503: Program Analysis

Assignment 2:
Reasoning about programs

Due: **Tuesday**, April 4 before class

When you submit your completed assignment, please indicate how many hours it took to complete. This will not factor into your grade.

Stein's algorithm[1] computes the greatest common divisor (GCD) of two integers. On some CPU architectures, Stein's algorithm admits a faster implementation than the far more famous Euclidean algorithm[2] for computing GCDs. Here is one possible implementation of Stein's algorithm:

```
1   def gcd(int a, int b):
2       int d ← 0
3       while a is even and b is even:
4           a ← a/2
5           b ← b/2
6           d ← d + 1
7       while a ≠ b:
8           if a is even: a ← a/2
9           elif b is even: b ← b/2
10          elif a > b: a ← (a − b)/2
11          else: b ← (b − a)/2
12      return a ∗ 2^d
```

You do not need to understand why Stein's algorithm works to do this assignment, but reading the implementation above closely will help. Answer each of the following questions and submit your solutions online via Canvas.

1. A program will crash if it ever divides by zero. Does this program ever crash due to division by zero? Carefully explain how you figured this out.

2. Stein's algorithm is intended to compute a value; it should always terminate. Is it possible for this program to run forever? Carefully explain how you figured this out.

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[1]https://en.wikipedia.org/wiki/Binary_GCD_algorithm
[2]https://en.wikipedia.org/wiki/Euclidean_algorithm