Problem 174: What to Do?

Difficulty: Medium

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Problem Background

Computers have a limited number of resources available; they only have so much memory, disk space, and computing power available. The computer's operating system is responsible for managing competing demands for these resources, and often have to make decisions about what software gets priority use of those resources.

You're working with Lockheed Martin Space to develop a satellite for the National Oceanic and Atmospheric Administration (NOAA) to conduct various experiments high above Earth's atmosphere. Your team has been asked to design a priority scheduler that will determine what the satellite should be doing at any point in time.

Problem Description

The satellite's computer breaks down time into computing cycles, starting with cycle 1. Each task will take a certain number of cycles to complete, and once a task is completed, it should not be executed again. Tasks have a priority associated with them; at the start of each computing cycle, the scheduling algorithm should instruct the satellite to work on the highest priority task (higher priorities have larger values) from amongst those it has not yet completed, possibly causing it to switch between tasks. In the event two tasks have the same priority, run the one that appears first in the list of tasks. Tasks also have a time constraint, represented by a cycle number. A task may not be worked unless the current cycle number is greater than or equal to the task's time constraint.

Your scheduling algorithm will need to provide a report of what the satellite will be doing during each cycle for a given number of cycles. If the satellite is not able to work any incomplete tasks due to time constraints, the satellite should perform the "Wait" task for one cycle, and evaluate the situation again at the start of the next cycle. It may not be possible to complete all tasks in the time allotted.

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing two positive integers, separated by a comma, representing:
  - C, the number of cycles the scheduling algorithm should schedule
  - T, the number of tasks the satellite should be instructed to perform

- T lines, providing information about the tasks to be completed by the satellite. Each line will contain the following information, separated by commas:
  - A string providing a unique description of the task, which may contain letters and spaces
  - A positive integer representing a priority level for the task
  - A positive integer representing the task's time constraint, the earliest cycle number at which the task can be started
  - A positive integer representing the number of cycles this task will take to complete

```
1
10,7
Execute Experiment A,11,4,2
Reorient to Target A,4,1,2
Capture Imagery,5,1,3
Station Keeping,10,1,2
Transmit Results,20,8,1
Reorient to Target B,12,4,1
Execute Experiment B,2,2,3
```

Sample Output

For each test case, your program must print C lines containing information about the satellite's tasking during each computing cycle. Each line should contain the cycle number (starting with 1), a comma, and the description of the task to execute during that cycle. If there is no task to execute, print "Wait" in place of the task description.

```
1,Station Keeping
2,Station Keeping
3,Capture Imagery
4,Reorient to Target B
5,Execute Experiment A
6,Execute Experiment A
7,Capture Imagery
8,Transmit Results
9,Capture Imagery
10,Reorient to Target A
```