

Problem D: RSA

Reyno has invented his own encryption algorithm (called Reyno's Super Algorithm), which he uses to encrypt messages he sends to his friends. His algorithm works as follows:

- 1) He writes down his message. If it has an odd length, he adds a space to the end.
- 2) He breaks his message into pairs of characters, forming N pairs in total.
- 3) He converts each pair into a number by multiplying the ASCII value of the first character by 128 and adding the value of the second character.
- 4) He generates N pseudo-random numbers $a_1, a_2, a_3, \dots, a_N$.
- 5) He multiplies the value of the first pair by a_1 and outputs the result modulo 40,009 (which is prime).
- 6) He repeats step 5 for the second, third, fourth, etc. pair until he encrypts the entire message.

To generate the random numbers, he uses a linear congruential generator (which you have seen before). His generator uses the function:

$$a_k = 1997 * a_{k-1} \bmod 40009$$

Which means that to generate the K^{th} random number (a_k), he multiplies the $K-1^{\text{th}}$ number (a_{k-1}) by 1997 modulo 40009. For the first number (a_1), also known as the seed value, he picks a random number that he really likes.

Reyno thinks his algorithm is unbreakable. Can you prove him wrong?

Input:

The first line of the input provides the number of test cases, T ($1 \leq T \leq 100$). T test cases follow. Each test case begins with the integer N ($1 \leq N \leq 1,000$). The next line contains N integers, the encrypted values of the message.

For 50% of the cases, Reyno picks a seed value less than or equal to 1000 and only uses uppercase letters and spaces

Output:

For each test case, output the original message. If there are multiple solutions, output the one with the smallest seed value.

Sample Input:

```
3
6
9285 14187 23117 13153 39535 12859
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19

11055 2553 29781 23952 11741 3298 15519 1333 12875 23540 747

19405 34018 37512 25977 36696 20201 2481 20533

9

35534 39644 22348 34428 2726 25535 33105 3555 6320

Sample Output:

HELLO WORLD

THIS IS REYNO'S UNBREAKABLE ALGORITHM

FOUR MILK NO SUGAR

Explanation for Sample Output:

In the first test case, Reyno uses a seed value of 1, which means the encryption works as follows:

Value	Original Pair (Value)	Encrypted Value
1	"HE" (9285)	9285
1997	"LL" (9804)	14187
27118	"O " (10144)	23117
22469	"WO" (11215)	13153
20504	"RL" (10572)	39535
17281	"D " (8736)	12859