Assignment II
CSL671 : ARTIFICIAL INTELLIGENCE

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1 Formulation -

Generate a boolean variable for i_{th} vertex of x_{th} subgraph as $y_{x,i}$.
There are k subgraphs and n vertices.

2 Clauses/Rules -

- **RULE 1 -**
  If two vertices i and j are in a same subgraph x, there must be an edge between them.
  $y_{x,i} \wedge y_{x,j} \rightarrow e_{i,j}$
- **RULE 2 -**
  Each edge $e_{i,j}$ should be present in atleast 1 subgraph x.
  $e_{i,j} \rightarrow (y_{1,i} \wedge y_{1,j}) \vee (y_{2,i} \wedge y_{2,j}) \ldots (y_{k,i} \wedge y_{k,j})$
- **RULE 3 -**
  Each subgraph x should have atleast 1 vertex.
  $y_{x,1} \vee y_{x,2} \vee y_{x,3} \vee \ldots . y_{x,n}$
- **RULE 4 -**
  No subgraph p can be a proper subgraph of any other subgraph q.
  $(y_{p,1} \wedge \neg y_{q,1}) \vee (y_{p,2} \wedge \neg y_{q,2}) \vee \ldots . (y_{p,n} \wedge \neg y_{q,n})$

3 Approach -

We have converted these clauses into CNF form and give it as an input to SAT solver.

Number of variables - $nk + k^2n + n^2k$ *(which is polynomial in the input)*

Time complexity - $\mathcal{O}(k^2n + n^2k)$