Here are some additional descriptions for these three algorithms of this homework.

Conductance

In graph theory, the conductance of a cut $(S, \bar{S})$ in a graph is defined as:

$$\varphi(S) = \frac{\sum_{i \in S, j \in \bar{S}} a_{ij}}{min(a(S), a(\bar{S}))}$$

Where the a_{ij} are the entries of the adjacency matrix for *G*, so that a(S) is the total number (or weight) of the edges incident with *S*. $a(S) = \sum_{i \in S} \sum_{j \in V} a_{ij}$

In this assignment, you can classifies edges into two categories, by the lowest bit value of the source vertex. Given a edge e(u, v) , it's red if $u\&1! = 0$, otherwise is black. A edge is crossover, if its source and target vertices belong to different categories.

So, the conductance value of a graph need be calculated in this assignment is:

$$conductance = \frac{\#crosssover\ edges}{min\{|\#red\ edges|, |\#black\ edges|\}}$$

PageRank-Delta

PageRank-Delta is similar to PageRank, but only update vertices whose PageRank value has changed by more than some Δ-fraction.

In this assignment, each iteration of PageRank Delta:

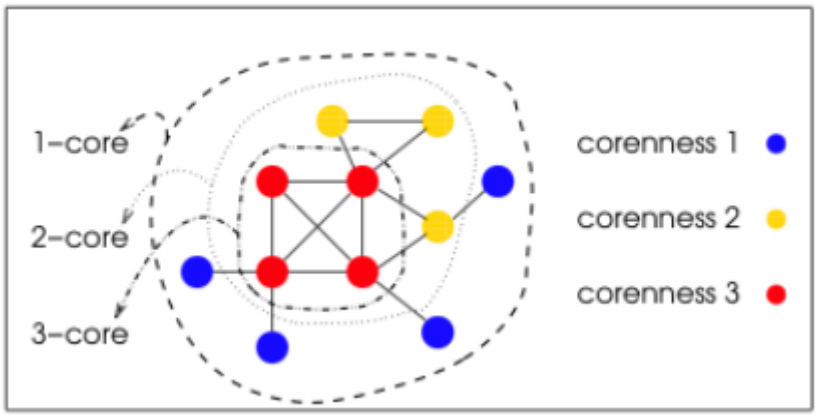
$$Rank(A) = Rank(A) + Delta(A)$$
$$Delta(A) = 0.85 * (\frac{Delta(B)}{L(B)} + \frac{Delta(C)}{L(C)} + \dots)$$

where $Delta(A)$ is added, if $\frac{Delta(A)}{Rank(A)}$ is larger than *propagation_threshold*.

k-Cores

A k-core of a graph G is a maximal connected subgraph of G in which all vertices have degree at least k (the degree here is the degree in the final subgraph). Equivalently, it is one of the connected components of the subgraph of G formed by repeatedly deleting all vertices of degree less than k. If a non-empty k-core exists, then, clearly, G has degeneracy at least k, and the degeneracy of G is the largest k for which G has a k-core.

Here is a example:



You can read the wiki for more detailed information of k-core.

https://en.wikipedia.org/wiki/Degeneracy_(graph_theory)

In this assignment, you can implement this algorithm in two ways:

1. Your code is used to calculate the coreness value of all vertices. And output the largest coreness value.
2. Your program need a parameter called k, and return or output vertices whose coreness values is greater than or equal to k.

The input graph of k-core algorithm need be undirected.