CALIFORNIA STATE UNIVERSITY, LOS ANGELES
PROGFEST 2012

Problem 6
Cracking the Code

Problem: A plain text message p of length n is to be transmitted over a secure channel. The sender chooses an integer $m \geq 2n$, and integers s, t, i, and j, where $0 \leq s, t, i, j < m$ and $i < j$. The scheme works as follows: m is the length of the transmitted ciphertext string, c. Initially, c contains m empty slots. The first letter of p is placed in position s of c. The kth letter, $k \geq 2$, is placed by skipping over i empty slots in c after the (k-1)st letter, wrapping around to the beginning of c if necessary. Slots already containing letters are not counted as empty. For instance, if the message is PRAGUE, if s = 1, i = 6, and m = 15, then the letters are placed in c as follows:

```
A P _ U _ _ _ _ R G _  _  E  _  _
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
```

Starting with the first empty slot in or after position t in string c, the plain text message is entered again, but this time skipping j empty slots between letters. For instance, if t = 0 and j = 8, the second copy of p is entered as follows (beginning in position 2, the first empty slot starting from t = 0):

```
A P P U R _ A U R G E  G  E  _  _
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
```

Finally, any remaining unfilled slots in c are filled in with randomly chosen letters:

```
A P P U R A A U R G E  G  E  W  E
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
```

Supposedly, the duplication of the message, combined with the use of random letters, will confuse decryption schemes based upon letter frequencies and that, without knowledge of s and i, no one can figure out what the original message is. Your job is to try to prove this idea wrong. Given a number of ciphertext strings (and no additional information), you will determine the longest possible message that could have been encoded using the above.

Input: A number of ciphertext strings, one per line. Each string will consist only of upper case alphabetic letters, with no leading or trailing blanks; each will have length between 2 and 40. Input for the last test case is followed by a line consisting of the letter X.

Output: For each input ciphertext string, print the longest string that could be encrypted in the ciphertext. If more than one string has the longest

Sample Input	Sample Output
APPURAAURGEGEWE ABABABAB THEACMPROGRAMMINGCONTEST X	Code 1: PRAGUE Code 2: Codeword not unique Code 3: Codeword not unique