ATILIM ÜNİVERSİTESİ

Faculty of Engineering

Computer Engineering Department

CMPE 323 – Algorithms

HOMEWORK #3

Academic Year: Fall 2020-21
Due Date: 13.12.2020 (Sunday), Hr: 23:59
Due Place: Upload to the Course Moodle Site
Instructor: Assoc. Prof. Dr. Hürevren Kılıç
Assistants: Buğra Yener Şahinoğlu, İbrahim Tarakçı

(Medicine Designer)

Imagine that we have a set S of **symptoms** of a new unknown disease and we want to design a **medicine** that fixes all the symptoms of the disease. Also, suppose that in our lab, we developed a set X of **solutions** each of which fixes some sub-group of the symptoms. We want to design our medicine by selecting among the developed solutions while avoiding to use too many solutions. We further assume that individual and/or combined use of the solutions does neither have side-effect on patients nor reduces (or deletes) their effectiveness over the symptoms that they fix.

Do the following:

1. Design and implement **a greedy approximation algorithm** that finds the **minimum** number of solutions for medicine design purpose such that they fix all the symptoms shown by the disease when they are combined. (**Coding Part Submission**)
2. Analyze your algorithm. What is the **worst-case** and the **best-case** running-time complexity of it? (**Analysis Part Submission**)

EXAMPLE:

Corona-Virus is known to show the following enumerated symptoms S_i [1]:

- Fever or chills (S_1)
- Cough (S_2)
- Shortness of breath or difficulty breathing (S_3)
- Fatigue (S_4)

- Muscle or body aches (S_5)
- Headache (S_6)
- New loss of taste or smell (S_7)
- Sore throat (S_8)
- Congestion or runny nose (S_9)
- Nausea or vomiting (S_{10})
- Diarrhea (S_{11})

Assume that we have the following developed enumerated solutions X_i that fix some sub-group of symptoms of the disease:

Solution X_1 fixes the symptoms $\{S_3, S_4, S_7, S_8\}$

Solution X_2 fixes the symptoms $\{S_1, S_5\}$

Solution X_3 fixes the symptoms $\{S_2, S_3, S_6, S_7, S_{10}, S_{11}\}$

Solution X_4 fixes the symptoms $\{S_5, S_6, S_9, S_{10}\}$

Solution X_5 fixes the symptoms $\{S_1, S_2, S_3, S_4\}$

Solution X_6 fixes the symptoms $\{S_7, S_8, S_{11}\}$

Then, an optimal solution for this problem instance is: $X_4 \cup X_5 \cup X_6 = S$. In other words, when we use combination of 3 solutions (namely X_4, X_5, X_6) they fix all the symptoms of the disease. And, there is no medicine containing less than 3 solutions and fixes all the symptoms.

SAMPLE INPUT:

```
11                          // Number of symptoms
1 Fever or chills           // Symptom ID & its names
2 Cough
3 Shortness of breath or difficulty breathing
4 Fatigue
5 Muscle or body aches
6 Headache
7 New loss of taste or smell
8 Sore throat
9 Congestion or runny nose
10 Nausea or vomiting
11Diarrhea
```

6 **// Number of solutions**

1 3 3 4 7 8 **// Solution ID & Number of symptoms that it fixes & List of the symptoms**

2 2 1 5

3 6 2 3 6 7 10 11

4 4 5 6 9 10

5 4 1 2 3 4

6 3 7 8 11

Your program must be able to generate a possible output given below.

SAMPLE OUTPUT:

Use solutions: 4, 5 and 6 for your medicine.

References:

[1] https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html

PS:

1. You are **required** to work either **alone or** in **at most two-person** group.
2. If you wish to work as a two-person group, both of the group members should send me (**NOT to the course assistants**!) an **e-mail** (**hurevren.kilic@atilim.edu.tr**) indicating the **name** of his/her **agreed** group member until 06.12.2020 (Sunday) Hr:23:59. **Otherwise**, it is **assumed** that you will work **alone** (as **default)**.
3. **Late submissions** will be graded by using formula **100-10*d^2** where **d** is the number of **late** submission **days**.
4. Note that besides from submitting the homework, you are also required to **code review & demonstration** of your code.
5. Percentages of **submission** and **demo** parts are **%70** and **%30** of your overall Homework #2 grade, respectively. Submissions without online code review & demonstrations **gets 0 (zero)** grade from both parts.
6. **Time table** for the **code review & demos** is planned to be **announced later** at the course Moodle site.
7. For your answer **Part 1**, you can prefer any one of **C, C++** or **Python** as your implementation language.
8. Your answer for **Part 2** should be submitted as a handwritten separate file.