COMP9021 PRINCIPLES OF PROGRAMMING
Term 3, 2021

Assignment 1 – More Hints

1. **Explaining the following example of the third kind of input (Please convert *** minimally):**

```
$ python3 roman_arabic.py
How can I help you? Please convert ABCADDEFGF minimally
Sure! It is 49269 using BA_C_DEF_G
```

First, remember the two important Roman numeral rules below:

1. A Roman symbol is repeated three times but not more than that. However, the symbols **V** (5), **L** (50) and **D** (500) are never repeated.

2. The Roman symbols **V** (5), **L** (50) and **D** (500) are never written to the left of a symbol of greater value, i.e., **V** (5), **L** (50) and **D** (500) are never subtracted. The symbol **I** (1) can be subtracted from **V** (5) and **X** (10) only. The symbol **X** can be subtracted from **L** (50) and **C** (100) only.

Note also that "minimally" means we are looking for a generalised Roman **symbols** that can convert the given **numeral** into a **smallest integer number**.

Let us start assigning Roman numeral values from the **right-hand side** such that the value is **minimum**.

Starting with **F**, we can see it is repeated and we have to assign the minimum value to **FGF** in order to assign the minimum value to **F**. From a number of various combinations, we know that the only possible solution here is **F=10** and **G=1** (try out combinations of **1**, **5**, **10** here to see why this is the right one). Thus **FGF=19**.

Let us move now to the next element, which is **E**. We also need to consider the element after **E** in order to assign a smaller combination, if possible, in this case. The next element is **D**, which is repeated and therefore cannot be less than **E**. Thus, we assign **E** the smallest number not used yet, which is **50**. Moving on to **D**, since it is repeated, it cannot be greater than the next element **A**. Thus, we assign the smallest number not yet used which is **100** to **D**.

Till now, our number **DDEFGF** is resulting in **269** using **DEF_G** (value **5** not assigned).

The next element is **A** and it is repeated. To assign a value to **A**, we must assign a value so that **ABCA** does not violate Roman numeral rules. That is, A < B and B > C. Because of AB (A and B being next to each other), we cannot assign A as 500 (500 cannot be subtracted from any number).

Let us say we assign 1000 to A. Then B can be either 5000 or 10000. B cannot be 5000 because that would mean C can only be 500. Also, B cannot be 10000 as it would mean C should be 5000 or 500 (both are invalid assignments).

Let us try to assign **10000** to **A** (it cannot be assigned 5000 since it is repeated). B can be either 50000 or 100000. If B is 50000, C can be either 5000, 1000 or 500. C cannot be 5000 or 500 (since they be subtracted from any number). C can be 1000.

Consequently, the smallest we can come up with here is **10000** for **A**, **50000** for **B**, and **1000** for C, and **ABCA = 50000 - 10000 + 10000 - 1000 = 49000**.

Thus, the total becomes **49269** using **BA_C_DEF_G** (values **5**, **500** and **5000** not assigned).

2. **More examples about the third kind of input (`Please convert *** minimally`):**

```
$ python3 roman_arabic.py

How can I help you? Please convert AZERTY minimally

Sure! It is 444 using ZAREYT
```

```
$ python3 roman_arabic.py

How can I help you? Please convert XXXVVVIII minimally

Sure! It is 333 using X_V_I
```

```
$ python3 roman_arabic.py

How can I help you? Please convert AhZhJ minimally

Sure! It is 691 using Ah_Z_J
```

```
$ python3 roman_arabic.py

How can I help you? Please convert BCBC minimally

Hey, ask me something that's not impossible to do!
```