Assignment 2: Systematically Calculate the Multiplicative Inverse

Due date: April 20th, 2025

You will be working in a group of 2 students to implement the following multiplicative inverse algorithm (it means create the code in any programming language you are familiar with):

Input: two positive integers b and a.
Output: the inverse of a modulo b, a^{-1} mod b, if it exists.
Initialize: $b_0 = b,\ a_0 = a,\ r_0 = 0,\ r = 1,\ \mathrm{q} = \left\lfloor \frac{b_0}{a_0} \right\rfloor,\ s = b_0 - qa_0.$
Step 1: **While** $s > 0$ **do**
Step 1.1: $\mathrm{temp} = r_0 - qr.$
Step 1.2: **If** $\mathrm{temp} \geq 0$ **then** $\mathrm{temp} = \mathrm{temp} \mod b$.
Step 1.2.1: **Else** $\mathrm{temp} = b - ((-\mathrm{temp}) \mod b)$.
Step 1.3: $r_0 = r$.
Step 1.4: $r = \mathrm{temp}$.
Step 1.5: $b_0 = a_0$.
Step 1.6: $a_0 = s$.
Step 1.7: $\mathrm{q} = \left\lfloor \frac{b_0}{a_0} \right\rfloor$.
Step 1.8: $s = b_0 - qa_0$.
Step 2: **End While**
Step 3: **If** $a_0 \neq 1$ **then output** a has no inverse modulo b
Step 3.1: **Else return** $a^{-1} = r \mod b$.

The algorithm takes two positive numbers, it outputs the multiplicative inverse if the two inputs are coprime, i.e., the inverse exists, if not, it notifies the user that there is no inverse for the provided two inputs. For this task, you are requested to submit the following:

1. The program code you implemented.
2. A file readme containing the following:
   a. An example input numbers and expected outputs. [provide a snapshot for the output screen]
   b. A detailed description of the way you used your program to find out the multiplicative inverse. This includes detailed instructions for compiling and executing the programs. The program will be tested according to your instructions to produce the expected outputs. Your details must include the following:
      1- Short program overview [what it does]
      2- Prerequisite..
      3- Provide the procedures (steps) for the compiling and executing

4- Show the type of the input data and provide a snapshot
5- View the output result and provide a snapshot
6- Test your program with the following inputs:
    a. Input: 3 and 11
    b. Input: 10 and 17
    c. Input: 2 and 4