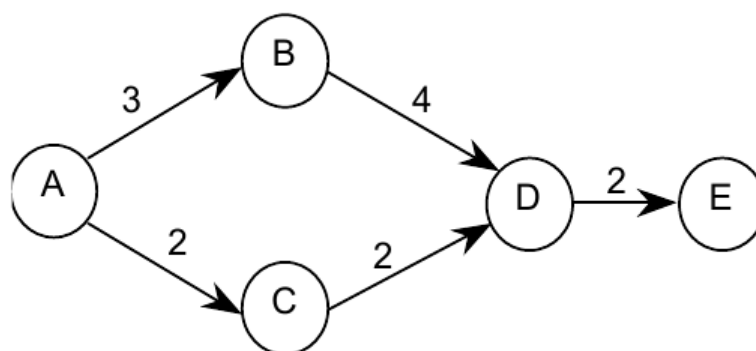


2214 Activity Scheduling in Project Management

Mr. John Chong is a project manager in NewAge.com Pte Ltd. His task is to schedule activities in a project to make sure that the project can be completed in a minimum amount of time. An *activity* is a part of the project that takes place over a period of time and a *milestone* is the completion of an activity (or a group of activities). Activities in a project are usually specified using an *activity graph* as shown below. Nodes in the activity graph are milestones and links are activities. The label of a link indicates the duration of the corresponding activity (in the unit of days). An activity can be specified using a *starting* and an *ending milestone*. For example, activity *BD* takes 4 days to complete. It starts from milestone *B* and ends at milestone *D*. Each activity graph has exactly one *start* and one *finish milestone*. In the following diagram, the start milestone is *A* and the finish milestone is *E*.



An activity graph also depicts the dependencies among activities and milestones. An activity starting from a milestone can only begin after all activities ending at that milestone have been completed. For instance, activity *DE* can only begin after activities *BD* and *CD* have been completed.

Given an activity graph, the minimum amount of time it will take to complete the project can be easily calculated. This is referred to as the *minimum duration* of the project. The minimum duration of the project depicted by the above activity graph is 9 days. It is determined by the activities *AB*, *BD* and *DE*. However, besides minimum duration, John also needs to know:

1. the earliest time an activity may begin (referred to as *earliest starting time*, EST, of an activity), and
2. the latest time an activity may begin so that the project may still be completed in minimum duration (referred to as *latest starting time*, LST, of an activity).

For example, in the above activity graph, activities *AB* and *AC* can begin immediately since they do not depend on any other activities. So, their EST is 1 (i.e., day 1). Activity *BD* can only begin after activity *AB* has been completed. Its EST, therefore, is 4. Similarly, the EST of activity *CD* is 3. Activity *DE* can only begin after activities *BD* and *CD* have been completed. Since *BD* cannot be completed until day 8 and *CD* cannot be completed until day 6, the earliest starting time for activity *DE* is 8.

In order to complete the project in minimum duration, activity *DE* then must begin at day 8. So, its LST is 8. For activity *DE* begins at day 8, activity *BD* has to start at day 4. However, activity *CD* can begin as late as day 6 without delaying the schedule of activity *DE*. So, LSTs of activities *BD* and *CD* are 4 and 6 respectively. Similarly, LSTs of activities *AB* and *AC* can be calculated. They are 1 and 4 respectively.

In this problem, you are requested to develop a program to help John schedule activities in a project. Activities and their duration are specified in the input. Your program should output the EST and LST of each activity and the list of activities that determine the minimum duration of the project.

Input

The input consists of a number of test cases, each of which ends with a '#' sign. A test case describes an activity graph. It consists of a start and a finish milestone of the activity graph and a list of activities. Each activity is specified in the following format by a starting milestone, an ending milestone and its duration:

starting_milestone ending_milestone duration

Milestones are specified using alphabet characters and duration is specified using integers.

Output

For each test case, the EST and LST of each activity should be printed out in the following format (see the sample output below):

starting_milestone ending_milestone EST LST

Activities that determine the minimum duration of the project should also be printed out (see the sample output below).

Sample Input

```
A
E
A B 3
A C 2
B D 4
C D 2
D E 2
#
A
F
A B 2
A C 3
B D 3
B E 2
C D 1
C E 3
D F 4
E F 2
#
```

Sample Output

```
Test Case 1
A B 1 1
A C 1 4
B D 4 4
C D 3 6
```

D E 8 8

Activities that determine minimum duration

A B

B D

D E

Test Case 2

A B 1 1

A C 1 2

B D 3 3

B E 3 6

C D 4 5

C E 4 5

D F 6 6

E F 7 8

Activities that determine minimum duration

A B

B D

D F