

Lab10 Questions

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Lab10.A:LGM

- ▶ Satori is an LGM, so she decided to play a card game with herself, irotaS.
- ▶ Satori found herself many cards. There are totally 4 types of cards. According to today's weather, both Satori and irotaS can consume 2 cards to produce 1 new card of certain type.
- ▶ Formally speaking, given a 4×4 symmetric matrix T whose entries are among $0, 1, 2, 3$ (the matrix index starts from 0). $T_{i,j} = k$ means that consuming one type i card and one type j card will produce a type k card. Some of the combinations are invalid and $k = -1$ for these cases.
- ▶ Satori and irotaS take turns to move. Satori moves first. In each move, the operator consumes two cards and produce a new one according to the matrix. The player who cannot move loses the game.
- ▶ Satori and irotaS decide to play Q rounds today. In round i , she has $a_{i,0}, a_{i,1}, a_{i,2}, a_{i,3}$ cards for each type, respectively. They wonder who will win the game in each round.

Sample 1 Input

3 3 3 3
3 3 3 3
3 3 0 3
3 3 3 -1
3
1 1 0 1
0 1 2 1
0 0 0 2

4x4 symmetric matrix *T*

| | 0 | 1 | 2 | 3 |
|---|---|---|---|----|
| 0 | 3 | 3 | 3 | 3 |
| 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 0 | 3 |
| 3 | 3 | 3 | 3 | -1 |

card type:
card number:

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1 | 0 | 1 |

Satori
1 1 → 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 0 | 2 |

3 3 → -1, irotaS cannot move, fail

Satori
1 3 → 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

Satori
0 3 → 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 1 | 0 | 1 |

irotaS
0 3 → 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

irotaS
1 3 → 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 0 | 1 |

Satori moves first, the first move must choose 1 1 → 3, then she will win.

Satori cannot move, fail

| | 0 | 1 | 2 | 3 |
|---|---|---|---|----|
| 0 | 3 | 3 | 3 | 3 |
| 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 0 | 3 |
| 3 | 3 | 3 | 3 | -1 |

Satori
 $2\ 2 \rightarrow 0$
 or
 $2\ 3 \rightarrow 3$

....

Satori fail

card type:
card number:

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 1 | 2 | 1 |

Satori
 $1\ 3 \rightarrow 3$

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

Satori moves first, the first move must choose $1\ 3 \rightarrow 3$, then she will win.

irotaS

$2\ 2 \rightarrow 0$

$2\ 3 \rightarrow 3$

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

Satori
 $0\ 3 \rightarrow 3$

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 0 | 1 |

irotaS cannot move, fail

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 1 | 1 |

Satori
 $2\ 3 \rightarrow 3$

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| 0 | 0 | 0 | 1 |

irotaS cannot move, fail

| | 0 | 1 | 2 | 3 |
|---|---|---|---|----|
| 0 | 3 | 3 | 3 | 3 |
| 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 0 | 3 |
| 3 | 3 | 3 | 3 | -1 |

| | | | | |
|--------------|---|---|---|---|
| card type: | 0 | 1 | 2 | 3 |
| card number: | 0 | 0 | 0 | 2 |

3 3 → -1, Satori cannot move, fail

1 1 0 1
0 1 2 1
0 0 0 2



Sample 1 Output

Satori
Satori
irotaS

Lab10.B: Let there be love

- ▶ FluffyBunny wants to fly N balloons which are initially tied on the ground. She will manually untie balloons one at a time. At any time, if balloon $i - 1$ and $i + 1$ are both untied, balloon i will untie and fly away automatically.
- ▶ Now FluffyBunny wonders the number of ways to fly all the N balloons. Two ways are considered different if either the set of balloons she fly manually is different or the order of balloons she manually fly is different.
- ▶ As the answer might be extremely large, please output the number modulo M .

Sample 1 Input

3 100000007

| 1 | 2 | 3 |
|---|---|---|
|---|---|---|

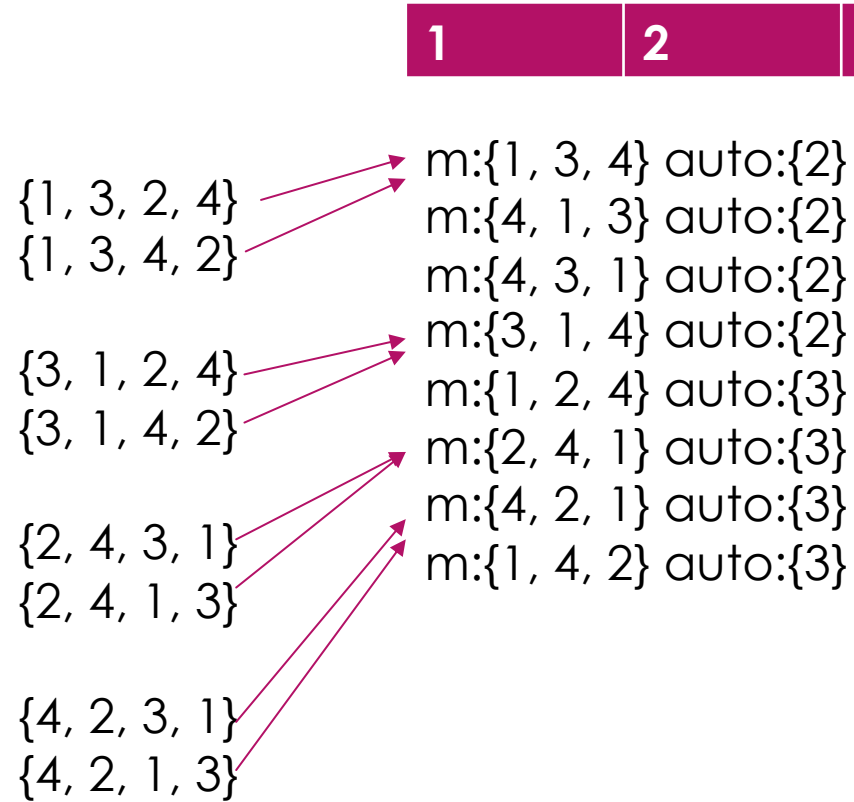
m:{1, 3} auto:{2}
m:{3, 1} auto:{2}
m:{1, 2, 3} auto:∅
m:{3, 2, 1} auto:∅
m:{2, 1, 3} auto:∅
m:{2, 3, 1} auto:∅

Sample 1 Output

6

Sample 2 Input

4 100000007



$$P_4^4 - 4 = 20$$

Sample 2 Output

20