University of Aberdeen, Department of Computing Science

CS1028 Practical 3

Programming for Science and Engineering

30 September, 2019

1 Questions for Beginners

Everybody should be able to answer all of the questions in this section.

1.1 Questions:

1. Does (math.sqrt(2) * math.sqrt(2) == 2) evaluate to True or False?
2. Compose a program that takes two positive integers as command-line arguments and writes True if either evenly divides the other.
3. Compose a program that takes two integers m and d from the command line and writes True if day d of month m is between March 20 and June 20, and False otherwise. (Interpret m with 1 for January, 2 for February, and so forth.)
4. Compose a program that takes three integer command-line arguments and writes 'equal' if all three are equal, and 'not equal' otherwise.
5. Write a code fragment that takes two float command-line arguments, and writes True if both are strictly between 0 and 1 and False otherwise.

6. What is the value of **j** after each of the following code fragments is executed?

```
a. j = 0
   for i in range(0, 10):
       j += i

b. j = 1
   for i in range(0, 10):
       j += j

c. for j in range(0, 10):
       j += j
```

7. Compose a program that, using one for loop and one if statement, writes the integers from 1000 (inclusive) to 2000 (exclusive) with five integers per line. Hint: use the % operator.

8. Describe what happens when you invoke rulern.py with an argument that is too large. For example, try executing the command python rulern 100.

9. What are m and n after the following code is executed?

```
n = 123456789
m = 0
while n != 0:
    m = (10 * m) + (n % 10)
    n //= 10
```

10. Compose a program that takes a command-line argument n and writes all the positive powers of 2 less than or equal to n. Make sure that your program works properly for all values of n. (Your program should write nothing if n is negative or zero.)

2 Some More Advanced Questions

Once you have completed Section 1, you should now be getting more familiar with the kind of things you can do with Python.
If you feel sufficiently confident, feel free to try these harder questions.

1. Order check. Compose a program that takes three floats x, y, and z as command-line arguments and writes True if the values are strictly ascending or descending (x $<$ y $<$ z or x $>$ y $>$ z), and False otherwise.

2. Uniform random numbers. Compose a program that writes five uniform random floats between 0 and 1, their average value, and their minimum and maximum value. Use the built-in max() and min() functions.

3. Ramanujan's taxi. S. Ramanujan was an Indian mathematician who became famous for his intuition for numbers. When the English mathematician G. H. Hardy came to visit him in the hospital one day, Hardy remarked that the number of his taxi was 1729, a rather dull number. To which Ramanujan replied, "No, Hardy! No, Hardy! It is a very interesting number. It is the smallest number expressible as the sum of two cubes in two different ways." Verify this claim by composing a program that takes a command line argument n and writes all integers less than or equal to n that can be expressed as the sum of two cubes in two different ways. In other words, find distinct positive integers a, b, c, and d such that a3 + b3 = c3 + d3. Use four nested for loops.

4. Counting primes. Compose a program that takes a command-line argument n and writes the number of primes less than n. Use it to write the number of primes less than 10 million. Note: if you are not careful to make your program efficient, it may not finish in a reasonable amount of time. Later in Section 1.4, you will learn about a more efficient way to perform this computation called the Sieve of Eratosthenes.

5. Pepys's problem. In 1693 Samuel Pepys asked Isaac Newton which is more likely: getting 1 at least once when rolling a fair die six times or getting 1 at least twice when rolling it 12 times. Compose a program that could have provided Newton with a quick answer.