

3. Read the provided code, and then answer the following questions:

```
1  #Read the user's number
2  num = int(input("Enter a number:"))
3
4  #Add the number to itself, then square the result
5  num1 = num + num
6  num2 = num1 * num1
7
8  #print the result
9  print("The original number was", num, "The new number is", num2)
```

(a) Which of these lines are comments? (Write the line numbers)

Lines 1, 4, and 8

(b) Which of these lines utilize an arithmetic operator? (Write the line numbers)

Lines 5-6

(c) Which lines use either input or output? (Write the line numbers)

Lines 2, 9

4. Read the provided code, then answer the following questions:

```
1  a = int(input("Enter a number: "))
2  b = int(input("Enter another number: "))
3
4  c = a // b
5  d = a % b
6
7  print("Your new number is:", c, "r", d)
```

(a) Describe, in your own words, what this program does. Feel free to put the program into a code editor and run it a few times.

This program asks for two inputs, assigning them 'a' and 'b'. It then creates two new variables, 'c' and 'd'. Line 4 divides 'a' and 'b' and returns the integer result and assigns this result 'c'. Line 5 takes the remainder after dividing 'a' and 'b' and assigns this 'd'. Line 7 prints the results of 'c' and 'd' with an 'r' in between.

(b) Is there a way to make what the program does a little more clear? What would you add 'r' in between or change to do so?

This program lacks comments explaining the code. There could be one comment for lines 1 and 2 saying "gather user input, assign A and B". Line 4 can have "return integer division and assign C". Line 5 can have "get modulus/remainder and assign D". Line 7 can have "print C and D with 'r' in between".

5. Explain in your own words the importance of variables in code. Why do we use them? What are some examples of using variables that you can think of?

Variables contain data that allow to communicate/alter data. Examples of variables are strings and integers.

6. A programmer wants to write code to read in three inputs from the user, and add them together for later use in the program. Their code looks like this:

```
1 #Read in three numbers
2 num1 = int(input())
3 num2 = int(input())
4 num3 = int(input())
5
6 #Add the numbers together
7 num1 + num2 + num3
```

There is a semantic error in their code, what is it?

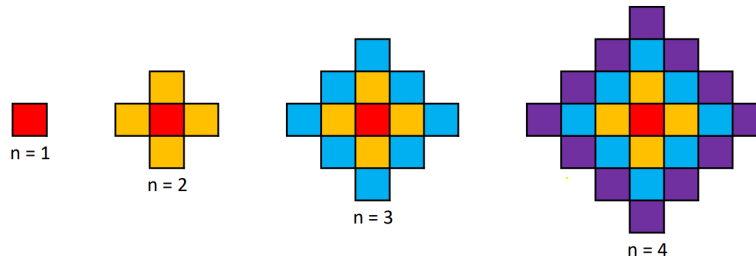
This code never prompts the user for 3 inputs.

Additionally, the code would set num1, 2, and 3 to the same number.

Note: The last problem on each worksheet will typically be harder, longer and attempt to stretch your problem-solving skills. Give these your best attempt if you wish. Getting the right answer is less important than practicing your problem solving process. The solution to each of these problems will tie into an optional studio problem that will become available the following class day.

7. While playing with geometric figures Alex accidentally invented the concept of an n^{th} order rhombus in a cell grid (note this is not the same definition you learned in geometry).

A 1^{st} order rhombus is a 1×1 square (that is, just a cell). A n^{th} order rhombus is obtained from a $(n - 1)^{\text{th}}$ order rhombus by adding cells to all outside borders. See the figures below.



Let $T(n)$ denote the total number of cells in a n^{th} order rhombus. Given n , can you derive a formula in terms of n for $T(n)$?

- (a) Consider a sequence of values where each value i in the sequence denotes the number of cells in a rhombus with $n = i$. This sequence starts 1, 5, 13, ... Write the first 5+ terms of this sequence. (Do not draw and count, instead find a pattern).

1, 5, 13, 25, 37

- (b) Write the first 5+ terms of the sequence denoting the *increase* in the number of cells as n grows from 1. The sum of this sequence plus $n_1 = 1$ should be equal to the total number of cells in a n^{th} order rhombus (that is, $T(n)$).

- (c) The natural numbers are the sequence 1, 2, 3, ..., n . Find a mapping from your answer to part (b) to the natural numbers.

- (d) The sum of the first n natural numbers is given by the closed formula $\frac{n(n+1)}{2}$. Use this formula and your answer to part (c) to derive a formula for $T(n)$. (Hint: you may need to shift the terms of a sequence to the left/right so they line up. Consider how you can do this).

- (e) Assume that n will be provided over standard input (input() function). Write a Python program below that outputs the number of cells in a n^{th} order rhombus using your formula from part (d) (you shouldn't need more than 5 lines of code).

- (f) Intuitively, the number of cells in a n^{th} order rhombus is always an integer. But your formula from part (d) resembles $\frac{n(n+1)}{2}$, which has division by two. For division by two to always result in a whole number, the dividend must be even. Explain **why** the products $n(n+1)$ and $n(n-1)$ are always even.

After the studio for this week opens, consider submitting your working program to the “Rhombus” studio problem for testing and credit.