

University of Cape Town ~ Department of Computer Science
Computer Science 3003S Theory of Algorithms ~ 2014

Practical Test 1 Session 1 Question 1

100 Marks

Procedure

You may consult the electronic Java and C/C++ API documentation (docs.cs.uct.ac.za), and submit to the automatic marker via Vula (vula.uct.ac.za), but nothing else! You may NOT use your class notes, textbooks, internet or files on your flash disk, hard drive, etc.

You may use only the computers in the lab. No tablets, headphones or other personal devices are permitted.

File names

- Use `modulus.c` if you are writing your program in C.
- Use `modulus.cpp` if you are writing your program in C++.
- Use `Modulus.java` if you are writing your program in Java.

Note that case matters.

Submission

The automatic marker contains a submission entry bearing the same title as this question sheet.

Submit your source file within a single compressed, '.ZIP', archive.

Make sure you create a '.ZIP' archive, not a gzipped, '.gz', or tar-gzipped, '.tgz', or other kind of file.

Make sure your source file is the only item within the archive. Especially, avoid submitting an archive containing a folder containing the file.

When submitting a Java source file copied from an editor like Eclipse or Netbeans, please remove any package line that may appear at the beginning of the code.

Scoring

Each test case that is answered correctly will earn 10 points.

Problem Description

Write a program that, given a positive integer, N , and a non-negative integer, Z , counts the number of pairs of positive integers X and Y ($0 < X < N$, $0 < Y < N$) for which $(X * Y) \% N == Z$.

The modulus (or modulo) operation finds the remainder when one number is divided by another. For example: $8 \% 3$ is 2. (This is expressed in C, C++ and Java with the % operator, so $8 \% 3 == 2$.)

Example:

Given that $N = 6$ and $Z = 3$, the following pairs of integers would be counted, giving an answer of 5:

1, 3
3, 1
3, 3
3, 5
5, 3

Note that the order within the pair matters. For example, (1, 3) and (3, 1) are counted as distinct pairs.

Input and Output

Program input and output will make use of `stdio` streams (`System.in` and `System.out` in Java) i.e. not file I/O.

Input consists of two lines, the first containing the integer N , and the second containing the integer Z .

Constraints:

$$1 \leq N \leq 1,000$$
$$0 \leq Z < N$$

Output consists of a single integer (the number of different pairs of positive integers, X and Y , for which $(X * Y) \% N == Z$) followed by a line break --- in Java, for example, use `System.out.println`, not `System.out.print`. The automatic marker expects this precise form.

Sample Input:

6
3

Sample output:

5

END