B. 數字轉換 (Password)

time limit per test: 1 second
memory limit per test: 512 megabytes

我們活在陰影下的生與死，為了所愛之人，也為了素未謀面的人們。

FBI (Fudan Boling Instagram) 探員 Matt 正在接收一項任務指令，但是他忘記怎麼把加密文字轉換成正常文字了，請你幫幫他吧！

你需要協助他完成以下的解密流程：

1. Shift Rows：

   將 16 個 base64 字元擺成 4×4 矩陣，進行如下操作：

   原始矩陣：

   $$\begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{10} & s_{11} & s_{12} & s_{13} \\ s_{20} & s_{21} & s_{22} & s_{23} \\ s_{30} & s_{31} & s_{32} & s_{33} \end{bmatrix}$$

   Shift Rows 之後的矩陣：

   $$\begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{11} & s_{12} & s_{13} & s_{10} \\ s_{22} & s_{23} & s_{20} & s_{21} \\ s_{33} & s_{30} & s_{31} & s_{32} \end{bmatrix}$$

2. Mix Columns：

   這步驟請對以下矩陣進行「矩陣乘法」，在此，題目會輸入變數op，若$op = 1$，則混和後的矩陣為

   $$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{11} & s_{12} & s_{13} & s_{10} \\ s_{22} & s_{23} & s_{20} & s_{21} \\ s_{33} & s_{30} & s_{31} & s_{32} \end{bmatrix}$$

   若$op = 2$，混和後的矩陣為

   $$\begin{bmatrix} 2 & 1 & 1 & 3 \\ 3 & 2 & 1 & 1 \\ 1 & 3 & 2 & 1 \\ 1 & 1 & 3 & 2 \end{bmatrix} \times \begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{11} & s_{12} & s_{13} & s_{10} \\ s_{22} & s_{23} & s_{20} & s_{21} \\ s_{33} & s_{30} & s_{31} & s_{32} \end{bmatrix}$$

3. 重複步驟 1 和 2 共 10 次：

   每一輪先做 Shift Rows，再做 Mix Columns。

4. 輸出結果： 先將矩陣內的所有元素「對64取餘數」後，將最終的矩陣轉回 base64 字元，若矩陣為

   $$\begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{10} & s_{11} & s_{12} & s_{13} \\ s_{20} & s_{21} & s_{22} & s_{23} \\ s_{30} & s_{31} & s_{32} & s_{33} \end{bmatrix}$$

   ，則拼接為$s_{00}\ s_{01}\ s_{02}\ s_{03}\ s_{10}\ s_{11}\ s_{12}\ s_{13}\ s_{20}\ s_{21}\ s_{22}\ s_{23}\ s_{30}\ s_{31}\ s_{32}\ s_{33}$。

   接著將每個數字對透過以下 Base64 表進行轉換，並將轉換後的字元接在一起，得到答案：

0	A	32	g
1	B	33	h
2	C	34	i
3	D	35	j
4	E	36	k
5	F	37	l
6	G	38	m
7	H	39	n
8	I	40	o
9	J	41	p
10	K	42	q
11	L	43	r
12	M	44	s
13	N	45	t
14	O	46	u
15	P	47	v
16	Q	48	w
17	R	49	x
18	S	50	y
19	T	51	z
20	U	52	0
21	V	53	1
22	W	54	2
23	X	55	3

24	Y	56	4
25	Z	57	5
26	a	58	6
27	b	59	7
28	c	60	8
29	d	61	9
30	e	62	+
31	f	63	/

提示: 設有兩個 4×4 矩陣 A 和 B：

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \quad B = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} \\ b_{21} & b_{22} & b_{23} & b_{24} \\ b_{31} & b_{32} & b_{33} & b_{34} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix}$$

則它們的乘積

$$C = A \times B = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31} + a_{14}b_{41} & a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} + a_{14}b_{42} & a_{11}b_{13} + a_{12}b_{23} + a_{13}b_{33} + a_{14}b_{43} & a_{11}b_{14} + a_{12}b_{24} + a_{13}b_{34} + a_{14}b_{44} \\ a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31} + a_{24}b_{41} & a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32} + a_{24}b_{42} & a_{21}b_{13} + a_{22}b_{23} + a_{23}b_{33} + a_{24}b_{43} & a_{21}b_{14} + a_{22}b_{24} + a_{23}b_{34} + a_{24}b_{44} \\ a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31} + a_{34}b_{41} & a_{31}b_{12} + a_{32}b_{22} + a_{33}b_{32} + a_{34}b_{42} & a_{31}b_{13} + a_{32}b_{23} + a_{33}b_{33} + a_{34}b_{43} & a_{31}b_{14} + a_{32}b_{24} + a_{33}b_{34} + a_{34}b_{44} \\ a_{41}b_{11} + a_{42}b_{21} + a_{43}b_{31} + a_{44}b_{41} & a_{41}b_{12} + a_{42}b_{22} + a_{43}b_{32} + a_{44}b_{42} & a_{41}b_{13} + a_{42}b_{23} + a_{43}b_{33} + a_{44}b_{43} & a_{41}b_{14} + a_{42}b_{24} + a_{43}b_{34} + a_{44}b_{44} \end{bmatrix}$$

若 $A = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$，則$C = B$

Input

第一行輸入一數op

第二行輸入一行字串str，代表需解密字串。

字串str以每兩位元的方式對照，轉化成$s_{00}s_{01}s_{02}s_{03}s_{10}s_{11}s_{12}s_{13}s_{20}s_{21}s_{22}s_{23}s_{30}s_{31}s_{32}s_{33}$

- $1 \leq op \leq 2$
- str長度為32，且保證str合法

Output

輸出一行文字，代表解密後的文字

Examples

input
2 0102030405060708091011121314151 6
output
li3sbQJGtq/0jYRO

input
1 17023623140506031454123825532312
output
RCkXGDOFO2MmXMZ1

Note

子任務	分數	額外輸入限制
1	30	$op = 1$
2	70	無特殊限制

以範例測資1做一次 Shift Rows 與 Mix Columns 為例: $str = 0102030405060708091011121314151 6$，則
$s_{00} = 01, s_{01} = 02, s_{02} = 03, s_{03} = 04, s_{10} = 05, s_{11} = 06, s_{12} = 07, s_{13} = 08, s_{20} = 09, s_{21} = 10, s_{22} = 11, s_{23} = 12, s_{30} = 13, s_{31} = 14, s_{32} = 15, s_{33} = 16$
，矩陣為

$$\begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{10} & s_{11} & s_{12} & s_{13} \\ s_{20} & s_{21} & s_{22} & s_{23} \\ s_{30} & s_{31} & s_{32} & s_{33} \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}$$

進行Shift Rows 之後的矩陣：

$$\begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{11} & s_{12} & s_{13} & s_{10} \\ s_{22} & s_{23} & s_{20} & s_{21} \\ s_{33} & s_{30} & s_{31} & s_{32} \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 8 & 5 & 6 & 7 \\ 11 & 12 & 9 & 10 \\ 16 & 13 & 14 & 15 \end{bmatrix}$$

進行Mix Columns後的矩陣:

$$\begin{bmatrix} 2 & 1 & 1 & 3 \\ 3 & 2 & 1 & 1 \\ 1 & 3 & 2 & 1 \\ 1 & 1 & 3 & 2 \end{bmatrix} \times \begin{bmatrix} s_{00} & s_{01} & s_{02} & s_{03} \\ s_{11} & s_{12} & s_{13} & s_{10} \\ s_{22} & s_{23} & s_{20} & s_{21} \\ s_{33} & s_{30} & s_{31} & s_{32} \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 1 & 1 & 3 \\ 3 & 2 & 1 & 1 \\ 1 & 3 & 2 & 1 \\ 1 & 1 & 3 & 2 \end{bmatrix} \times \begin{bmatrix} 1 & 2 & 3 & 4 \\ 8 & 5 & 6 & 7 \\ 11 & 12 & 9 & 10 \\ 16 & 13 & 14 & 15 \end{bmatrix}$$

$$= \begin{bmatrix} 69 & 60 & 63 & 70 \\ 46 & 41 & 44 & 51 \\ 64 & 54 & 53 & 60 \\ 74 & 69 & 64 & 71 \end{bmatrix}$$

進行10次 Shift Rows 與 Mix Columns 操作後，矩陣為

$$\begin{bmatrix} 2401033381 & 2401021474 & 2401035831 & 2401014124 \\ 2401060763 & 2401039056 & 2401058313 & 2401046406 \\ 2401060205 & 2401048298 & 2401062655 & 2401040948 \\ 2401037731 & 2401016024 & 2401035281 & 2401023374 \end{bmatrix}$$

對矩陣中的每個元素除以64取餘數後，矩陣為

$$\begin{bmatrix} 37 & 34 & 55 & 44 \\ 27 & 16 & 9 & 6 \\ 45 & 42 & 63 & 52 \\ 35 & 24 & 17 & 14 \end{bmatrix}$$