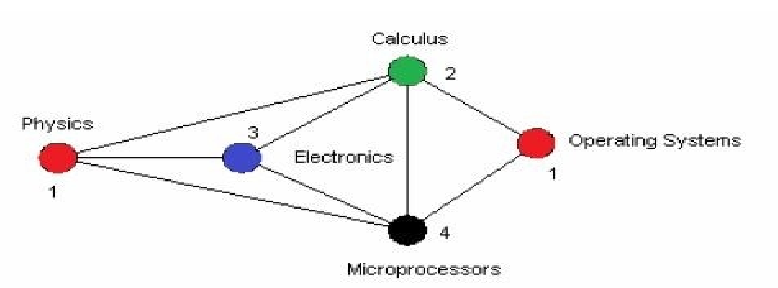
[For the CSP topics in AI lab quiz, you should study the slide provided for the AI theory. In addition, you should study the description of the CSP assignment task.]

A k-coloring of graph G is an assignment of integers {1, 2, …, k} (the colors) to the vertices of G in such a way that neighbors receive different integers. The chromatic number of G is the smallest k such that G has a k-coloring.

There are several interesting practical problems that can be modeled by graph coloring. The basic example is the following. Assume that we have to schedule a set of interfering jobs, it has to be determined when each job is executed. Let G be the conflict graph of the jobs: the vertices of the graph corresponds to the jobs, two vertices are connected by an edge if the corresponding two jobs cannot be executed at the same time (for example, they use a shared resource or interfere in some other way). The colors correspond to the available time slots, every job requires one time slot. There is a one-to-one correspondence between the feasible schedulings of the jobs and the colorings of the graph: vertex *v* receives color *i* if and only if the corresponding job is executed in time slot *i* . Clearly, the graph has a k-coloring if and only if the jobs can be done in k time slots such that interfering jobs are not executed simultaneously. Therefore the chromatic number of the graph equals the minimum makespan of the scheduling problem, the minimum time required to finish the jobs.

The important task of scheduling courses (and/or final examinations) at a college or university is an example of timetabling. Timetabling is the scheduling of a set of related events in a minimal block of time such that no resource is required simultaneously by more than one event. In university timetabling, the resources involved, which we assume may be required by no more than one course at any particular time, are teachers, classrooms, and students. University course timetabling problems involve pairwise restrictions on the courses being scheduled; that is, there exist restrictions on which pair of courses can be scheduled simultaneously.

The problem of timetabling courses at a university can be modeled and solved using graph coloring techniques. Traditional graph coloring models for timetabling involve graphs in which a vertex represents a course to be scheduled, an edge represents a pair of courses that conflict (i.e., cannot be scheduled for the same time period), and the color of a vertex represents the time period to which that course is to be scheduled.



The figure above illustrates an example of a simple timetabling instance in which we have five courses to be scheduled: Physics, Calculus, Electronics, Operating Systems, and Microprocessors. Four time slots are required in a valid schedule.

To create a conflict graph, we need to make the adjacency matrix A (5 X 5) and A [i, j] = 1 if course i and course j can not be scheduled at the same time slot. This may happen if one teacher is assigned to teach both course i and course j, or a student is registered to both courses.

In this assignment, you will need to create a conflict graph and solve the coloring of this graph using CSP techniques. For applying CSP methods, you need to specify the variables, values that the variables can take on or the domains, and the constraints between the variables. For graph coloring, you need to make a conflict graph. However, before making the conflict graph, you need to construct the adjacency matrix which records the conflict information between a pair of courses.

Your task is to find out a valid timetable for the following courses:
PHY 101, PHY 234, PHY 235, PHY 239, PHY 240, PHY 245, PHY 265, PHY 303, PHY 304, PHY 401, PHY 402, PHY 405, PHY 407, PHY 408, PHY 501, PHY 502, PHY 505, PHY 506, PHY 509, PHY 510, PHY 515, PHY 519

The following is the course assignment for the teachers who teach more than one course:
(1) Prof. John teaches both PHY 245 and PHY 265.
(2) Prof. Ian teaches both PHY 234 and PHY 405 and PHY 304.
(3) Prof. Mary teaches both PHY 510 and PHY 519.
(4) Prof. Sue teaches both PHY 101 and PHY 303.
(5) Prof. Richard teaches both PHY 407 and PHY 408.
(6) Prof. Bill teaches both PHY 505 and PHY 506.

The following courses have at least one student in common, which means these pair of courses can not be scheduled at the same time slot:
(1) PHY 234 and PHY 304
(2) PHY 401 and PHY 402
(3) PHY 501 and PHY 502
(4) PHY 505 and PHY 506
(5) PHY 234 and PHY 240
(6) PHY 240 and PHY 245
(7) PHY 245 and PHY 304
(8) PHY 407 and PHY 408