

**Artificial Intelligence Assignment 2**  
**Discover of Drug Agencies**

**Aakash Kumar (2012CS10201)**

**Ritesh Baldva (2012CS50711)**

In the present assignment we wanted to find out drug “cliques” from an undirected graph, representing different persons having phone conversations. And we have to convert this problem to a SAT problem. Now the various conditions/constraints for this problem are converted to SAT as follows:

1. First we take  $K$  variables for every edge present in the clique. Now we have  $EK$  variables ( $E$  is the number of edges in the graph). By the given conditions : Any edge should be present in at-least one clique and each clique should have at-least one edge (due to graph being connected, min size of clique : 2). This gives us  $(E + K)$  clauses.
2. We have  $K$  variables for each node also.  $J$ 'th variable for the  $i$ 'th node is true if the  $i$ 'th node is present in the  $j$ 'th clique.
3. Now a clique has to be a complete graph, i.e. for all pairs of nodes if there exists an edge between them in the original graph then that edge must also exist in the clique, otherwise the nodes can't be together. Now taking  $K$  variables corresponding to every node in the graph, this gives us  $({}^NC_2)*K$  clauses. We also add the condition that if an edge is present in a clique then both the nodes of that edge must also exist in the clique.
4. Now we have to check that any clique should not be a subset of another. This means that there has to be atleast one node, say  $i$ , if present in the clique  $1$  should not be present in clique  $2$ . This checks whether  $1$  is a subset of  $2$ . Now we also check that  $2$  is not a subset of  $1$ . But since this gives a disjunction of conjunctions, we introduce new variables corresponding to these clauses ( $b_{ij}$ ). And we have  $({}^KC_2)*2$  clauses.
5. Now we introduce bi implications for the new variables and convert into CNF form, which gives us three conditions for every variable. And we have  $(3*N*K*(K-1))$  clauses.

Thus we have  $O(N*N*K + E*K)$  number of clauses for the minisat solver.

And after obtaining output from the minisat solver we simply just parse to it show the different cliques present if possible(depends on minisat output).

People discussed with:

Shubham Solanki, Ayush Sakhuja