Computer Programming
Spring 2020

CSI2100-01 Lab 9

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Overview

- Programming Problems

- Deliverables, Due Date and Submission

- Notes:

  1) Please consider using the OnlinePythonTutor when debugging your code.
  2) Some lab problems can be tested with Hyeongjae Python.
     - Please refer to the last page of this assignment for details.
  3) Because of our coronavirus precautions, you are provided with an excerpt of the relevant sections of the textbook together with this lab assignment.

Programming Problems

Problem 1: Use the stack module from the textbook (Chapter 7.6.3, pp. 264—266, **provided** with the lab spec on YSCEC) and write a program that asks the user to enter a series of parentheses and/or braces, then indicates whether or not they are properly nested.

Example 1:

```
    Enter parentheses and/or braces: ((){}{()})
    Nested properly.
```

Example 2:

```
    Enter parentheses and/or braces: (()}
                                                 (
    Not properly nested.                       (
```

Hint 1: As the program processes characters, have it push each left parenthesis or left brace. When it reads a right parenthesis or right brace, have it pop the stack and check that the popped item is a matching parenthesis or brace. (If not, the parentheses/braces are **not** nested properly.) After processing the last character from the user input, check whether the stack is empty; if so, the parentheses/braces are matched. If the stack is not empty (or if a stack underflow occurs), the parentheses/braces are not matched.

Hint 2: you can assume that the user enters nothing except parentheses and braces.

Hint 3: You are required to use the stack module as given in the text book (not using the stack module is forbidden and will be detected during automated grading). Please pay utmost attention to type in the textbook's stack module correctly. If your code relies on a stack-module with mis-spelled function names or other deviations, it will fail during automated grading. **Please do not hand in the stack module.**

Problem 2: Some calculators use a system of writing mathematical expressions in so-called reverse Polish notation (RPN). In this notation, operators are placed after their operands instead of between their operands. For example, 1 + 2 would be written 1 2 + in RPN, and 1 + 2 * 3 would be written as 1 2 3 * +. RPN expressions can be easily evaluated using a stack (**please use the one provided on YSCEC**). The algorithm involves reading the operators and operands in an expression from left to right, performing the following actions:

- ❑ When an **operand** is encountered, push it onto the stack.
- ❑ When an **operator** is encountered, pop its operands from the stack, perform the operation on those operands, and then push the result onto the stack.

Write a program that evaluates RPN expressions. The input operands will be integers. You can assume at least one blank between each pair of operators and/or operands. The operators are +, -, *, /, and =. The = operator pops the top-most stack item and displays it. Afterwards, the user is prompted to enter another expression. The process continues until the user enters a character that is not an operator and not an operand:

```
Enter an RPN expression: 1 2 3 * + =
Value of expression: 7
Enter an RPN expression: 5 8 * 4 9 - / =     40(-5)/=
Value of expression: -8
Enter an RPN expression: 3 12 - 9 10 / * =    -9 0.9 *
Value of expression: -8.10
Enter an RPN expression: q
```

Hints:

You are allowed to use the split() method to process the user input.

In case of malformed expressions, your calculator should output ``**Evaluation error**" and terminate the program. Stack underflow because of an insufficient number of operands makes an expression malformed. A non-empty stack after having popped the operand of the "=" operation indicates a malformed expression. An expression must contain exactly one "=" operator, which must occur in the last (right-most) position.

In the following you find several examples of malformed expressions.

```
1 2 + * =      # stack underflow     3 * ?
+ =            # stack underflow
=              # stack underflow
1 5            # "=" not in right-most position
1 = 2 2 +      # "=" not in right-most position
1 2 3 + =      # stack not empty after "="
```

How to detect malformed expressions: it is a good strategy to check errors (1) before and/or (2) after performing an operation.

For example, if your calculator encounters the "*" operator, it needs to pop 2 operands from the stack. If popping fails because of an empty stack, the calculator has encountered a stack underflow.

If the stack is not empty after popping the element that should be displayed for the "=" operator, the expression is malformed, too. See the above examples for more checks that your calculator must conduct to catch all malformed expressions.

Expressions may contain division operators and hence result in floating-point numbers. Therefore, convert all numbers from the user-input to float and have your calculator calculate with those floating-point numbers.

An expression that contains a division by zero counts as a malformed expression. Your calculator must not attempt the division by zero (and crash), but rather check the division operands in advance and announce a malformed expression.

Floating-point results shall be displayed with two digits after the fractional point.

Integer results should be displayed without a fractional point. For example: ``5.10'' (float) and ``5'' (integer).

Use float.is_integer(some_number) to find out whether some_number is an integer.

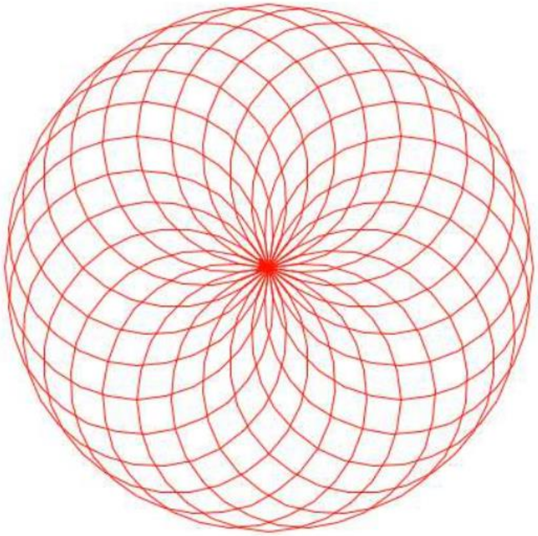
To be continued on the following page.

```
10 0 / =
```

Problem 3: Consider the palindrome checker program from Section 7.3.7 (page 267 and following). Rewrite this program to remove the stack. Strictly speaking, no stack nor any other auxiliary data-structure is needed to solve this problem. However, it is fully up to you how you solve this problem (that means, additional data-structures other than stacks will be accepted as a solution, too).

Problem 4: Use the below function template and complete it such that it draws a flower composed of circles as shown.

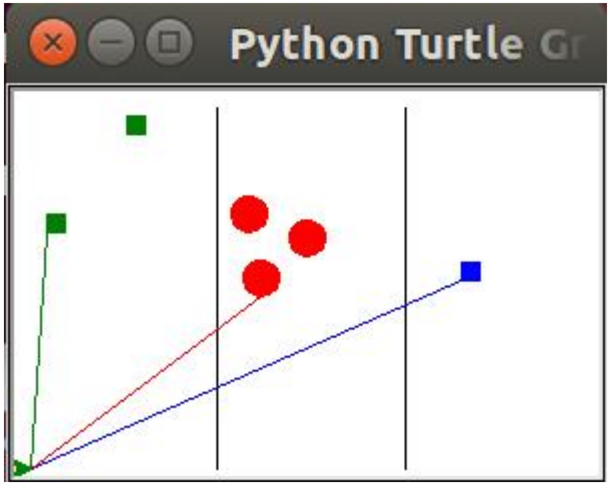
```
def drawFlower(myturtle, r):
  """ Draws a flower composed of 24 circles
      on the screen. The radius of the
      circles is ``r''.
      The drawing color is ``red''.
      The turtle ``myturtle'' is already
      positioned in the center of the flower.
  """
  # Your code here:
  ...
# Nothing else.
```



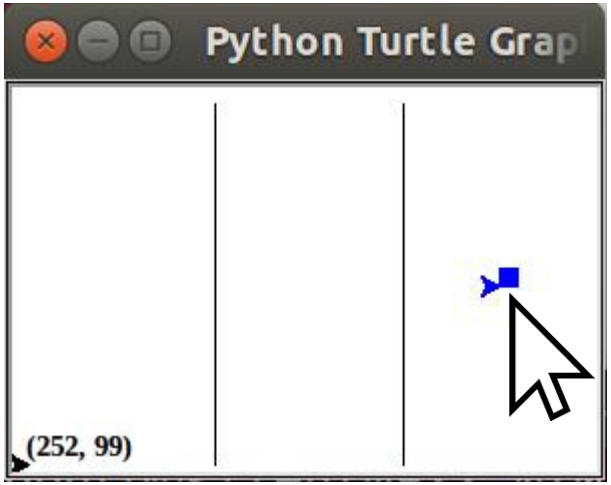
Inside your function, please set the turtle's pen color to red and hide the turtle before starting to draw. Prior to returning from your function, you do not have to unhide the turtle, and you do not have to restore its previous pen color.

Problem 5: Download and study program CallbackFunction.py from the Lab9 folder on YSCEC. The program sets up three sections on the screen, divided by 2 vertical bars ``|". Two handlers for user key-presses (functions **writeText** and **closeDown**) and a handler for mouse-clicks (function **drawShape**) are installed. Click on different sections on the window to see what happens in the mouse-click handler. Press the relevant keys to see what happens in the handlers for user key-presses.

Your task is to modify its keyboard handler such that at any time the user presses the "Up" key, the coordinate of the turtle will be displayed at coordinate (0,0) at the lower-left corner of the screen (see the below example, which also includes the user's mouse pointer). Coordinates must be displayed as integers. See below-right for how your program should work.



Version from YSCEC



(252, 99)

Your modified version

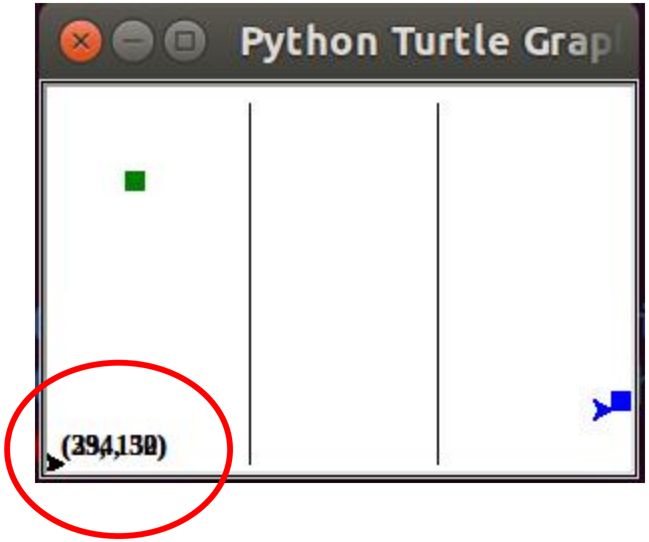
Hint: Writing something on the screen can be accomplished with a turtle's `write()` method.

For example:

```
myturtle.write('Hello!', font = ('Times New Roman', 8, 'bold'))
```

Therein, the named "font" parameter specifies the font, followed by the font-size (8) and bold-face ('bold').

As shown in the below example, subsequent write commands mix with previous text. Before issuing a write-command, you must therefore erase the previous text. But you are not allowed to delete other screen content. One way to achieve this is to create **a second turtle**, which is used exclusively for text-output. Use your ``text" turtle's `clear()` method to remove the previous text before outputting new text.



Erase previous text before new text output!

Marking Criteria

- Marking Criteria
  - Score is only given to programs that compile and produce the correct output with Python version 3.
  - Points are deducted for programs that are named wrongly. See the list of deliverables for the required file names.
  - Points are deducted for programs that produce warnings.
  - Points deductions on programming style: please provide comments in your code.
    - Please provide docstrings with **all your** functions.
    - It is not necessary to provide docstrings for functions **in code provided to you**.
  - Please pay particular attention to the **requested output format** of your programs. Deviating from the requested output format results in points deductions
  - Use of modules:
    - You are allowed to use the `sys` module with all programing problems.
    - You are allowed/asked to use the modules stated with individual programming problems and contained in provided code (for example, the `stack` module with Problem 1 and Problem 2 and the `turtle` module with Problem 5).
    - No other modules are allowed.

Text

Plagiarism

- Plagiarism (Cheating)
  - This is an individual assignment. All submissions are checked for plagiarism.
  - Once detected, measures will be taken for **all** students involved in the plagiarism incident (including the ``source'' of the plagiarized code).

Deliverables, Due Date and Submission

- Please prepare the files for the programming problems. The names of the files, their due dates and the archive file-name is given in the below table.
  - Please upload your archive file by the stated due date on YSCEC.
- Lab problems marked as '✓' can be tested on our Hyeongjae Python site http://hyeongjaepython.elc.cs.yonsei.ac.kr/

Problem	File name	Due	Archive name	Hyeongjae Python
1	lab9_p1.py	Wednesday May 27, 2020 23:00	lab9_<student id>.zip	✓
2	lab9_p2.py			—
3	lab9_p3.py			✓
4	lab9_p4.py			—
5	lab9_p5.py			—