Problem 218: Lost in the Mail

Difficulty: Hard

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Problem Background

System Solutions, a division within Lockheed Martin Rotary and Mission Systems, helps to run postal sorting machines that sort around ¼ of the world's postal mail every day. They provide services to companies such as the United States Postal Service (USPS), Royal Mail, and PostNord.

Systems like these use various methods to track and correctly sort mail so it gets to the correct recipient. In the US, a system called intelligent mail barcode (IMb) is used to track all letter-based mail using a barcode which the sorting machines translate to route the post accordingly. This barcode system uses a series of long and short bars to encode information about who is sending some mail, what is being sent, how to send it, and where it's going.

Problem Description

You are a Lockheed Martin Engineer working with USPS on a new mail sorting system using a new version of the IMb system. You have been tasked with writing the program to translate the decoded barcode from the 27-digit payload into the data elements the system needs to route the letter to the correct recipient. The data payload is split into several elements, as described below:

- Digits 1-18: Tracking code, which can be broken down further as follows:
  - Digits 1-3: Service type identifier; for this problem, this will be one of these values:
    - 042 or 261 - Standard Class Mail
    - 040 or 300 - First Class Mail
    - 710 or 712 - Priority Mail
  - Digits 4-9: Mailer ID Code, which uniquely identifies the sender
  - Digits 10-18: Serial Number, which uniquely identifies the mail being sent
- Digits 19-27: Routing code, which can be broken down further as follows:
  - Digits 19-23: A five-digit ZIP code
  - Digits 24-27: A four-digit ZIP+4 extension code

This payload data is concatenated into a single 27-digit number; for example, a company with the mailer ID "123456" might generate the following payload for something they intend send via first-class mail to Lockheed Martin headquarters in Bethesda, Maryland:

040 123456 123456789 20817 1803

This number is then encoded into a 48-character string used to generate the barcode itself, using the following process:

1. Start with a value of 100,001
2. Add the 9-digit routing code to that value
3. Multiply the value by 50
4. For each of the 18 digits in the tracking code, from left to right, multiply the value by 10, then add that digit of the tracking code.
5. Convert the resulting value into a binary number
6. Add leading 0's to bring the binary value to a length of 96 bits
7. For each pair of bits in the binary value, from left to right, identify the resulting barcode character as shown in the table below:

Binary Value	00	01	10	11
Decimal Value	0	1	2	3
Barcode Character				
Description	Tracker	Ascender	Descender	Full Bar
Text Representation	T	A	D	F

This will result in a barcode consisting of 48 bars. This would be printed on envelopes using the barcode characters shown above, but for this problem, we'll represent these bars with the letters shown in the "Text Representation" row. The example payload given above will result in the barcode:

TDTADDAAFDDFAFFFFDDADFTAADATTFTAFTAAATADATFATAAA

Your task is to write a program which reads a series of the new IMb barcodes, decodes them, and compiles a set of statistics regarding the mail identified by those barcodes.

Sample Input

The first line of your program's input, **received from the standard input channel**, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing a single positive integer, X, representing the number of barcodes to be read in this test case
- X lines, each containing a single 48-character string containing the letters A, D, F, and/or T, representing each of the barcodes to be read

```
1
5
TDTADDAAFDDFAFFFFDDADFTAADATTFTAFTAAATADATFATAAA
DTTADAFFTTFTDFDTFAAADAAFATATAFFTFTFFDDDATTDTDFTA
TFAATTFTAFTAFAAADFDAAFAFFDDADDTTTFTTTDFFFFTAFDAA
AFDDFFDAFATATATTTFTFTTFFTAFFTFFAAAFADATTTAFTTTDA
TDTADDAAFDDFAFFFFFTFTTAAFFFFFADFTDTFFAADFTFDTTDA
```

Sample Output

For each test case, your program must print six lines of output:

- A line containing the text "Packages Sorted: #" where # is the number of barcodes processed
- A line containing the text "Standard Class: #" where # is the number of standard-class packages included in the test case
- A line containing the text "First Class: #" where # is the number of first-class packages included in the test case
- A line containing the text "Priority Mail: #" where # is the number of priority mail packages included in the test case
- A line containing the text "Most frequent mailer ID: #" where # is the six-digit mailer ID that occurred most frequently amongst the processed barcodes. In the event of a tie, list the mailer ID that appeared first in the list of barcodes.
- A line containing the text "Most frequent ZIP code: #" where # is the five-digit ZIP code that occurred most frequently amongst the processed barcodes. In the event of a tie, list the ZIP code that appeared first in the list of barcodes.

```
Packages Sorted: 5
Standard Class: 1
First Class: 2
Priority Mail: 2
Most frequent mailer ID: 123456
Most frequent ZIP code: 20817
```