CS6023 : GPU Programming

Assignment-4

Deadline: 23:55 May 3, 2023

1 Problem statement

There are N computer centres and each computer centre has a variable P number of facility rooms. Each facility room provide a certain type of facility like super computer, mainframes, workstation, personal computers etc. and each room has a variable capacity C. There are users who want to avail this facility should interact with an application. There are a total of 24 time slots(1 hour each) in a day and a user can book 1 to 24 number of slots depending on the availability.

The user should request by providing details to the application like computer centre number, facility room number, the starting slot to use the facility and the number of slots to reserve the facility. If the number of slots requested is 5 and start slot is 16 then 16,17,18,19,20 will be reserved. A request might not be granted and is a failure if there are no slots available for a particular facility.

The application can get multiple requests R from users at a particular time. The application should parallelize the processing of requests by using GPU cores.

At the end after all the requests have been processed, print the total number of successful requests and total number of failed requests. Also, print the total successful requests and failed requests for each computer centre.

2 Constraints

$1 \leq T \leq 10$

$1 \leq N \leq 100000$

$1 \leq P \leq 30$

$1 \leq C \leq 100$

$1 \leq slots \leq 24$

$1 \leq R \leq 100000$

3 Input and Output format

3.1 Input format

The first line of the input would be the total number of test cases.

For each test case, do the following

- The first line contains the number of computer centres.
- For each computer centre,
  - computer centre number, number of facility rooms P
  - The next line contain P space-separated integers i.e. facility room numbers
  - The next line contain P space-separated integers i.e. capacity C of each facility room
- The next line contain the total number of requests R.
- The next R lines contains details of each request from user which are followed below,
  - Request ID, computer centre number, facility room number, Starting slot number, number of slots to be reserved.

3.2 Output format

For each test case, print the total number of successful requests and failed requests separated by a space and in the next N lines. For each computer center, print total successful requests, total failed requests

4 Sample I/O

4.1 Input

3	(total number of testcases)
2	(total number of Computer centres for test case 1)
0 2	(Computer centre number 0, number of facility rooms)
0 1	(Facility room numbers for comp. centre 0)
1 2	(Capacities for each facility room)
1 3	(Computer centre number 1, number of facility rooms)

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0 1 2                    (Facility room numbers for comp. centre 1)
1 2 2                    (Capacities for each facility room)
4                        (Total number of requests R)
0 1 0 21 3               (Request 1 id, comp. centre, facility room, start slot, slots)
1 1 0 23 2               (Request 2 ...)
2 1 1 27 4               (Request 3 ...)
3 0 1 12 2               (Request 4 ...)
2                        (start of test case 2 ...)
0 3
0 1 2
2 1 5
1 2
0 1
1 1
4
0 1 1 13 9
1 0 0 5 15
2 1 1 12 4
3 1 1 17 2
1                        (start of test case 3 ...)
0 4
0 1 2 3
1 2 1 5
6
0 0 1 5 10
1 0 0 5 10
2 0 0 2 4
3 0 1 2 4
4 0 1 7 9
5 0 1 10 30
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4.2 Output

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3 1 (For test case 1, total 3 successful requests and 1 failed request)
2 1 (for computer centre 0, 2 successful requests and 1 failed request.)
1 0 (for computer centre 1, 1 successful request and 0 failed request.)
2 2 (test case 2...)
1 2
1 0
4 2 (test case 3...)
4 2
```

In test case 1, There was one failed request because, request id 0 requested for 21, 22, 23 slots of facility 0 in computer centre 1 and request id 1 requested for 23, 24 slots of same facility and it has a capacity of only 1. Other requests

did not have any clash.

In test case 2, Request 0 will take facility 1 of computer centre 1 from time slot 13 to 21. Request 1 will take facility 0 of computer centre 0 from time slot 5 to 19. Request 0 and 1 will be successful. Request 2 will be failed because slot 13 to 21 is requested by request 0, so request 2 can't get slot from 12 to 15 as the capacity of facility 1 of computer center 0 is just 1. Similarly, request 3 will not get granted.

5 Points to be noted

- There could be a race condition if two requests are targeting the same facility of a computer centre, so make sure consistency is maintained.
- If multiple requests are targeting the same facility and the room is out of capacity, then the requests with smaller id numbers should be prioritised.
- Do not write any print statements inside the kernel
- Sequential implementation (apart from where absolutely needed) of the above functionality will lead to '0' marks on the assignment.
- You are free to use any number of function/kernel

6 Submission guidelines

- Submit your .cu file with file name as RollNumber.cu on moodle.

7 Learning suggestions

- Write a CPU-version of code achieving the same functionality. Time the CPU code and GPU code separately for large inputs and compare the performances.
- Usage of syncronization.