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1.1

Screenshot of topological sorted List

```
-----Topological Order-----
MATH 1390 COLLEGE ALGEBRA
CSCI 1470 COMPUTER SCIENCE I
CSCI 1480 COMPUTER SCIENCE II
CSCI 2320 DATA STRUCTURES
CSCI 3385 ARTIFICIAL INTELLIGENCE
CSCI 3381 OBJECT-ORIENTED SOFTWARE DEVELOPMENT WITH JAVA
CSCI 4490 SOFTWARE ENGINEERING
CSCI 3370 PRINCIPLES OF PROGRAMMING LANGUAGES
CSCI 4320 COMPILER CONSTRUCTION
CSCI 3360 DATABASE SYSTEMS
CSCI 4370 DATA MINING
CSCI 3350 FILE STRUCTURES
CSCI 3345 HUMAN-COMPUTER INTERACTION
CSCI 3335 NETWORKING
CSCI 4355 DISTRIBUTED OBJECT COMPUTING
CSCI 3190 SOCIAL IMPLICATIONS OF TECHNOLOGY
CSCI 2440 ASSEMBLY LANGUAGE AND COMPUTER ORGANIZATION
CSCI 3380 COMPUTER ARCHITECTURE
MATH 1591 Calculus I
MATH 2330 Discrete Mathematics
CSCI 4390 THEORY OF COMPUTATION
CSCI 3330 ALGORITHMS
CSCI 4365 WEB TECHNOLOGY
CSCI 4353 INTRODUCTION TO MULTIMEDIA COMPUTING
CSCI 4340 INTRODUCTION TO PARALLEL PROGRAMMING
CSCI 4315 INFORMATION SECURITY
CSCI 4300 OPERATING SYSTEMS
CSCI 4345 INTRODUCTION TO REAL-TIME SYSTEM CONCEPTS AND IMPLEMENTATION
MATH 3320 Linear Algebra
CSCI 4350 COMPUTER GRAPHICS
CSCI 4310 INTRODUCTION TO SCIENTIFIC COMPUTING
```

Screenshot of prerequisites of the input course code:

```
>>>>>>prereqs for:      CSCI 4490<<<<<<<
CSCI 1470
CSCI 1480
CSCI 2320
CSCI 3381
CSCI 4490
```

```
>>>>>>prereqs for:      CSCI 4340<<<<<<<
CSCI 1470
CSCI 1480
CSCI 2440
CSCI 2320
MATH 1390
MATH 1591
MATH 2330
CSCI 3330
CSCI 4340
```

```
>>>>>>prereqs for:      MATH 2330<<<<<<<
MATH 1390
MATH 1591
CSCI 1470
MATH 2330
```

```
>>>>>>prereqs for:      CSCI 4310<<<<<<<
MATH 1390
MATH 1591
CSCI 1470
CSCI 1480
CSCI 2320
MATH 2330
MATH 3320
CSCI 4310
```

Screenshot of schedule building (Nicky's version - for actual solution see §1.1b)

```
-------Limit for concurrent courses taken:      2------
Semester 1
CSCI 1470
MATH 1390
-----------------
Semester 2
CSCI 1480
MATH 1591
-----------------
Semester 3
CSCI 2320
MATH 2330
-----------------
Semester 4
CSCI 3335
MATH 3320
-----------------
Semester 5
CSCI 3370
CSCI 3350
-----------------
Semester 6
CSCI 3190
CSCI 3345
-----------------
Semester 7
CSCI 3381
CSCI 3360
-----------------
Semester 8
CSCI 3385
CSCI 2440
-----------------
Semester 9
CSCI 3330
CSCI 4300
-----------------
-----------------
Semester 10
CSCI 4365
CSCI 4345
-----------------
Semester 11
CSCI 4340
CSCI 4320
-----------------
Semester 12
CSCI 4355
CSCI 4310
-----------------
Semester 13
CSCI 4315
CSCI 4490
-----------------
Semester 14
CSCI 4390
CSCI 3380
-----------------
Semester 15
CSCI 4370
CSCI 4350
-----------------
Semester 16
CSCI 4353
-----------------
```

```
-------Limit for concurrent courses taken:      3------
Semester 1
CSCI 1470
MATH 1390
-----------------
Semester 2
CSCI 1480
MATH 1591
-----------------
Semester 3
CSCI 2320
MATH 2330
-----------------
Semester 4
CSCI 3335
MATH 3320
CSCI 3370
-----------------
Semester 5
CSCI 3350
CSCI 3190
CSCI 3345
-----------------
Semester 6
CSCI 3381
CSCI 3360
CSCI 3385
-----------------
Semester 7
CSCI 2440
CSCI 3330
CSCI 4300
-----------------
Semester 8
CSCI 4365
CSCI 4345
CSCI 4340
-----------------
-----------------
Semester 9
CSCI 4320
CSCI 4355
CSCI 4310
-----------------
Semester 10
CSCI 4315
CSCI 4490
CSCI 4390
-----------------
Semester 11
CSCI 3380
CSCI 4370
CSCI 4350
-----------------
Semester 12
CSCI 4353
```

```
-------Limit for concurrent courses taken:      4------
Semester 1
CSCI 1470
MATH 1390
-----------------
Semester 2
CSCI 1480
MATH 1591
-----------------
Semester 3
CSCI 2320
MATH 2330
-----------------
Semester 4
CSCI 3335
MATH 3320
CSCI 3370
CSCI 3350
-----------------
Semester 5
CSCI 3190
CSCI 3345
CSCI 3381
CSCI 3360
-----------------
Semester 6
CSCI 3385
CSCI 2440
CSCI 3330
CSCI 4300
-----------------
Semester 7
CSCI 4365
CSCI 4345
CSCI 4340
CSCI 4320
-----------------
-----------------
Semester 8
CSCI 4355
CSCI 4310
CSCI 4315
CSCI 4490
-----------------
Semester 9
CSCI 4390
CSCI 3380
CSCI 4370
CSCI 4350
-----------------
Semester 10
CSCI 4353
-----------------
```

1.1b

Screenshot of schedule building (Lance's version) N=2

```
-------Limit for concurrent courses taken:      2------

>>>>>>>Semester:1 <<<<<<<<
Considering:    [CSCI 1470, MATH 1390]
Taking the following:
CSCI 1470
MATH 1390

>>>>>>>Semester:2 <<<<<<<<
Considering:    [MATH 1591, CSCI 1480]
Taking the following:
MATH 1591
CSCI 1480

>>>>>>>Semester:3 <<<<<<<<
Considering:    [CSCI 2440, CSCI 2320, MATH 2330]
Taking the following:
CSCI 2320
MATH 2330

>>>>>>>Semester:4 <<<<<<<<
Considering:    [CSCI 2440, MATH 3320, CSCI 3345, CSCI 3335, CSCI 3190, CSCI 4390, CSCI 3370, CSCI 3381,
CSCI 3360, CSCI 3350, CSCI 3330, CSCI 3385]
Taking the following:
CSCI 2440
CSCI 3330
```

```
>>>>>>>Semester:5 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4365, MATH 3320, CSCI 3345, CSCI 3335, CSCI 4315, CSCI 4390,
CSCI 3380, CSCI 3370, CSCI 3381, CSCI 4340, CSCI 3360, CSCI 3350, CSCI 4353, CSCI 3385]
Taking the following:
MATH 3320
CSCI 3360

>>>>>>>Semester:6 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4365, CSCI 4310, CSCI 3345, CSCI 3335, CSCI 4315, CSCI 4390,
CSCI 3380, CSCI 3370, CSCI 3381, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 3381
CSCI 3370

>>>>>>>Semester:7 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4365, CSCI 4310, CSCI 3345, CSCI 3335, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4320, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 4300
CSCI 3335

>>>>>>>Semester:8 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4320, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 4353
CSCI 3385
```

```
>>>>>>>Semester:10 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350]
Taking the following:
CSCI 4340
CSCI 3350

>>>>>>>Semester:11 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370]
Taking the following:
CSCI 3380
CSCI 4370

>>>>>>>Semester:12 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390]
Taking the following:
CSCI 4490
CSCI 4390

>>>>>>>Semester:13 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315]
Taking the following:
CSCI 3345
CSCI 4315
```

```
>>>>>>>Semester:14 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345]
Taking the following:
CSCI 4310
CSCI 4345

>>>>>>>Semester:15 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365]
Taking the following:
CSCI 4355
CSCI 4365

>>>>>>>Semester:16 <<<<<<<<
Considering:    [CSCI 3190]
Taking the following:
CSCI 3190
```

— N=3

```
-------Limit for concurrent courses taken:      3------

>>>>>>>Semester:1 <<<<<<<<
Considering:    [CSCI 1470, MATH 1390]
Taking the following:
CSCI 1470
MATH 1390

>>>>>>>Semester:2 <<<<<<<<
Considering:    [MATH 1591, CSCI 1480]
Taking the following:
MATH 1591
CSCI 1480

>>>>>>>Semester:3 <<<<<<<<
Considering:    [CSCI 2440, CSCI 2320, MATH 2330]
Taking the following:
CSCI 2440
CSCI 2320
MATH 2330

>>>>>>>Semester:4 <<<<<<<<
Considering:    [MATH 3320, CSCI 3345, CSCI 3335, CSCI 3190, CSCI 4390, CSCI 3380, CSCI 3370, CSCI 3381,
CSCI 3360, CSCI 3350, CSCI 3330, CSCI 3385]
Taking the following:
MATH 3320
CSCI 3360
CSCI 3330
```

```
>>>>>>>Semester:5 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4365, CSCI 4310, CSCI 3345, CSCI 3335, CSCI 4315, CSCI 4390,
CSCI 3380, CSCI 3370, CSCI 3381, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 3335
CSCI 3381
CSCI 3370

>>>>>>>Semester:6 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4320, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 4300
CSCI 4353
CSCI 3385

>>>>>>>Semester:7 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4320]
Taking the following:
CSCI 4350
CSCI 3350
CSCI 4320
```

```
>>>>>>>Semester:8 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340]
Taking the following:
CSCI 3380
CSCI 4370
CSCI 4340

>>>>>>>Semester:9 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390]
Taking the following:
CSCI 4315
CSCI 4490
CSCI 4390

>>>>>>>Semester:10 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345]
Taking the following:
CSCI 4310
CSCI 3345
CSCI 4345

>>>>>>>Semester:11 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365]
Taking the following:
CSCI 3190
CSCI 4355
CSCI 4365
```

— N=4

```
-------Limit for concurrent courses taken:      4------

>>>>>>>Semester:1 <<<<<<<<
Considering:    [CSCI 1470, MATH 1390]
Taking the following:
CSCI 1470
MATH 1390

>>>>>>>Semester:2 <<<<<<<<
Considering:    [MATH 1591, CSCI 1480]
Taking the following:
MATH 1591
CSCI 1480

>>>>>>>Semester:3 <<<<<<<<
Considering:    [CSCI 2440, CSCI 2320, MATH 2330]
Taking the following:
CSCI 2440
CSCI 2320
MATH 2330

>>>>>>>Semester:4 <<<<<<<<
Considering:    [MATH 3320, CSCI 3345, CSCI 3335, CSCI 3190, CSCI 4390, CSCI 3380, CSCI 3370, CSCI 3381
, CSCI 3360, CSCI 3350, CSCI 3330, CSCI 3385]
Taking the following:
MATH 3320
CSCI 3381
CSCI 3360
CSCI 3330
```

```
>>>>>>>Semester:5 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4300, CSCI 4365, CSCI 4310, CSCI 3345, CSCI 3335, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 3370, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4353, CSCI 3385]
Taking the following:
CSCI 4300
CSCI 3335
CSCI 3370
CSCI 3385

>>>>>>>Semester:6 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340, CSCI 3350, CSCI 4350, CSCI 4320, CSCI 4353]
Taking the following:
CSCI 4350
CSCI 3350
CSCI 4353
CSCI 4320

>>>>>>>Semester:7 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490,
CSCI 4390, CSCI 3380, CSCI 4370, CSCI 4340]
Taking the following:
CSCI 4390
CSCI 3380
CSCI 4370
CSCI 4340
```

```
>>>>>>>Semester:8 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310, CSCI 4345, CSCI 3345, CSCI 4315, CSCI 4490]
Taking the following:
CSCI 3345
CSCI 4345
CSCI 4315
CSCI 4490

>>>>>>>Semester:9 <<<<<<<<
Considering:    [CSCI 3190, CSCI 4355, CSCI 4365, CSCI 4310]
Taking the following:
CSCI 3190
CSCI 4355
CSCI 4365
CSCI 4310
```

1.2

Initially, we discovered a pattern from a manual inspection of the dataset: for any parallel capacity greater than or equal to 2, the first three semesters only allowed 2 courses per semester to be taken due to prerequisite constraints. Using the algorithms we developed from the previous part of the project, namely the DFS algorithm, we were able to identify certain high-heat courses that were required as prerequisites for many courses, as well as some courses that weren't a prerequisite of any other course. This observation prompted us to adopt a frequency table approach to rank the priority of courses, where the most frequently appearing prerequisites would have the highest priority. The driving logic behind this decision was that the most frequently appearing courses must be the most important in terms of unlocking other courses, therefore we should take them first. With this bearing, we utilized the previously completed topological sort to generate feasible semester plans, hoping that we could achieve optimality.

However, with this initial draft of an idea, the code breaks at n=3 due to a combination of incorrect hard-coded logic and a fundamental flaw in the approach we used to generate the final order. The failure manifested as an infeasible combination of courses in one of the semesters, where one of the courses generated did not have all of its prerequisites fulfilled. Due to the underlying logical flaw this discovery exposed, and inspired by what was mentioned in class by Dr. Le, we developed a second algorithm that approached the problem with an iterative and less convoluted approach.

In this new approach, we utilize the fact that the DFS algorithm can return the full prerequisite chains of each of the 31 courses in the catalog to our advantage, and construct a greedy algorithm. Using the full prerequisites of each course, we iteratively select up to n unique courses that appear the most in the other courses' prerequisite chains that we can actually take. Despite the similarities in the logic between this approach and that of our first endeavor, the inclusion of the full prerequisite chain for courses eliminates the possibility for incorrect orders, and hence generates a better, and more importantly feasible, solution. While the optimality of this approach is debatable due to its computational redundancy in certain areas and the fact that greedy algorithms do not guarantee globally optimal solutions, it generates feasible solutions that match up with hand-estimated solutions.

Through this second algorithm we learned that although it was not necessary to maintain an entire frequency table like we did in our initial attempt, the decision-making heuristic we used in that first attempt was actually essentially correct. Furthermore, much of the infrastructure utilized in the previous parts of the project, as well as our first attempt at problem 3, was reusable and was in fact incorporated into the final solution.

This made us realize that through prototyping and attacking the problem from different angles, we can learn different things from different points of failure and apply them to a better solution down the line. Moreover, the collaborative aspect of this project further solidified our belief in working together, since without our joint work as well as Dr. Le's pointers we probably would not have arrived at this solution.

1.3:

The strategies for our question 3 algorithm include the following:

- Lance's method (1.1b - ACTUAL SOLUTION) :
    1. Get full list of prerequisites of all the courses through DFS (our method for question 2)
    2. Consider all the first prerequisites of all the list of courses (or abstractly, the "first column")
    3. Add all of them in to a hash sets making sure there are no duplicates
    4. If number of unique courses in the first column is less than equal to limit, take all of them (for example, if the limit = 2, the number of unique courses in the first column = 2, then semester 1 = the two corresponding prerequisites)
    5. If bigger than limit, then find the most frequent prerequisites within the limit (for example, if limit is 2 but number of unique courses in the first column =4, then find the 2 most common prerequisites)
    6. After finding them, go through the list and delete the prerequisites that is taken from above steps
    7. And then moving to the following "column" (for example: the 2nd prerequisites of all the courses)
    8. Table stops when number of courses taken is equal to number of courses in the course catalog.

- Nicky's method:
    1. Keep track of what type of courses there are (Math and CSCI), create corresponding lists and a final list (Math list, CS list, Final list)
    2. Create a frequency table, tracking the number of times a course is required as a prerequisite (CSCI 2320)
    3. Find the most frequent prerequisite, and find the prereqs (and the prereqs of preqes etc.) of that course using DFS (CSCI 1470, CSCI 1480) - store to CS list (because it is identified as CSCI course)
    4. Add all the courses that uses this prereq (CSCI 2320) to the CS list
    5. Then find the most common Math prereqs, and make the math list
    6. Combine Math and CS list to Final List
    7. Check what courses are left, check if there prereqs are satisfied, if yes, add to list, if not, perform DFS to track, and add it later to prevent taking the course and its prereq at the same time
    8. Divide the final list to the corresponding number of courses per semester that user inputs (But make sure when user input>1 , first to third semester can only include 2 courses)