# 5 Fibonacci Number Again

## Problem Introduction

In this problem, your goal is to compute $F_n$ modulo $m$, where $n$ may be really huge: up to $10^{18}$. For such values of $n$, an algorithm looping for $n$ iterations will not fit into one second for sure. Therefore we need to avoid such a loop.

To get an idea how to solve this problem without going through all $F_i$ for $i$ from 0 to $n$, let's see what happens when $m$ is small — say, $m = 2$ or $m = 3$.

| $i$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $F_i$ | 0 | 1 | 1 | 2 | 3 | 5 | 8 | 13 | 21 | 34 | 55 | 89 | 144 | 233 | 377 | 610 |
| $F_i$ mod 2 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| $F_i$ mod 3 | 0 | 1 | 1 | 2 | 0 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 0 | 2 | 2 | 1 |

Take a detailed look at this table. Do you see? Both these sequences are periodic! For $m = 2$, the period is 011 and has length 3, while for $m = 3$ the period is 01120221 and has length 8. Therefore, to compute, say, $F_{2015}$ mod 3 we just need to find the remainder of 2015 when divided by 8. Since $2015 = 251 \cdot 8 + 7$, we conclude that $F_{2015} \bmod 3 = F_7 \bmod 3 = 1$.

This is true in general: for any integer $m \geq 2$, the sequence $F_n$ mod $m$ is periodic. The period always starts with 01 and is known as Pisano period.

## Problem Description

**Task.** Given two integers $n$ and $m$, output $F_n$ mod $m$ (that is, the remainder of $F_n$ when divided by $m$).

**Input Format.** The input consists of two integers $n$ and $m$ given on the same line (separated by a space).

**Constraints.** $1 \leq n \leq 10^{18}$, $2 \leq m \leq 10^5$.

**Output Format.** Output $F_n$ mod $m$.

**Sample 1.**

Input:

```
239 1000
```

Output:

```
161
```

$F_{239} \bmod 1\,000 = 39\,679\,027\,332\,006\,820\,581\,608\,740\,953\,902\,289\,877\,834\,488\,152\,161 \pmod{1\,000} = 161.$

**Sample 2.**

Input:

```
2816213588 30524
```

Output:

```
10249
```

$F_{2\,816\,213\,588}$ does not fit into one page of this file, but $F_{2\,816\,213\,588} \bmod 30\,524 = 10\,249$.

## Need Help?

Ask a question or see the questions asked by other learners at this forum thread.