

Programming Project 08

Assignment Overview

This assignment will give you more experience on the use of functions.

This assignment is worth 50 points (5.0% of the course grade) and must be **completed and turned in before 11:59 on Monday, October 29, 2007.**

Background

You are a new graduate from MSU Engineering College and you got a job working for Corning Glass works. They make hundreds of different glasses and the manager wants you to construct a program that can be used to keep track of the glasses and automate the calculation of box size and weight for a dozen glasses. The fluid volume (oz.) they need to hold and the height (in.) of the fluid in the glass specify the product. For example, a glass may be specified to hold 8 ounces of fluid and that the height of the fluid in the glass will be 3 inches. Other characteristics such as the glass's exterior dimensions (height and diameter) must be inferred from the fluid volume and fluid height. In addition, the glass thickness is specified and assumed to be uniform for the sides and the bottom of the glass cylinder. Because the products can have different densities a property of density must also be used which will impact the weight of the glass (necessary to calculate the weight of a box of glasses).

For the purposes of this assignment glasses will be cylinders, i.e. a boring design.

A function called `box_size()` is required to provide the inside dimensions (in inches) of a box to hold a dozen glasses. This box should use the minimum amount of cardboard. The problem is that glasses can be stacked many different ways and you have to figure out the arrangement that will use the least amount of material to build the box. A function called `box_arrange()` is used to report the layout of the glasses in the box so that a minimum amount of cardboard is used. Packing material is ignored in the calculations—assume that glasses are packed together with nothing in between.

Here is some information you will need.

- A glass is specified using four inputs:
 - Volume (capacity) specified in fluid ounces.
 - Height of fluid specified in inches.
 - Density of glass specified in ounces (Avoirdupois) per cubic inch.
 - Thickness of glass specified in inches.
- Density of glass ranges from 1.5 ounces to 1.8 ounces (Avoirdupois) per cubic inch.
- 1 fluid ounce displaces 1.805 cubic inches.
- Note the distinction between fluid ounces and “dry” ounces (Avoirdupois)

Requirements

You must use at least eight functions including the functions `box_size()` and `box_arrange()` specified above. Some may be only one line long. You will be judged on the appropriateness of your function choices. Part of this assignment is about choosing functions.

You must have at least one function which calls a function which calls yet another function.

You must not use global variables—we will make an exception for the constant pi. That is, all variables you use in your function must be passed in as parameters or named locally. Most of my functions returned a floating-point value, but I found it convenient to use a tuple to return box dimensions from the `box_arrange()` function.

Since a glass is specified by four values that never change, a tuple is an ideal data structure for your glass. Most of my functions had only one parameter: the tuple representing a glass.

INPUT

Input will be in the form of a file “test.txt” containing lines where each line describes a glass using four numbers (space separated) as specified above and in the following order: volume, height, density, thickness.

The inputs are expected to be floating point values.

OUTPUT

Output the input values: volume, height, density, thickness.

Output the arrangement of glasses in rows x columns x stacks.

Output the dimensions of the box (l x w x h).

Output the final weight of the box contents in pounds.

Include dimensions for each value, e.g. 12 ounces per cubic inch

Deliverables

You must use handin to turn in the file **proj08.py** – this is your source code solution; be sure to include your section, the date, the project number and comments describing your code. Please be sure to use the specified file name, and save a copy of your proj08.py file to your H drive as a backup.

Other good information

Hints:

- Geometry will be useful:
The inside volume of a hollow cylinder = $h\pi(R_o^2 - R_i^2)$
where R_o is the outside radius, and R_i is the inside radius.
Be careful with units: for example, if the radius is in inches, the volume will be cubic inches, but the liquid volume of the glass is specified in fluid ounces.
- Most of the work is in the two box functions. The glass height and diameter determine the size of the box so work out this problem with pencil and paper first. A good starting point is to fix the box arrangement to 3 wide by 4 long by 1 high. Once you get the rest working, you can do the `box_arrange` function properly.
- Most functions can be done with only one statement.
- For `box_arrange()` there are a number of cases to be considered, but not too many. If you have something like twenty-five, you have many more than you need. (Also, I used a dictionary to keep track of arrangements and their volumes, i.e. a tuple for arrangement as a key with value as a volume.)
- I had functions such as `boxArea`, `outsideRadius`, `volumeOfGlassInCubicInches`, `weightOfContents`, etc.