

# COMP 1012 Fall 2016 Assignment 1

**Due Date: Friday, September 23, 2016, 11:59 PM**

## New Material Covered

- constants, variables
- computation
- trigonometric functions
- printed output
- formatting

Notes:

- When programming, follow the posted programming standards to avoid losing marks. A program called CheckStandardsV2.py will be provided to enable you to check that you are following standards.
- Name your script file as follows: <LastName><FirstName>A1Q1.py. For example, LiJaneA1Q1.py is a valid name for a student named Jane Li. If you wish to add a version number to your file, you may add it to the end of the file name. For example, SmithRobA1Q1V2.py is a valid name for Rob Smith's script file.
- Submit output in a similarly-name output file: e.g., <LastName><FirstName>A1Q1Output.txt. To generate this file, open a new empty tab in Spyder and save it under the name above. Then copy and paste the output of your program from the console window to this file, and save it.
- You must complete the checklist for a **Blanket Honesty Declaration** in UM Learn to have your assignment counted. This one honesty declaration applies to all assignments in COMP 1012.
- To submit the assignment follow the instructions on the course website carefully (link: [http://www.cs.umanitoba.ca/~comp1012/Documents/Handin\\_UMLearn.pdf](http://www.cs.umanitoba.ca/~comp1012/Documents/Handin_UMLearn.pdf)). You will upload both script file and output via a dropbox on the course website. There will be a period of several days before the due date when you can submit your assignment. **Do not be late!** If you try to submit your assignment within 48 hours **after** the deadline, it will be accepted, but you will receive a penalty (of 25% per day late).

## Question 1—Calculations [12 marks]

### Description

In one script file, calculate and print the following quantities:

1. the Calorie<sup>1</sup> content of the maple coating on a doughnut.
2. the distance between two cities using the Great Circle formula.

Print an overall header for your output, a header for each of the two sections, and a final termination message giving the date and time when the program was run, and the name of the programmer. Sample output for slightly different values is shown at the end of the assignment.

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<sup>1</sup> Why is Calorie capitalized? The type of "calorie" used in dietary calculations is actually a kilocalorie in terms of the calorie used in chemistry. A Calorie (abbreviation Cal) is the amount of energy needed to raise the temperature of a kilogram of water by one degree Celsius [<http://en.wikipedia.org/wiki/Calorie>].

### Doughnut Details

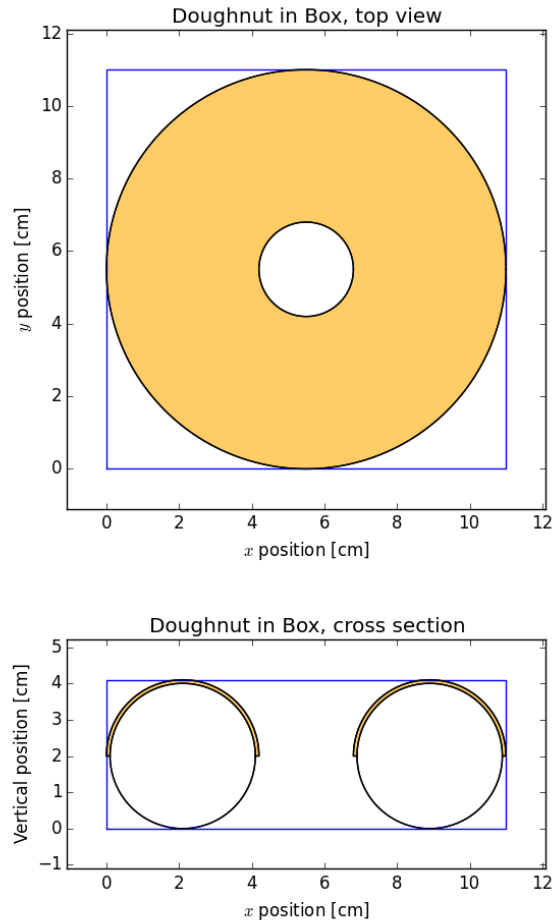
Assume the doughnut is a perfect torus that just fits into a square box 11.0 cm across and 4.1 cm high. In the picture to the right, the box is shown with a blue line. The maple coating on the doughnut is 1.0 mm thick, but it covers only the top half of the doughnut. Assume that 11.0 cm is the outer diameter of the doughnut *with* the coating on; without it, the diameter of the doughnut would be smaller by twice the thickness of the coating.

A doughnut is roughly the shape of a torus, which is a tube curved around to join with itself. Look up the properties of a torus at

<http://mathworld.wolfram.com/Torus.html>.

Choose an appropriate formula from this page to calculate the volume of a torus. (Reference this webpage and any other sources you use, including ones mentioned below in comments in your code.) Determine the volume of the coating by finding the doughnut volume including the coating and the volume without it, and subtracting. Remember: the coating covers only the top half of the doughnut!

To determine the Calorie content, assume the coating has the density of honey [1.36kg/L] and the energy content of sugar [3.04 Cal/g] <sup>2</sup>.



### Great Circle Details

How far apart are two points on the surface of the earth? The shortest distance between two points on the surface of a sphere is an arc, not a straight line. To find this distance, we use the great-circle formula. Simply stated, the distance is given by the formula:

$$d = r_e \Delta\sigma$$

where  $r_e$  is the radius of the earth<sup>3</sup>, 6371 km and  $\Delta\sigma$  is the **central angle** formed by lines connecting the two points to the centre of the earth.

In this question, the location of the points on the surface of the earth will be given by latitude and longitude. Latitude is an angle between -90 and 90 that gives the angle between that point and the equator, while longitude is an angle between 180 and -180 that gives the angle between the point and a fixed principal meridian. For instance, the location of Winnipeg is approximately 50 degrees N (+50) and 97 degrees W (-97). You will be given more precise values for latitude and longitude. In Python, you must convert angles from degrees to radians to use the math module trigonometric functions (define and use a conversion constant).

<sup>2</sup> [https://en.wikipedia.org/wiki/Honey#Nutritional\\_and\\_sugar\\_profile](https://en.wikipedia.org/wiki/Honey#Nutritional_and_sugar_profile)

<sup>3</sup> [https://en.wikipedia.org/wiki/Earth\\_radius](https://en.wikipedia.org/wiki/Earth_radius)

To calculate the central angle, we will be using a special case of the *Vincenty formula*<sup>4</sup>. Note that it is recommended to use the atan2 function rather than the ordinary arctangent function.

### Hand-in

Hand in your script file, and a sample run of your code using *a* height of 4.1 cm and a diameter of 11 cm (with coating) for your doughnut, and the distance between Winnipeg and Mumbai, India (latitude: 19.07°, longitude: 72.88°).

Note:

- The following output is for different values than you are supposed to use. A good strategy is to first get your program running for the sample values shown, so that you can check the answers, and then change the numbers in your program to the required values.
- Some lines of the output shown below end in an asterisk (\*). All numbers printed in those lines should be calculated. Your final output should not have the asterisk.

### Sample Output

```

ASSIGNMENT 1: BASIC CALCULATIONS

CALORIE CONTENT OF THE COATING ON A DOUGHNUT

CONSTANTS
Conversion:      1 cm = 10 mm
Conversion:      1 L  = 1000 cm^3
Conversion:      1 kg = 1000 g

DOUGHNUT DIMENSIONS
Diameter with coating      = 11.0 cm
Height, coating on top only = 4.5 cm
Radius a of tube, no coating = 2.2 cm *
Radius c to centre of tube = 3.2 cm *
Volume without coating     = 305.7 cm^3 *
Volume with coating all over = 334.1 cm^3 *
Volume of half coating     = 14.2 cm^3 *
Coating density            = 1.36 kg/L
Mass of half coating       = 19.3 g *
Calorie content of sugar   = 3.04 Cal/g
Calorie content of coating = 59 Cal *

GREAT CIRCLE DISTANCE

Earth radius      6371 km
Winnipeg, Canada
Latitude:        49.91°
Longitude:       -97.24°
Perth, Australia
Latitude:        -31.94°
Longitude:       115.97°
Distance:        16627.78 km *

Programmed by Rodney Dogood
Date: Fri Sep 9 15:50:32 20165
End of processing

```

Note that this sample output uses a height of 4.5 cm; for handing in, use 4.1 cm.

Use data for Winnipeg and Mumbai, India for handing in.

<sup>4</sup> [https://en.wikipedia.org/wiki/Great-circle\\_distance#Computational\\_formulas](https://en.wikipedia.org/wiki/Great-circle_distance#Computational_formulas)

<sup>5</sup> To get a string with the current time, import the module `time`, and call `time.ctime()`.