Project Euler #198: Ambiguous Numbers

This problem is a programming version of Problem 198 from projecteuler.net

A best approximation to a real number x for the denominator bound d is a rational number r/s (in reduced form) with $s \le d$, so that any rational number p/q which is closer to x than r/s has $q > d$.

Usually the best approximation to a real number is uniquely determined for all denominator bounds. However, there are some exceptions, e.g. $9/40$ has the two best approximations $1/4$ and $1/5$ for the denominator bound 6. We shall call a real number x *ambiguous*, if there is at least one denominator bound for which x possesses two best approximations. Clearly, an ambiguous number is necessarily rational.

How many ambiguous numbers $x = p/q$, $a/b < x < c/d$, are there whose denominator q does not exceed N?

Input Format

The only line of each test case contains exactly five space-separated integers: a, b, c, d and N.

Constraints

- $a/b,\ c/d \le 10^3$
- $0 \le a,\ c \le N$
- $0 < b,\ d \le N$
- $1 < N \le 2 \times 10^9$

Output Format

On a single line print the answer modulo $10^9 + 7$.

Sample Input 0

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1 4 1 2 25
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Sample Output 0

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3
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Explanation 0

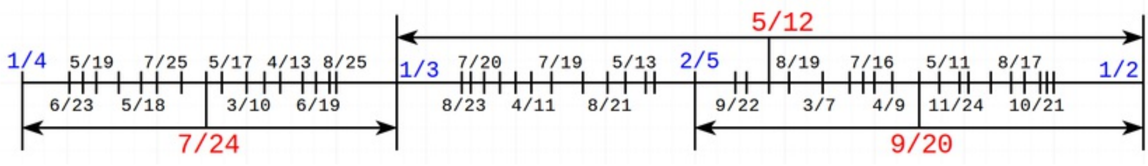
There are 49 rational numbers between $1/4$ and $1/2$ with the denominator no greater than 25:

$6/23$, $5/19$, $4/15$, $3/11$, $5/18$, $7/25$, $2/7$, $7/24$, $5/17$, $3/10$,
$7/23$, $4/13$, $5/16$, $6/19$, $7/22$, $8/25$, $1/3$, $8/23$, $7/20$, $6/17$,
$5/14$, $9/25$, $4/11$, $7/19$, $3/8$, $8/21$, $5/13$, $7/18$, $9/23$, $2/5$,
$9/22$, $7/17$, $5/12$, $8/19$, $3/7$, $10/23$, $7/16$, $11/25$, $4/9$, $9/20$,
$5/11$, $11/24$, $6/13$, $7/15$, $8/17$, $9/19$, $10/21$, $11/23$ and $12/25$.

Only three of them are *ambiguous* numbers: $7/24$, $5/12$ and $9/20$

- $1/3$ and $1/4$ are the two best approximations of $7/24$ for the denominator bound 5;

- $1/2$ and $1/3$ are the two best approximations of $5/12$ for the denominator bound 4;
- $1/2$ and $2/5$ are the two best approximations of $9/20$ for the denominator bound 6.



Therefore the answer is 3.