Algorithms for the Compartment Problem of Small Size

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In places where there are limited resources, there is a very common situation; people have to share spaces, equipment, tools, etc. In an University, classrooms have to be assigned to different subjects to be taught. Groups have to share classrooms with other groups, that occupy them in different days and hours. A similar situation occurs in the use of computers, transportation vehicules, etc. It is desired to assign the minimal number of resource units, pointing out to the users that they have to share them.

In an instance of the Compartment Problem we have a given resource, a set of requested timetables and a vector d where each component $d(i)$ denotes the demand of the resource in the timetable i. A Compartment is a set of pairwise time periods disjoint timetables and Total Compartment is a partition of the available calendar. The problem is to find the minimum resource units to be shared in each total compartment to satisfy the demand.

If we consider that the Dimension of the Compartment Problem is defined by the number of variables involved in the definition of the requested timetables, the Available Calendar of the resource used is defined by the cartesian product of the discrete sets in which the time, for the study, has been divided and the Size of the problem is defined by the cardinality of the Available Calendar, then the total compartments accrues considerably with the size of the problem.

We associate an hypergraph to model the problem, considering that the vertex correspond to the possible timetables and the edges to the possible total compartments.

We take advantage of the properties of the hypergraph to obtain an algorithm to solve the problem for small cases.