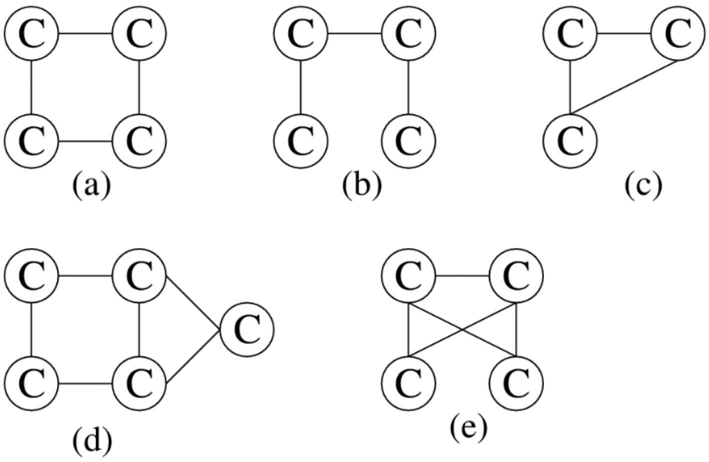
Assignment 3

The deadline of assignment 3 is:

Fri 25 May, 5:00 pm

Question 1 (5 marks)

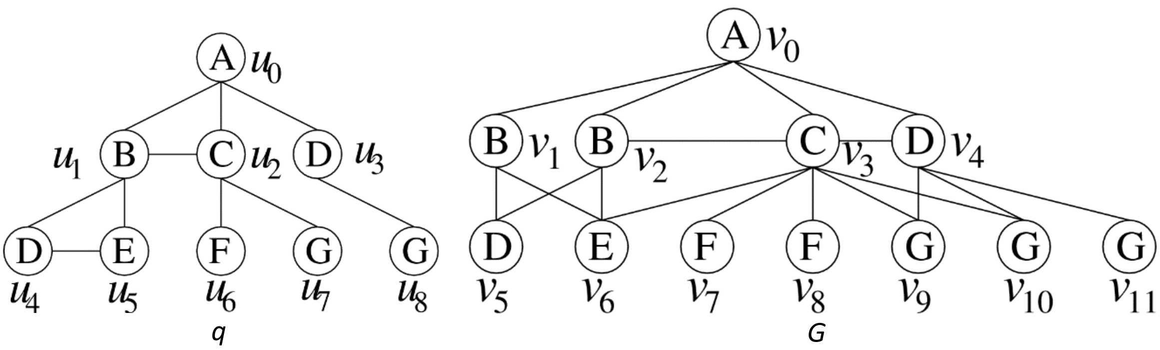
Given a graph database *D* containing following graphs:



1) Suppose *minFreq* = 3, draw at least 4 frequent patterns/fragments in the graph database *D*. A graph/pattern *g* is frequent if its occurrence frequency is no less than *minFreq*. (5 marks)

Question 2 (10 marks)

Given the following query *q* and data graph *G*.



1) Please draw a Neighborhood Equivalence Class tree (NEC tree) of query *q*. (5 marks)

The Neighborhood Equivalence Class(NEC) of a query vertex *u* is a set of query vertices, which are equivalent to *u*. The equivalence is defined as follows:

Let $\cong$ be an equivalence relation over all query vertices in *q* such that, $u_i\,(\in V(q))\cong u_j\,(\in V(q))$ if for every embedding *m* that contains (u_i, v_x) and (u_j, v_y) (v_x, $v_y \in V(g)$), there exists an embedding *m'* such that $m' = m - \{(u_i, v_x), (u_j, v_y)\} \cup \{(u_i, v_y), (u_j, v_x)\}$.

Please read the following paper for more detail:

Han, W. S., Lee, J., & Lee, J. H. (2013, June). Turbo iso: towards ultrafast and robust subgraph isomorphism search in large graph databases. In Proceedings of the 2013 ACM SIGMOD International Conference on Management of Data (pp. 337-348). ACM.

2) Please decompose the vertex set of query *q* according to Core-Forest-Leaf decomposition. That is, decompose the vertex set of *q* into three sets including the core-set, the forest-set and the leaf-set. (5 marks)

Given a query *q*, the Core-Forest-Leaf decomposition consists of core-forest decomposition and forest-leaf decomposition.

Core-Forest Decomposition

Edges of *q* can be categorized into two categories regarding a spanning tree q_T of *q*: edges in q_T are called tree edges while edges of *q* that are not in q_T are called non-tree edges regarding q_T.

Our core-forest decomposition is to compute a small dense subgraph containing all non-tree edges regarding any spanning tree, which is defined as follows. Given a query *q*, the core-forest decomposition of *q* is to compute the minimal connected subgraph *g* of *q* that contains all non-tree edges of *q* regarding any spanning tree of *q*; g is called the core-structure of *q*. The subgraph of *q* consisting of all other edges not in the core-structure called the forest-structure of *q*, denoted *T*. We call the vertex set of the core-structure as the core-set $\boldsymbol{V_C}$ and the forest-structure of *q* doesn't contain any vertices in $\boldsymbol{V_C}$.

Forest-Leaf Decomposition

Given the forest-structure *T*, rooting each tree in forest-structure at its connection vertex with core-structure. The set $\boldsymbol{V_I}$ is called the leaf set which contains all the degree-one vertices in the trees of forest-structure. The set of vertices not in $\boldsymbol{V_C} \cup \boldsymbol{V_I}$ is called the forest set $\boldsymbol{V_T}$.

Let $V(q)$ denotes the vertex set of *q*, $V(q) = \boldsymbol{V_C} \cup \boldsymbol{V_T} \cup \boldsymbol{V_I}$ and $\boldsymbol{V_C} \cap \boldsymbol{V_T} = \boldsymbol{V_C} \cap \boldsymbol{V_I} = \boldsymbol{V_T} \cap \boldsymbol{V_I} = \emptyset$.

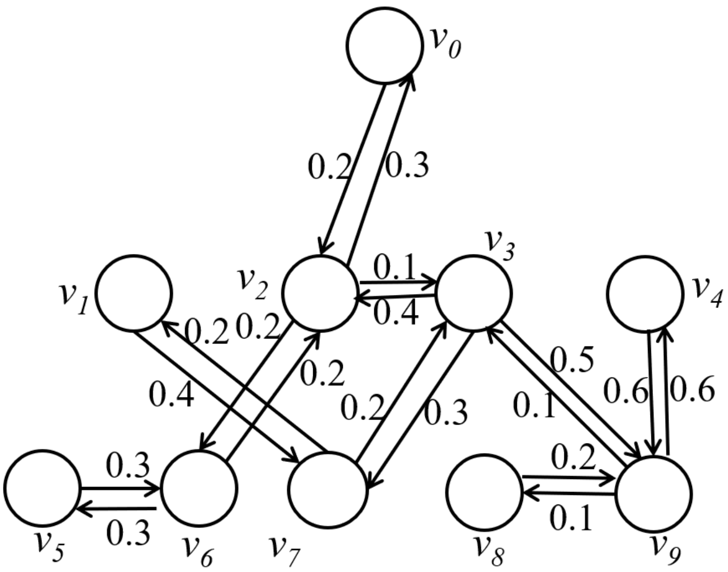
Please read the following paper for more detail:

Bi, F., Chang, L., Lin, X., Qin, L., & Zhang, W. (2016, June). Efficient subgraph matching by postponing cartesian products. In Proceedings of the 2016 International Conference on Management of Data (pp. 1199-1214). ACM.

Considering Figure 4 in the above paper, we can decompose the vertex set of *q* into:
The core set: u_0, u_1, u_2
The forest set: u_3, u_4, u_5, u_6
The leaf set: u_7, u_8, u_9, u_{10}

Question 3 (5 marks)

Given a social influence graph G_1 as following:



1) Choose one activated seed *s* from v_0 ~ v_9 which can generate the largest influence spreads (i.e., let $w(s) = 1$, maximize $\sum_{i=0}^{9} w(v_i)$). (5 marks)

Initially, all the vertices are inactivated. We define $w(u)$ as the probability of a vertex *u* which can be activated. In graph G_1, $p(u, v)$ on a directed link from *u* to *v* is the probability that *v* is activated by *u* after *u* is activated (e.g., ~~$p(v_0, v_1) = 0.3$~~ $p(v_0, v_2)=0.2$). For example, $w(v_0) = 1$, $w(v_2) = 0.2$, and $w(v_3) = 0.2 * 0.1 = 0.02$ if we choose v_0 as the activated seed.

Assignment Submission

We accept electronic submissions only. Please submit your assignments as follows:

- The file name should be ass3.pdf.
- Ensure that you are in the directory containing the file to be submitted. (note: we only accept files with .pdf extension)
- Type “give cs9311 ass3 ass3.pdf” to submit.
- Please keep a screen capture (including **timestamp** and the **size** of submitted file) for your submissions as proof in case that the system is not working properly. If you are not sure how, please have a look here.

Note:

1. If the size of your pdf file is larger than 2MB, the system will not accept the submission. If you face this problem, try converting to compressed pdf.
2. If you have any problems in submissions, please email to kai.wang@unsw.edu.au.
3. We do not accept e-mail submissions, and the submission system will be immediately closed after the deadline.

Late Submission Penalty

Zero mark