BLG221E - DATA STRUCTURES
PROJECT 2
STARTING DATE: 09.05.2013

Graph Coloring

Assigning colors to each vertex in a graph such that no two neighbor nodes have the same color is called Graph Coloring. Therefore, no two adjacent vertices can have same color in the graph. The purpose of this operation is coloring the graph with the minimum number of colors. The total number of colors used in coloring is named as chromatic number.

One of the algorithms that is used in Graph Coloring is Welch and Powell Algorithm. This algorithm mainly depends on the degrees of the vertices in the graph. Degrees of the vertices are sorted in descending order and first color is assigned to the vertex with the highest degree.

Pseudo code of the Welch and Powell Algorithm is given below.

Welch and Powell Algorithm

> *1. Sort the vertices in descending order according to their degrees*
>
> *2. Assign the first color to the first node (with the highest degree) and assign the same color to the vertices in such a way that no two neighbors are colored with the same color*
>
> *3. Go on with the next color, assign this color to the node in the order and give the same color to the other nodes that are not colored before and no two neighbors are colored with the same color*
>
> *4. Stop executing step 3 when all the nodes are colored*

Assigning Exams in a University

In a university, final exams should be scheduled in such a way that a student's all courses' exams are in different sessions. Furthermore, a student can be registered to more than one course at a semester. List of the courses that each student takes are given and the problem is assigning the sessions in such a way that no conflict among sessions occurs. This problem can be represented as a graph and solved by using a graph coloring algorithm.

Courses are the vertices on the graph and courses that are taken by the students are the edges. In this representation, after coloring the graph, chromatic number gives the number of exam sessions. Exams of the courses with the same color can be held at the same time.

Assume that there are 4 students and 6 courses.

Set of courses C = {C0, C1, C2, C3, C4, C5}   Set of students S = {S1, S2, S3, S4}
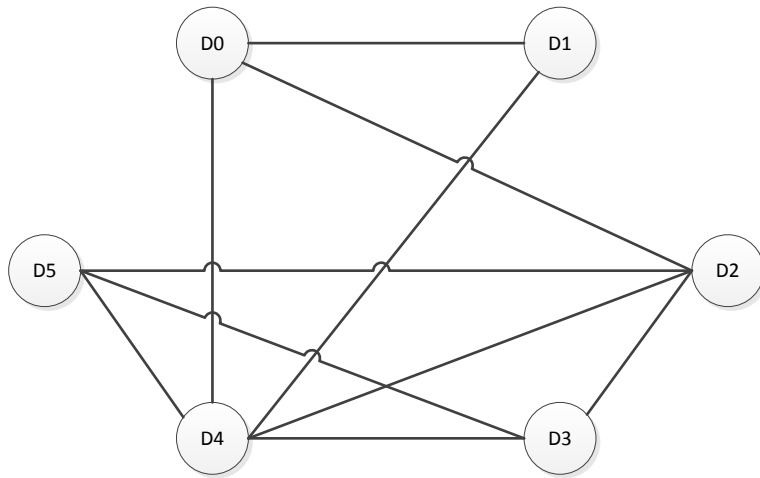
Courses taken by each student;

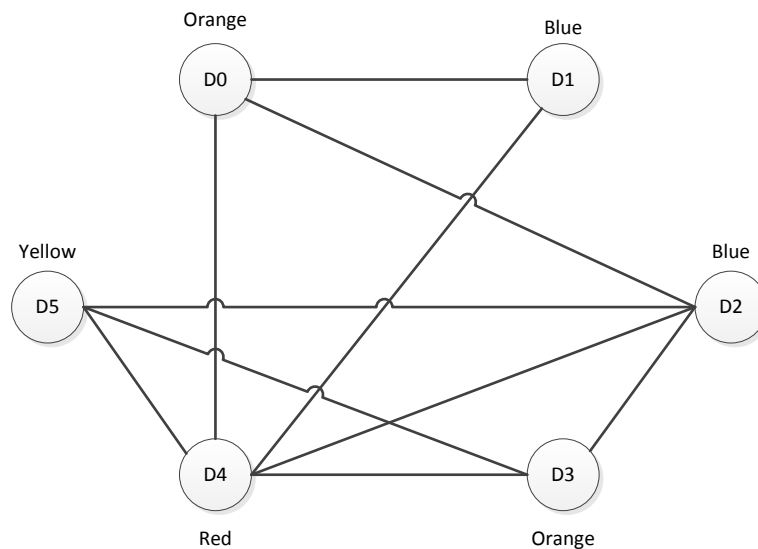Student 1: C0, C1, C4   Student 2: C0, C2, C4

Student 3: C2, C3, C5   Student 4: C3, C4, C5

Representation and coloring of this graph is given below.

Vertex	Degree
D4	5
D2	4
D0	3
D3	3
D5	3
D1	2

Initial Graph

Colored Graph

In this example, chromatic number is 4 which means 4 sessions are needed to schedule these exams. Exams of D4 and D5 should be held at separate sessions but exams of D1 and D2 can be scheduled at the same session.

Write a program that finds a suitable schedule with minimum colors when an input is given. Number of courses, students and course list for each student will be read from "input.txt". First number in the first line indicates the number of students and second number on this line is the number of courses. After the first line, other lines (each of them) indicates the course list for each student. For example, first student takes courses 0, 1, and 4. After execution of the program, color values should be printed to screen for each course.