04 Checkpoint: Variable Scope

Purpose

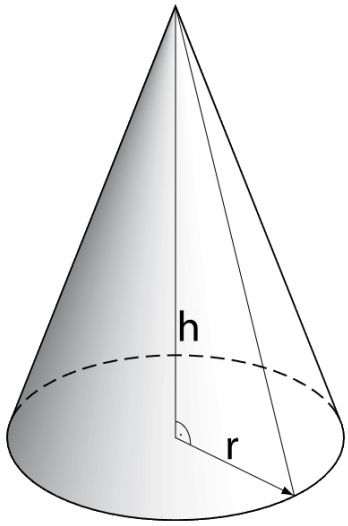
Check your understanding of parameters, arguments, and local variable scope by fixing a program that won't run because the programmer tried to use variables that were defined in a different function.

Helpful Documentation

1. The prepare content for the previous lesson explains what a parameter is.
2. The prepare content for a previous lesson explains what an argument is.
3. The prepare content for this lesson contains an example program with a mistake similar to the mistake that is in the example code below.

Problem Statement

The following example Python program is supposed to ask the user for the radius and height of a right circular cone and then compute and print the volume of that cone. The code is almost correct, but it contains a common mistake. The programmer who wrote it assumed that the `cone_volume` function could use the *radius* and *height* variables that are defined in the `main` function. Of course, this assumption is incorrect because as the prepare content for this lesson explains, variables defined inside a function have local scope and can be used only inside their containing function.



A right circular cone with radius *r* and height *h*

```
"""Compute and print the volume of a right circular cone."""

# Import the standard math module so that
# math.pi can be used in this program.
import math


def main():
    # Call the cone_volume function to compute
    # the volume of an example cone.
    ex_radius = 2.8
    ex_height = 3.2
    ex_vol = cone_volume()

    # Print several lines that describe this program.
    print("This program computes the volume of a right circular cone.")
    print(f"For example, if the radius of a cone is {ex_radius} and")
    print(f"the height is {ex_height}, then the volume is {ex_vol:.1f}")
    print()

    # Get the radius and height of the cone from the user.
    radius = float(input("Please enter the radius of the cone: "))
```

```
23      height = float(input("Please enter the height of the cone: "))
24
25      # Call the cone_volume function to compute the volume
26      # for the radius and height that came from the user.
27      vol = cone_volume()
28
29      # Print the radius, height, and
30      # volume for the user to see.
31      print(f"Radius: {radius}")
32      print(f"Height: {height}")
33      print(f"Volume: {vol:.1f}")
34
35
36  def cone_volume():
37      """Compute and return the volume of a right circular cone."""
38      volume = math.pi * radius**2 * height / 3
39      return volume
40
41
42  # Start this program by
43  # calling the main function.
44  main()
```

Assignment

Do the following:

1. Using VS Code, open a new file. Copy and paste all of the example program above into the new file. Save the new file as `cone_volume.py`
2. Run your `cone_volume.py` program. What error message do you see in the terminal frame?
3. Fix the `cone_volume` function which begins on line 36 by adding two parameters to its header. What parameter names should you use?

   Hint: the parameter names at line 36 and the variable names at line 38 must be the same.
4. Fix the call to the `cone_volume` function that is in `main` at line 13 by adding two arguments. Because the `cone_volume` function has two parameters (you added the two parameters in the previous step), each call to `cone_volume` must have two arguments. What variable names should you use for the arguments?

   Hint: the only variables that you can use must be defined inside `main` above line 13.
5. Fix the call to the `cone_volume` function that is in `main` at line 27 by adding two arguments. What variable names should you use for the arguments?

   Hint: the only variables that you can use must be defined inside `main` above line 27.
6. Save your program and run it again. Did it run correctly? If not, fix the mistakes until it runs correctly.

Testing Procedure

Verify that your program works correctly by following each step in this testing procedure:

1. After you finish the steps of this assignmnet, run your program and enter the inputs shown below. Ensure that your program's output matches the output below.

```
> python cone_volume.py
This program computes the volume of a right circular cone.
For example, if the radius of a cone is 2.8 and
the height is 3.2, then the volume is 26.3

Please enter the radius of the cone: 5
Please enter the height of the cone: 8.2
Radius: 5.0
Height: 8.2
Volume: 214.7
```

Sample Solution

When your program is finished, view the sample solution [↓] for this assignment to compare your solution to that one. Before looking at the sample solution, you should work to complete this checkpoint program. However, if you have worked on it for at least an hour and are still having problems, feel free to use the sample solution to help you finish your program.

Ponder

The original program that you copied and pasted to start this assignment didn't work because the programmer tried to use the *radius* and *height* variables inside the `cone_volume` function. However, the *radius* and *height* variables are defined inside the `main` function and therefore have local scope and cannot be used outside of `main`. To fix the program, you added two parameters to the `cone_volume` function and then added two arguments to each call of the `cone_volume` function. Why was local variable scope invented by computer scientists? How does local variable scope make a program easier to write and understand?

Submission

When complete, report your progress in the associated I-Learn quiz.