2016 Summer Entrance Examination

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Programming

INSTRUCTIONS

1. Do not open this problem brochure until the signal to begin is given.
2. Write your examinee ID number below on this cover page.
3. An answer sheet and a draft sheet accompany this brochure. Write down your examinee ID number on these sheets.
4. You may choose any programming language to answer.
5. You may consult only one printed manual of a programming language during the examination. *You can use or copy any libraries or program fragments stored in your PC, but you may not connect to the Internet.*
6. By the end of the examination, make a directory/folder on your PC, whose name is the same as your examinee ID number, and put your program files and related files into the directory/folder. Copy the directory/folder onto the USB flash drive that you received.
7. At the end of the examination, the USB flash drive, the answer sheet and the draft sheet will be collected.
8. After these are collected, stay at your seat, until all the examinee program results have been checked briefly by the test supervisor.
9. After the brief check, try to save your program execution environment on the PC so that you can run your program as soon as possible during the oral examination in the afternoon.
10. *Leave your PC and this brochure together in the room* for the oral examination and stay out of the room until you are called.

Examinee ID _____

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Programming

Write programs for the following questions. When writing the programs, you must not use a built-in library function that directly implements the specified behavior. For example, the program for (1) must not include a call to `to_i` in Ruby.

(1) Write a program that reads a number in the quaternary representation (base-4 positional notation) and prints it in the decimal representation. For example, it reads `123` and prints `27`.

(2) Suppose that symbols `a`, `b`, `c`, ..., `h` denote numbers 0, 1, 2, ..., 7, respectively. Write a program that reads a number expressed with `a`, `b`, `c`, ..., `h` in the octal representation and prints the number in the decimal representation. For example, it reads `bcd` and prints `83`.

(3) Write on the answer sheet decimal number `2015` in Roman numerals.

Roman numerals use seven symbols `I`, `V`, `X`, `L`, `C`, `D`, and `M`. Their values are 1, 5, 10, 50, 100, 500, and 1000, respectively. They are formed as follows:

> Numbers are formed by combining symbols and adding the values. So `II` is two ones, i.e. 2, and `XIII` is a ten and three ones, i.e. 13. There is no zero in this system, so 207, for example, is `CCVII`, using the symbols for two hundreds, a five and two ones. 1066 is `MLXVI`, one thousand, fifty and ten, a five and a one.
>
> Symbols are placed from left to right in order of value, starting with the largest. However, in a few specific cases, to avoid four characters being repeated in succession (such as `IIII` or `XXXX`) these can be reduced using subtractive notation as follows:
>
> - the numeral `I` can be placed before `V` and `X` to make 4 units (`IV`) and 9 units (`IX`) respectively
> - `X` can be placed before `L` and `C` to make 40 (`XL`) and 90 (`XC`) respectively
> - `C` can be placed before `D` and `M` to make 400 (`CD`) and 900 (`CM`)
>
> An example using the above rules would be 1904: this is composed of 1 (one thousand), 9 (nine hundreds), 0 (zero tens), and 4 (four units). To write the Roman numeral, each of the non-zero digits should be treated separately. Thus 1,000 = `M`, 900 = `CM`, and 4 = `IV`. Therefore, 1904 is `MCMIV`.
>
> (Reference: http://en.wikipedia.org/wiki/Roman_numerals)

The symbols have to be selected so that the number of the symbols will be the minimum. For example, `IV` is composed of two symbols.

(4) Write a program that reads a number in Roman numerals and prints it in the decimal representation. Assume that the number is more than 0 and less than 4000.

(5) Write a program that reads a number in the decimal representation and prints it in Roman numerals. The number is more than 0 and less than 4000.

(6) Extend the subtraction notation of Roman numerals as follows.

> A symbol can be placed between adjacent larger symbols α and β than that symbol, where $\alpha > \beta$ or α is blank. For example, `CIL` is `149` because $100 - 1 + 50 = 149$. `IL` is `49` because $-1 + 50 = 49$.

Write a program that reads a number in the decimal representation and prints it in the extended Roman numerals. The number is more than 0 and less than 4000. The symbols have to be selected so that the number of the symbols will be the minimum.

(7) Write a program that reads a number expressed in English and prints it in the decimal representation. The number is a positive integer less than 100000. For example, it reads:

```
fifty four thousand three hundred twelve
```

and prints `54312`. The program may accept at least one English expression for each number. For example, for 1200, the program may only accept either `one thousand two hundred` or `twelve hundred`.

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