

Program Assignment 3 for Introduction to Algorithms (1082)

Due date and time: 13:00 June 22, 2020

Theme Park

Mary works at a travel agency company and is asked to provide tour plans for tourists. Visiting theme parks which provide various play stations is an important activity for most of tourists. However, due to tight schedules, tourists would like to visit a theme park in a time period t as many play stations as possible.

A theme park map is a graph $G = (V, E)$ with edge weight function $w: E \rightarrow \mathcal{R}$ and vertex weight function $W: V \rightarrow \mathcal{R}$, where weight $w(i, j)$ denotes the time traveling between vertices i and j , and weight $W(a)$ denotes the time spent in vertex a . For example, Fig. 1 shows a theme park map of 5 vertices (play stations). Let a cycle from s to s denote a play plan in G starting from s , and the time of a play plan is the total time spent in vertices and edges of the plan. For example, cycle 1, 5, 2, 1 is a play plan starting from 1 in time $20 + 5 + 30 + 4 + 0 + 10 = 69$.

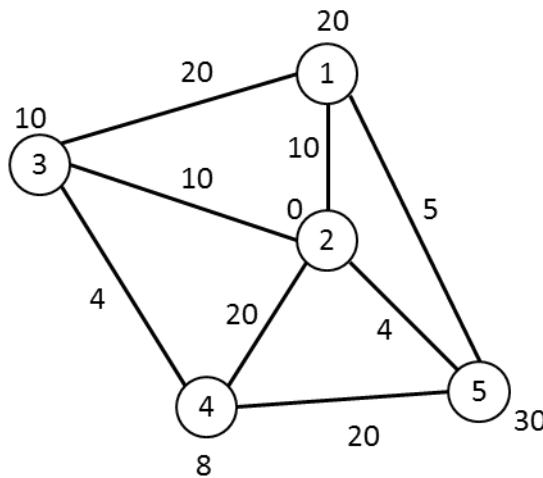


Fig. 1

A best play plan starting from s in time t is a play plan starting from s within time t that visits play stations (vertices) as many as possible. The following shows some solutions of possible the best play plans starting from 1 in Fig. 1.

If $t = 10$, there is no feasible best play plan starting from 1 in time 10.

If $t = 30$, there is no feasible best play plan starting from 1 in time 10.

If $t = 40$, the best play plan starting from 1 in time 40 is cycle 1, 2, 1 in time $20 + 10 + 0 + 10 = 40$.

If $t = 60$, the best play plan starting from 1 in time 60 is cycle 1, 5, 1 in time $20 + 5 + 30 + 5 = 60$.

If $t = 69$, the best play plan starting from 1 in time 69 is cycle 1, 5, 2, 1 in time $20 + 5 + 30 + 4 + 0 + 10 = 69$

If $t = 70$, the best play plan starting from 1 in time 70 is cycle 1, 2, 3, 1 in time $20 + 10 + 0 + 10 + 10 + 20 = 70$.

If $t = 71$, the best play plan starting from 1 in time 70 is cycle 1, 2, 3, 1 in time $20 + 10 + 0 + 10 + 10 + 20 = 70$.

Please write a program for Mary to find the best play plan starting from s in time t in graph G .

Input Format

Let $G = (V, E)$ be a graph with edge weight function $w: E \rightarrow \mathcal{R}$ and vertex weight function $W: V \rightarrow \mathcal{R}$, where weight $w(i, j)$ denotes the cost traveling between vertices i and j , and weight $W(a)$ denotes the cost through vertex a . Let $n = |V|$ and $m = |E|$, where $5 \leq n \leq 100$ and $5 \leq m \leq 1000$. Let $V = \{1, 2, \dots, n\}$ and (i_k, j_k) denote an edge in E , where $1 \leq k \leq m$.

- ◆ The file **graph** contains the information for graph G by the following format:

```
n m
W(1) W(2) ... W(n)
i1 j1 w(i1, j1)
i2 j2 w(i2, j2)
...
im jm w(im, jm)
```

- ◆ The file **query** contains the information for queries by the following format, where s denote starting vertex and t_i 's denote time limits for $1 \leq i \leq k$:

```
s
t1
t2
...
tk
```

Output Format

```
<The best play plan starting from s in time t1>
...
<The best play plan starting from s in time tk>
```

Sample Input

File **graph**

```
5 8
20 0 10 8 30
1 2 10
1 3 20
1 5 5
2 3 10
2 4 20
2 5 4
3 4 4
4 5 20
```

File **query**

```
1
10
```

30
40
60
69
70
71

Sample Output

t = 10: infeasible
t = 30: infeasible
t = 40: cycle 1, 2, 1 in time: $20 + 10 + 0 + 10 = 40$
t = 60: cycle 1, 5, 1 in time: $20 + 5 + 30 + 5 = 60$
t = 69: cycle 1, 5, 2, 1 in time: $20 + 5 + 30 + 4 + 0 + 10 = 69$
t = 70: cycle 1, 2, 3, 1 in time: $20 + 10 + 0 + 10 + 10 + 20 = 70$
t = 71: cycle 1, 2, 3, 1 in time: $20 + 10 + 0 + 10 + 10 + 20 = 70$

Report

The report file should follow the guidelines and upload to http://www.turnitin.com/zh_tw/home.

Bonus

You will get additional bonus if the previous requirements and one of the following are accomplished:

1. Provide time complexity analysis.
2. Provide visualization of results.

程式作業要求

報告撰寫格式

請以 A4 紙張列印，需包含：

A. 封面頁：班級、學號、姓名

B. 內 容：每頁須編上頁碼，行間距離 1.5 行距，除主標題使用 14pt 字外，其餘請使用 12pt 字。上下左右各 2.5 公分留白。請依下列章節撰寫：

1. 問題描述
2. 解題構想
3. 資料結構與演算法
4. 程式流程圖
5. 程式執行畫面
6. 程式碼 (含註解)

作業繳交時間

***繳交時間：2020/06/22(一) 13:00(逾期不能補交)**

***繳交地點：上課教室**

- 須繳交書面報告，報告電子檔(word 格式)上傳至 http://www.turnitin.com/zh_tw/home。報告電子檔須與書面報告一致，程式碼須是文字格式。

作業展示時間

***展示時間：2019/06/22(一)上課時間**

***地點：上課教室**

注意事項

1. 作業抄襲者**以 0 分計算**。
2. 程式的輸出入格式必須完全與題目敘述一致，否則作業**以 0 分計算**。請多嘗試一些測試資料來驗證程式的正確性。