Information Technology Research - Take Home Assignment 2
Spring 2022

The goal of this assignment is to simulate how students can be assigned to courses based on some predefined conditions. You will need to select or design data structures and algorithms based on everything you learned in this class to provide an optimal solution.

Due Date:
- 2022/06/02 (Thu) 9 pm

Conditions:
- Students are in a 4-year university.
- Each student is in a specific year.
- The higher-year students have priority in being assigned to courses.
- In the same year, students who have a smaller Id has priority in being assigned to courses.
- Every student will be assigned to only one course.
- There are many courses, each course accepts a limited number of students.
- Each student has their own preference for each course.
- Students that have priority and preference for a course need to be assigned to this course first.
- A student may have no preference for certain courses.
- Student satisfaction: # of students that was assigned to their first choice.

Requirements:
- Modify HW2.java which is posted in the online assignment of the course website.
- Complete the simulate function that assigns students to courses.
- Assign all students to courses, optimize the simulation performance, and optimize the satisfaction of the student body.
- Do not remove any code in HW2.java, but you can add your own code anywhere in the file.
- Use a data structure and an algorithm that can run fast at scale. Your solution needs to work with data (course, student) of much larger sizes.
- The performance and accuracy of your solution will be important parts of the grading criteria.
- Write a short report on the data structure and algorithm you selected or designed, why you chose them, and how they work. The report needs to be clear and concise.
- Write comments for each key operation.

Input:
- A list of students in an array
  - Each student (Student object) has the following attributes:
    - Student's year: 1-4
      - Priority: 4 > 3 > 2 > 1
    - Student's Id: integer

        - Priority: low > high
    - Student's preference for each course: [3,4,1,…]
        - In [3,4,1,2]: total of at least 4 courses, first choice is course with Id 3, second choice is course with Id 4…
        - In [2]: total of at least 2 courses, first choice is course with Id 2, no preference for other courses (can assign to any course).
- A list of courses in an array
    - Each course (Course object) has the following attributes:
        - Course Id: integer
        - Course name: String
        - Candidates (Student array): a list of students assigned to the course
            - Fill this array for each course is the goal of this assignment.

Expected Output:

- A completed simulate function that returns a Courses array with students assigned to it following the conditions described above.

Examples of Successful Simulation Results

- Test case1 input
    - Students [preferences are all 1,2,3,4]:
      [大 1 學號 11, 大 1 學號 12, 大 1 學號 13,
      大 2 學號 21, 大 2 學號 22, 大 2 學號 23,
      大 3 學號 31, 大 3 學號 32, 大 3 學號 33,
      大 4 學號 41, 大 4 學號 42, 大 4 學號 43]
    - Courses (capacity): [ITR(3), MIS(3), DataBase(3), and ResearchMethod(3)]
- Test case1 output

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Test case1:
ITR : [大4 學號41, 大4 學號42, 大4 學號43]
MIS : [大3 學號31, 大3 學號32, 大3 學號33]
DataBase : [大2 學號21, 大2 學號22, 大2 學號23]
ResearchMethod : [大1 學號11, 大1 學號12, 大1 學號13]
Students satisfaction: 3
Performance(time): 689500
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- Test case2 input
    - Students [preferences]:
      [大 1 學號 11[1,2,3], 大 1 學號 12[1,2,3], 大 1 學號 13[1,2,3],
      大 2 學號 21[1,2,3], 大 2 學號 22[1,2], 大 2 學號 23[2,1,3],
      大 3 學號 31[1,2,3], 大 3 學號 32[1,2,3], 大 3 學號 33[1,2,3],
      大 4 學號 41[], 大 4 學號 42[1,2,3], 大 4 學號 43[1,2,3]]
    - Courses (capacity): [ITR(6), MIS(2), DataBase(4)]
- Test case2 output

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Test case2:
ITR : [大4 學號42, 大4 學號43, 大3 學號31, 大3 學號32, 大3 學號33, 大2 學號21]
MIS : [大2 學號22, 大2 學號23]
DataBase : [大1 學號11, 大1 學號12, 大1 學號13, 大4 學號41]
Students satisfaction: 7
Performance(time): 42417
```

- We will also test your code's robustness with other types of inputs that include different students and courses that satisfy our requirement.

Deliverables:

- Report
    - Upload PDF format
    - Slides in 4:3 dimension
    - At most 5 slides
    - Include information about you (student id, name)
    - Include the following content
        - Describe the data structure & algorithm you selected or designed
        - Why you chose them (your thought process and rationales)
        - How they work (help us understand your logic and design)
    - References
- HW2.java
    - The java file should be uploaded to the course website.

Rules:

- THE ASSIGNMENT HAS TO BE WRITTEN INDEPENDENTLY BY YOU.
- You can discuss ideas with classmates and the TA if you cannot do it on your own, but make sure to credit the person who helped you in the comments.
- If you referenced an online source, also cite it.
- Late policy: this assignment will be docked 10% for every day late and will not be accepted 5 days after the due date.