Lab3 – Exchanging Tangyuans on Winter Solstice
## Deadline: 2022/01/07 23:55

Lab3 Objection

This is an exercise lab to review the **shortest path** and **max-flow min-cut problem**.

Lab3 Introduction

Winter Solstice is coming, and the neighbor invites Karen to a tangyuan party. She is going to buy the Tangyuans with different flavors. There are many supermarkets in the town, and Karen will buy tangyuan on her way to the party. Because Karen is almost late, she needs to go to the party as soon as possible.

When Karen arrives at the party, she finds that some people have tangyuan that she doesn't have. So she wants to get the tangyuan with different flavors as many as possible.

Input
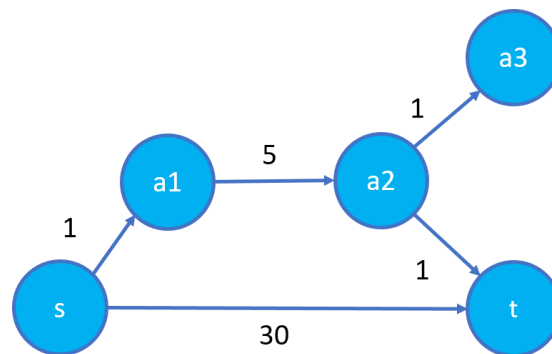
Example (input.txt)

```
home: s
party: t
tangyuan: 4
people: 3
3 1 2 2
3 3 4 4
supermarket: 3
a1 1
a2 1
a3 2
a1   s    1      // s → a1, distance = 1.
t    s    30
a2   a1   5
a3   a2   1
t    a2   1
```

Explanation of the Input

- The first line defines Karen's home.
- Second line defines the location of the party.
- The third line defines kinds of tangyuan.
- The fourth line defines the number of people (n) at the party.
- The next n lines describe each person's tangyuan. (Except Karen)

- Then, it will give the number of the supermarket. (m)
- The next m lines describe the flavor of tangyuan that each supermarket provides.
- Then, it will give the path between two locations. The first one is the destination, the second one is the departure, and the third one is the distance.

Note: **All the parameters in the input file are integer.**

Output
You will need to produce **2** output files. The first one is the single-source shortest path problem, the second one is the max flow min cut.

1. For the **shortest path problem**, you should list the distance of traveling from Karen's home to every other supermarket and the party in the town.

Output Format (short.txt)

```
s: 0
t: 7
a1: 1
a2: 6
a3: 7
```

Explanation of the Output
➢ In each line, you should output the distance of traveling from Karen's home to every other supermarket and the party.
➢ You still need to output Karen's home, and the distance must be 0.

2. For the **max-flow min-cut problem**, you should show that how many kinds of tangyuan Karen will get at most after exchanging.
Everyone except Karen exchanges duplicates for tangyuans he/she doesn't possess. The exchange ratio is always 1:1.
(Hint: Karen is clever, so she has realized that in some cases it is good for her to exchange one of her duplicate tangyuans for a tangyuan she already possesses.)

Output Format (max.txt)

```
2
```

Environment
1. Linux (Please make sure your code is available on our linux server. If it cannot be executed, .zip file, you will get zero point!!)
2. Please use argc and argv to read input and output files or you will get fail in this lab.

⚠Notice
1. Do not print anything on the terminal! **(-5%)**
2. Please check the output format! If output format is not correct, you will get **fail** in this lab.

Submission

Please upload the following materials in a .zip file (e.g. **<student_ID>.zip**) to New E3 by the deadline, specifying your student ID in the subject field. (If your submission file is not a .zip file, you will get zero point!!)

1. Source code (.cpp) (only one!!)
2. Report

⚠ Please check the .zip file with correct format as following figures. **(-5%)**
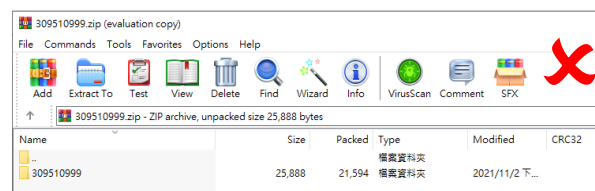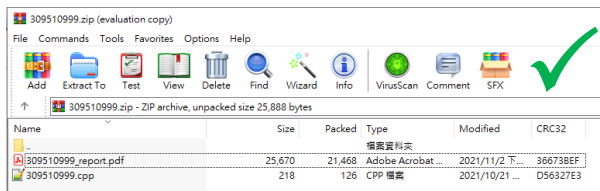
Evaluation

1. You **MUST WRITE YOUR OWN CODE**. Copying codes may get **FAIL** in this course.
2. For each case, it will be regarded as "failed" if you use more than time limit.
3. Naming rule.
   - A. Compile procedure: **g++ -std=C++11 <student_ID>.cpp -o Lab3**
   - B. Execution procedure: **./Lab3 [input] [output] [output]**
     For example: *./Lab3 case1.txt short.txt max.txt*
   - C. Source code: **<student_ID>.cpp**
     For example: *309510999.cpp*
   - D. Report: **<student_ID>_report.pdf**
     For example: *309510999_report.pdf*
   - E. .zip file: **<student_ID>.zip** (compress your source code and report)
     For example: *309510999.zip*

   ⚠ Naming Error or Farmat Error: **-5%** per file

4. Grading
   - A. Case(x5)   90%
     - In each case: 18%
       - ✓ shortest path   9%
       - ✓ max-flow min cut   9%
       - (Time limit: **30 seconds** for each small case)
   - B. Report   10%
     - • No more than 2 page
     - • Your report must contain:
       - i. Time complexity analysis
       - ii. The flow chart of you program

Due date

- Due date：2022/01/07 23:55
- **Penalty of 10%** of the total score per day for the first four days (weekend included) and will not be accepted afterwards