G(V,E)

origin

$for\ v_i \in V_\alpha, V_\alpha\ is\ define\ as\ the\ first\ \alpha\%\ percent\ of\ node\ for\ a\ given\ node\ list$

$split\ into\ k\ partition, v_i\ become\ k\ subnodes\ V_S = \{v_i^1, v_i^2 \dots v_i^k\}$

$the\ V_S\ build\ inner\ edge\ with\ given\ topology\ t$

$besides\ split\ its\ neighbor\ into\ k\ partition\ \{n_i^1, n_i^2 \dots n_i^k\}, which\ is\ a\ independent\ set$

$then\ each\ v_i^j \in V_s\ build\ outer\ edges\ with\ 1\ partition\ \{n_i^j\}$

non uniform

$for\ v_i \in V\ which\ deg(v) > thres_d, define\ k = \frac{deg(v_i)}{thres_d}$

$split\ into\ k\ partition, v_i\ become\ k\ subnodes\ V_S = \{v_i^1, v_i^2 \dots v_i^k\}$

$the\ V_S\ build\ inner\ edge\ with\ given\ topology\ t$

$besides\ split\ its\ neighbor\ into\ k\ partition\ \{n_i^1, n_i^2 \dots n_i^k\}, which\ is\ a\ independent\ set$

$then\ each\ v_i^j \in V_s\ build\ outer\ edges\ with\ 1\ partition\ \{n_i^j\}$

replication

$split\ into\ k\ partition, v_i\ become\ k\ subnodes\ V_S = \{v_i^1, v_i^2 \dots v_i^k\}$

$the\ V_S\ build\ inner\ edge\ with\ given\ topology\ t$

$besides\ split\ its\ neighbor\ into\ k\ partition\ \{n_i^1, n_i^2 \dots n_i^k\}, which\ is\ a\ independent\ set$

$then\ each\ v_i^j \in V_s\ build\ outer\ edges\ with\ m\ partition\ \{n_i^j \dots n_i^{j+m-1}\}$

loss

Define V_c as the spited node form V, k as the number of partitions, m as the number of replications

$$\Delta V = V_c * (k-1)$$

$$\Delta E = \Delta E_S + \Delta E_R$$

$$\Delta E \le \frac{V_c * k * (k-1)}{2} + \Sigma_{v \in V_c} neightbor(v) * (m-1)$$

$$while\ \Sigma_{v \in V_c} neightbor(v) * (m-1) \gg \frac{V_c * k * (k-1)}{2}$$

$$\Delta E \approx \Sigma_{v \in V_c} neightbor(v) * (m-1)$$

$$loss = w_1 * \Delta V + w_2 * \Delta E$$

we use bisection method to optimize the α for a tuple (k,m,loss)

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split

$time\ complexity: O(E)$

bisection method

$time\ complexity: O(V \log(deg(v)_{max}))$

percolation

$time\ complexity: O(V^2)$