A neighborhood proximity based algorithm for overlapping community structure detection in weighted networks

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Problems & Ideas

The **neighborhood proximity** of a pair (u, v) is

$$\rho(u,v) = \left(\frac{\sum_{w,x \in N_{uv}} a_{uw} + a_{vw} + a_{wx}}{\sum_{w \in N_{uv}} s_w} \right) \left(\frac{\sum_{w \in N_{uv}} \min(a_{uw}, a_{vw}) + a_{uv}}{\min(s_u, s_v)} \right)$$

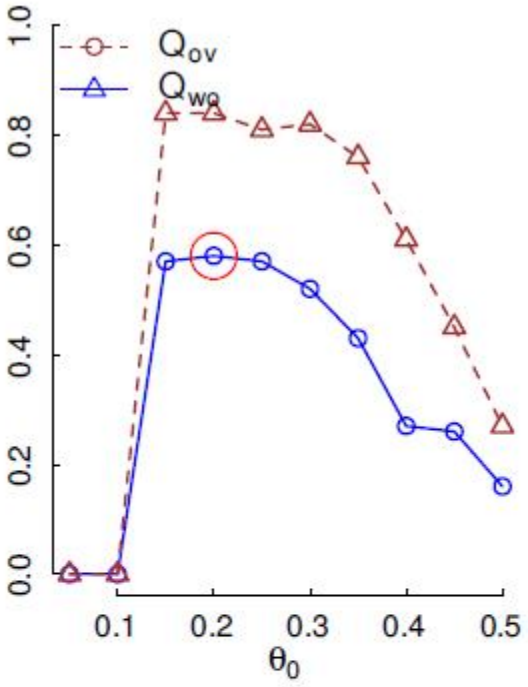
if $N_{uv} \neq \varnothing$. Otherwise, $\rho(u,v) = a_{uv} / \min(s_u, s_v)$.
The **weighted overlapping modularity** of a cover $\mathcal{K}$ is

$$Q_{\text{wo}}(\mathcal{K}) = \frac{1}{|\mathcal{K}|} \sum_{C \in \mathcal{K}} \left(1 - \frac{\sum_{v \in C} |m_v|}{|C| \,.\, |\mathcal{K}|} \right) \frac{d^{\text{int}}(C)}{d(C)},$$

and m_v = no. of communities v belongs to.

$$\mathcal{K} \text{ is optimal} \iff \begin{array}{ll} 1) & d^{int}(C)/d(C) = 1, \forall C \in \mathcal{K} \\ 2) & |\mathcal{K}| \text{ is highest possible.} \\ 3) & |m_v| \text{ is least possible }, \forall v \in V \end{array}$$

Main Contributions



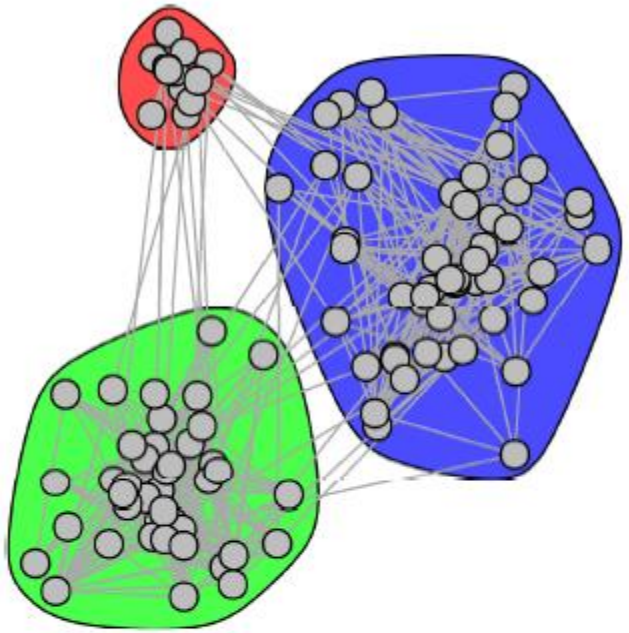


Figure: Community structure in US-POLBOOKS: The left panel plots the maximum values of Q_{ov} and Q_{wo} over 10 iterations of NPCD for each value of θ_0 in the range $\{0.05, 0.10, \ldots, 0.50\}$. The right panel plots the community structure corresponding to the maximum value of Q_{wo} over the entire range of θ_0.