

# Lab02 A Variant of the Fibonacci Sequence

## Task

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Do you still remember the Fibonacci sequence of the midterm exam?

Now we expect you to calculate a variant of the Fibonacci sequence:

$$\begin{aligned}F(0) &= F(1) = 1 \\F(N) &= F(N - 2) \% p + F(N - 1) \% q \quad (2 \leq N \leq 1024) \\p &= 2^k \quad (2 \leq k \leq 10), \quad 10 \leq q \leq 1024\end{aligned}$$

(% 是取模运算, 例如  $10 \% 7$  是 10 对 7 取模, 结果为 3)

Note that **p** will be stored in **x3100**, **q** will be stored in **x3101** and **N** will be stored in **x3102**.

Your job: store **F(N)** in **x3103**.

R0-R7 are set to zeroes at the beginning, and your program should start at x3000.

Here are some examples:

N	p	q	F(N)
100	256	123	146
200	512	456	818
300	1024	789	1219

## Score

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Correctness for 50% and the report for other 50%.

## Submission

Note that from this experiment, each experiment requires using **assembly code**.

Here are some notifications:

- Your program should start with **.ORIG x3000**
- Your program should end with **.END**
- Your last instruction should be **TRAP x25 (HALT)**
- **Capitalized** keywords(also labels) are recommended (For example, use "ADD" instead of "add", use "NUMBER" instead of "number" )
- **Spaces** after **commas** ( `ADD R0, R0, #1` rather than `ADD R0,R0,#1` )
- **Decimal** constants start with #, **hexadecimal** with lowercase x

- Write **comments** when necessary

You may also refer to the textbook for more details of code style.

Your submission be structured as shown below.

```
PB21*****_Name.zip
├── PB21*****_Name_report.pdf
└── lab2.asm
```

## Reports

Your reports should contain at least the five parts below:

- purpose
- principles (e.g. how to deal with modulus)
- procedure (e.g. bugs you encountered and how to solve them)
- results of your test
- answer to the question: How can you improve the efficiency of loop structure in your program? (Just describe your idea briefly.)

## Something Interesting

Here are some questions worth thinking:

**You don't have to answer them in your report!**

**You can answer in your report, but that will bring you no more extra points.**

**Don't worry!**

You may find that this Fibonacci sequence has periodicity sometimes. For example, assume  $(p,q)$  are  $(32, 16)$ ,  $(64, 32)$ , or  $(32, 64)$  respectively:

1. Can you make a conclusion of the least positive period of these sequences?
2. Can your conclusion apply to all integer  $p$  that  $4 \leq p \leq 1024$ ?  
If yes, prove that. If no, give a counterexample.