in the far left column, the fifth square from the bottom in the third column from the left, the third square from the bottom in the fifth column from the left, and the bottom square in the seventh column from the left. It shows blue squares in the sixth square from the bottom in the second column from the left, the fourth square from the bottom in the fourth column from the left, and the second square from the bottom in the sixth column from the left. It is labeled N=5.

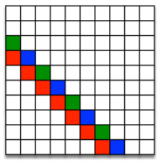
- ○ Pattern:



This square shows red squares in the sixth square from the bottom in the far left column, the fifth square from the bottom in the second column from the left, the fourth square from the bottom in the third column from the left, the third square from the bottom in the fourth column from the left, the second square from the bottom in the fifth column from the left, and the bottom square in the sixth column from the left. It shows blue squares in the seventh square from the bottom in the far left column, the fifth square from the bottom in the third column from the left, the third square from the bottom in the fifth column from the left, and the bottom square in the seventh column from the left. It shows green squares in the sixth square from the bottom in the second column from the left, the

fourth square from the bottom in the fourth column from the left, and the second square from the bottom in the sixth column from the left. It is labeled N=6.

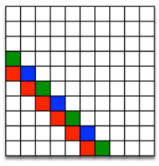
Pattern:



N=6

This square shows red squares in the seventh square from the bottom in the far left column, the sixth square from the bottom in the second column from the left, the fifth square from the bottom in the third column from the left, the fourth square from the bottom in the fourth column from the left, the third square from the bottom in the fifth column from the left, the second square from the bottom in the sixth column from the left, and the bottom square in the seventh column from the left. It shows green squares in the eighth square from the bottom in the far left column, the sixth square from the bottom in the third column from the left, the fourth square from the bottom in the fifth column fro the left, and the second square from the bottom in the seventh column from the left. It shows blue squares in the seventh square from the bottom in the second column from the left, the fifth square from the bottom in the fourth column from the left, the third square from the bottom in the sixth column from the left, and the bottom square in the eighth column from the left.It is labeled N=6.

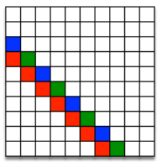
Pattern:



N=6

This square shows red squares in the sixth square from the bottom in the far left column, the fifth square from the bottom in the second column from the left, the fourth square from the bottom in the third column from the left, the third square from the bottom in the fourth column from the left, the second square from the bottom in the fifth column from the left, and the bottom square in the sixth column from the left. It shows green squares in the seventh square from the bottom in the far left column, the fifth square from the bottom in the third column from the left, the third square from the bottom in the fifth column from the left, and the bottom square in the seventh column from the left. It shows blue squares in the sixth square from the bottom in the second column from the left, the fourth square from the bottom in the fourth column from the left, and the second square from the bottom in the sixth column from the left. It is labeled N=6.

Pattern:



N=6

This square shows red squares in the seventh square from the bottom in the far left column, the sixth square from the bottom in the second column from the left, the fifth square from the bottom in the third column from the left, the fourth square from the bottom in the fourth column from the left, the third square from the bottom in the fifth column from the left, the second square from the bottom in the sixth column from the left, and the bottom square in the seventh column from the left. It shows blue squares in the eighth square from the bottom in the far left column, the sixth square from the bottom in the third column from the left, the fourth square from the bottom in the fifth column fro the left, and the second square from the bottom in the seventh column from the left. It shows green squares in the seventh square from the bottom in the second column from the left, the fifth square from the bottom in the fourth column from the left, the third square from the bottom in the sixth column from the left, and the bottom square in the eighth column from the left.It is labeled N=6.

2. 1 point

```
1  Consider an algorithm for the pattern of squares:
2
3  Given a non-negative integer N:
4    Start at the square (N,0), and color it red,
5    Count from 0 to N (exclusive), and for each
6    number that you count:
7      Move 1 square left and 1 square up,
8      Color the square red.
9    Start again at the square (N+1, 0), and color it
10   green,
11                    [omitted line]
12     Move 1 square left and 1 square up,
13     If i is even:
14       Color the square blue,
15     Otherwise:
16       Color the square green.
```

Which one of the following lines would make the algorithm correct?

Count from 0 to N+1 (exclusive), and for each number that you count (call it "i"):

Count from 0 to N (exclusive), and for each number that you count (call it "i"):

Count from 1 to N+1 (inclusive), and for each number that you count (call it "i"):

Count from 1 to N+2 (exclusive), and for each number that you count (call it "i"):

3. The numbers in the table below are the result of executing an algorithm that has one parameter N, a non-negative integer, and produces sequences of integers as outputs. For values of N from 0 to 5, the algorithm produces the following sequences of numbers as outputs:

1 point

N	output
0	
1	-1 0 3
2	-4 -3 0 5 12 21
3	-9 -8 -5 0 7 16 27 40 55
4	-16 -15 -12 -7 0 9 20 33 48 65 84 105
5	-25 -24 -21 -16 -9 0 11 24 39 56 75 96 119 144 171

Determine the algorithm that was used to generate the numbers in this table, and

1. Write it down.
2. Execute it for N = 6, and write down your result.

What is the sequence of numbers for N = 6?

(Give your answer as integers separated by single spaces.)

-36 -35 -32 -27 -20 -11 0 13 28 45 64 85 108 133 160 189 220 253

4. Which one of the following is a correct algorithm for the above numerical sequence?

1 point

- (●) Algorithm:

```
Given a non-negative integer N:
Make a variable called x, and set it to -N*N.
Count from 1 to 3N + 1 (exclusive), and for each number that you count (call it 'i'):
    Write down the value of x.
    Update x to be (x + 2i - 1).
```

- ( ) Algorithm:

```
Given a non-negative integer N:
Make a variable called x, and set it to -N*N.
Count from 0 to 3N + 1 (exclusive), and for each number that you count (call it 'i'):
    Write down the value of x.
    Update x to be (x + 2i - 1).
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- ( ) Algorithm:

```
Given a non-negative integer N:  Make a variable called x, and set it to -N*N.  Count fro
```

- ( ) Algorithm:

```
Given a non-negative integer N:
Make a variable called x, and set it to -N*N.
Count from 1 to 3N + 1 (exclusive), and for each number that you count (call it 'i'):
    Write down the value of x.
    Update x to be (x + 2i).
```

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