

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 classify edges into two categories, by the lowest bit value of the source vertex. Given an edge $e(u, v)$, it's red if $u \& 1 \neq 0$, 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:

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

Pagerank Delta

PageRank-Delta is similar to PageRank, but only update vertices whose PageRank value has changed by more than some Δ -fraction (in the x-stream code, the variable is called *propagation_threshold*).

In this assignment, each iteration of Pagerank Delta:

$$Rank(A) = Rank(A) + Delta(A)$$

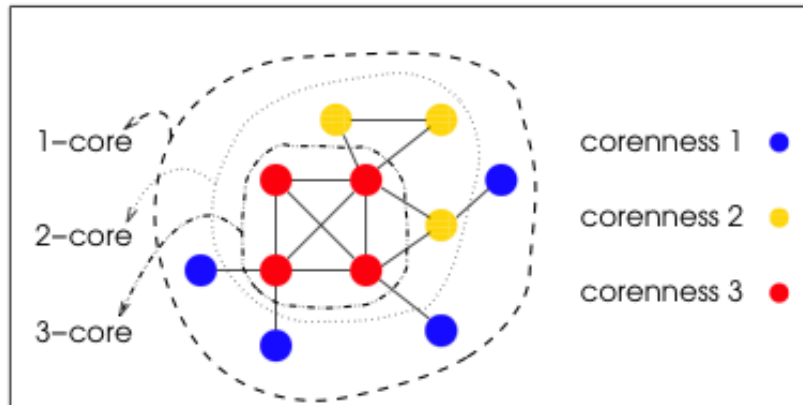
$$Delta(A) = 0.85 * \left(\frac{Delta(B)}{L(B)} + \frac{Delta(C)}{L(C)} + \dots \right)$$

where $\frac{\Delta(x)}{x}$ is added, if it's larger than *propagation_threshold*.

k-core

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 an example:



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

[https://en.wikipedia.org/wiki/Degeneracy_\(graph_theory\)](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 ouput vertices whose coreness values is greater than or equal to k .

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