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, ..., **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** mod 40009

Which means that to generate the Kth random number (**a**K), he multiplies the K-1th number (**a**K-1)by 1997 modulo 40009. For the first number (**a1**), 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 ≤ **T** ≤ 100). **T** test cases follow. Each test case begins with the integer **N** (1 ≤ **N** ≤ 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

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 |