Computational Number Theory
Programming HW 2

Due Date: 11/02/2024

You may reuse code/functions from your first assignment.

1. **Arithmetic in $\mathbb{Z}_n$** The input is a text file, with each line having three comma-separated integers: n, a, b, with $n > 1, 0 < a < n < 10^9$, $0 < b < 10^9$.

   For each triple (n, a, b), print the value of a^b in $\mathbb{Z}_n$, followed by true if $a \in \mathbb{Z}_n^*$ and false otherwise, followed by a^{-1} in $\mathbb{Z}_n$ (if the previous value was true, otherwise print nothing).

   Output for the sample input file (testinput-Zn.txt):

   ```
   10,true,14
   0,false
   37,true,53
   367482574,false
   85976398,true,147977274
   ```

2. **Chinese Remainder Theorem** Write a function that accepts four integers a, m, b, n with $0 < m, n < 10^9$, $0 \leq |a|, |b| < 10^9$ and returns the least non-negative integer x such that x simultaneously satisfies: $x \equiv a \pmod{m}$ and $x \equiv b \pmod{n}$. If $gcd(m, n) \neq 1$, your function outputs -1 (although a solution may exist).

   Output for the sample input file (testinput-crt.txt):

   ```
   14
   34
   -1
   1001
   3834241559682
   ```