CMPS 150
Fall 2021
Programming Assignment #2

Date Assigned: Friday, September 17, 2021
Due Date: 11:55 PM, Thursday, September 23, 2021

Objectives:
- using Python IDLE environment, input/processing/output method, math library, formatted output

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1) Include the following information as comments at the beginning of your source code. Name it `pa2.py`
   BE SURE it _**lines up**_ nicely as you see it below.

```
# Author:           Type-Your-Name
# ULID:             Type-Your-ULID
# Course/Section:   CMPS 150 - Lecture Section # ___
# Assignment:       pa2
# Date Assigned:    Friday, September 17, 2021
# Date/Time Due:    Thursday, September 23, 2021 -- 11:55 pm
#
# Description:      This program calculates the number of plants that can be placed
#                   in a given space using both a rectangular and triangular pattern
#                   for placement.  It uses basic numeric operators as well as the
#                   math library.  Finally, it displays formatted output.
#
# Certification of Authenticity:
# I certify that this assignment is entirely my own work.


# Ask the user for input.

# Compute the plant information for a rectangular grid  (round down using floor or //)

# Display the results using formatted print statements (see sample run)

# Compute the plant information for a triangular grid (round down using floor or //)

# Display the results using formatted print statements (see sample run)
```

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2) _Description_

Given the length and width of a rectangular area and the required plant spacing, you can calculate the number of plants that can be placed in a garden. Plants can be placed in a rectangular pattern (spaced in rows and columns equal distance apart) or a triangular pattern (staggered in equilateral triangles with equal distance between all plants).

Vertical line in the triangle indicates row spacing
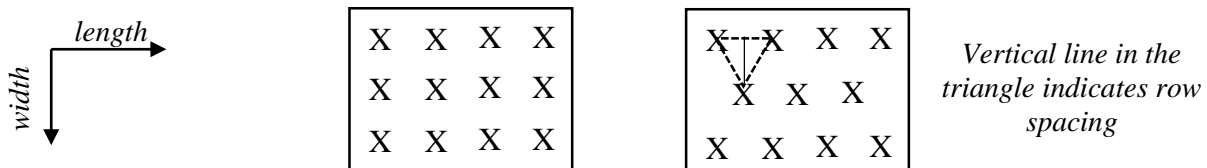
Your program should first ask the user to enter the length and width of the planting area and the amount of space required between plants. The units are not required but all values entered should be the same units (e.g., inches or feet). Then, your program will determine the number of plants that can be safely placed in that area for both a rectangular and triangular grid pattern.

Calculations for Rectangular Pattern

For a rectangular grid, first determine the number of rows and columns. When calculating these values, the results must be **rounded down** (any fractional leftover space is not enough room for a plant; HINT: consider the `floor` function from the math library or integer division). These values are calculated by:

$$number\ of\ rows = \left\lfloor \frac{length}{plant\ spacing} \right\rfloor$$

The ⌊ ⌋ brackets indicate the floor function (round the result down). Can also perform integer division //

$$number\ of\ columns = \left\lfloor \frac{width}{plant\ spacing} \right\rfloor$$

$$total\ number\ of\ plants = (number\ of\ rows) \times (number\ of\ columns)$$

Calculations for Triangular Pattern

For a triangular pattern, the space between rows is calculated by:

$$row\ spacing = \left(\frac{plant\ spacing}{2} \right) \times \sqrt{3} = plant\ spacing \times 0.866$$

The odd and even rows have a differing number of plants. The plants in the even rows are moved to the right by half a space compared to the first row. These equations are used to calculate the number of plants for each type of row. Again, all values must be rounded down:

$$number\ of\ plants\ in\ odd\ rows = \left\lfloor \frac{length}{plant\ spacing} \right\rfloor$$

$$number\ of\ plants\ in\ even\ rows = \left\lfloor \frac{length - (plant\ spacing \times 0.5)}{plant\ spacing} \right\rfloor$$

Next, you must determine how many odd and even rows there are:

$$total\ number\ of\ rows = \left\lfloor \frac{width - plant\ spacing}{row\ spacing} + 1 \right\rfloor$$

$$number\ of\ even\ rows = \left\lfloor \frac{total\ number\ of\ rows}{2} \right\rfloor$$

$$number\ of\ odd\ rows = total\ number\ of\ rows - number\ of\ even\ rows$$

The total plants is then calculated by:

$$total\ plants = (number\ of\ plants\ in\ odd\ rows \times number\ of\ odd\ rows) + (number\ of\ plants\ in\ even\ rows \times number\ of\ even\ rows)$$

Formatted Output: Integer values should be right justified and will not exceed four digits (see sample run). Floating point numbers must be displayed with 3 decimal places of precision (i.e., '.3f').

3) *Sample Runs*

Sample Run #1:

```
Enter the length of the planting area: 100
Enter the width of the planting area: 50
Enter the spacing between plants: 6

Plants in a Rectangular Grid
***************************
Num of rows:       16
Num of columns:     8
Total plants:      128

Plants in a Triangular Grid
***************************
Space between rows: 5.196
Odd Rows:
   Num of rows:       5
   Num of plants:    16
Even Rows:
   Num of rows:       4
   Num of plants:    16

Total number of rows:       9
Total number of plants:   144
```

Sample Run #2:

```
Enter the length of the planting area: 72
Enter the width of the planting area: 36
Enter the spacing between plants: 6

Plants in a Rectangular Grid
***************************
Num of rows:       12
Num of columns:     6
Total plants:      72

Plants in a Triangular Grid
***************************
Space between rows: 5.196
Odd Rows:
   Num of rows:       3
   Num of plants:    12
Even Rows:
   Num of rows:       3
   Num of plants:    11

Total number of rows:       6
Total number of plants:    69
```

4) _Upload to Moodle_

Get in a browser and login to Moodle.

Go to your Lecture section on the Moodle site.

Click on the link for submission of Programming Assignment #2.

Select to "Add a Submission" then "Upload a File"
Select to "Choose a File" and go about the process of browsing/finding "`pa2.py`" on the computer.
Select to "Upload this File"

When returned to the Upload screen, MAKE SURE to click on the "Save Changes" button.

You will be returned to the "Programming Assignment #2" screen.
This time you should see your source code file listed on it.

5) _Logout of Moodle_

You can turn in programs
up to 24 hours late for a maximum of 75% credit
or up to 48 hours late for a maximum of 50% credit