Efficient Approximate PageRank

Assignment 4 - Report

Hao Wang (haow2)

Q1:

We know di is the degree of vertx u in the ith push, which is defined by the architecture of the graph, so we can know that di >= 0.

So we can know that

$$\sum_{i=1}^{T} d_i = T\overline{d_i} \quad \text{and} \quad 0 \le \overline{d_i} \le \infty$$

Because: $\sum_{i=1}^{T} d_i \le \frac{1}{\epsilon\alpha}$ so we can know: $T\overline{d_i} \le \frac{1}{\varepsilon\alpha}$

Then we know , $T \le \frac{1}{\varepsilon\alpha\overline{d_i}}$

So T is finite, and the algorithm is guaranteed to finish after finite number of push operations.

Q2:

$$R_\alpha = \alpha\sum_{t=0}^{\infty}(1-\alpha)^t W^t = \alpha\left(I + \sum_{u=1}^{\infty}(1-\alpha)^u W^u\right)$$

So we can see:

$$sR_\alpha = \alpha s + s\left(\alpha\sum_{t=1}^{\infty}(1-\alpha)^t W^t\right) = \alpha s + (1-\alpha)s\left(\alpha I + \alpha\sum_{t=1}^{\infty}(1-\alpha)^t W^t\right)W = \alpha s + (1-\alpha)sR_\alpha W = s[\alpha + (1-\alpha)R_\alpha W]$$

So $pr(\alpha, s)$ is linear to s

Q3:

$$R_\alpha = \alpha\sum_{t=0}^{\infty}(1-\alpha)^t W^t = \alpha\left(I + \sum_{u=1}^{\infty}(1-\alpha)^u W^u\right)$$

So we can see:

$$sR_\alpha = \alpha s + s\left(\alpha\sum_{t=1}^{\infty}(1-\alpha)^t W^t\right) = \alpha s + (1-\alpha)s\left(\alpha I + \alpha\sum_{t=1}^{\infty}(1-\alpha)^t W^t\right)W = \alpha s + (1-\alpha)sR_\alpha W = \alpha s + (1-\alpha)R_\alpha sW$$

$$= \alpha s + (1-\alpha)\ pr(\alpha,\ sW)$$

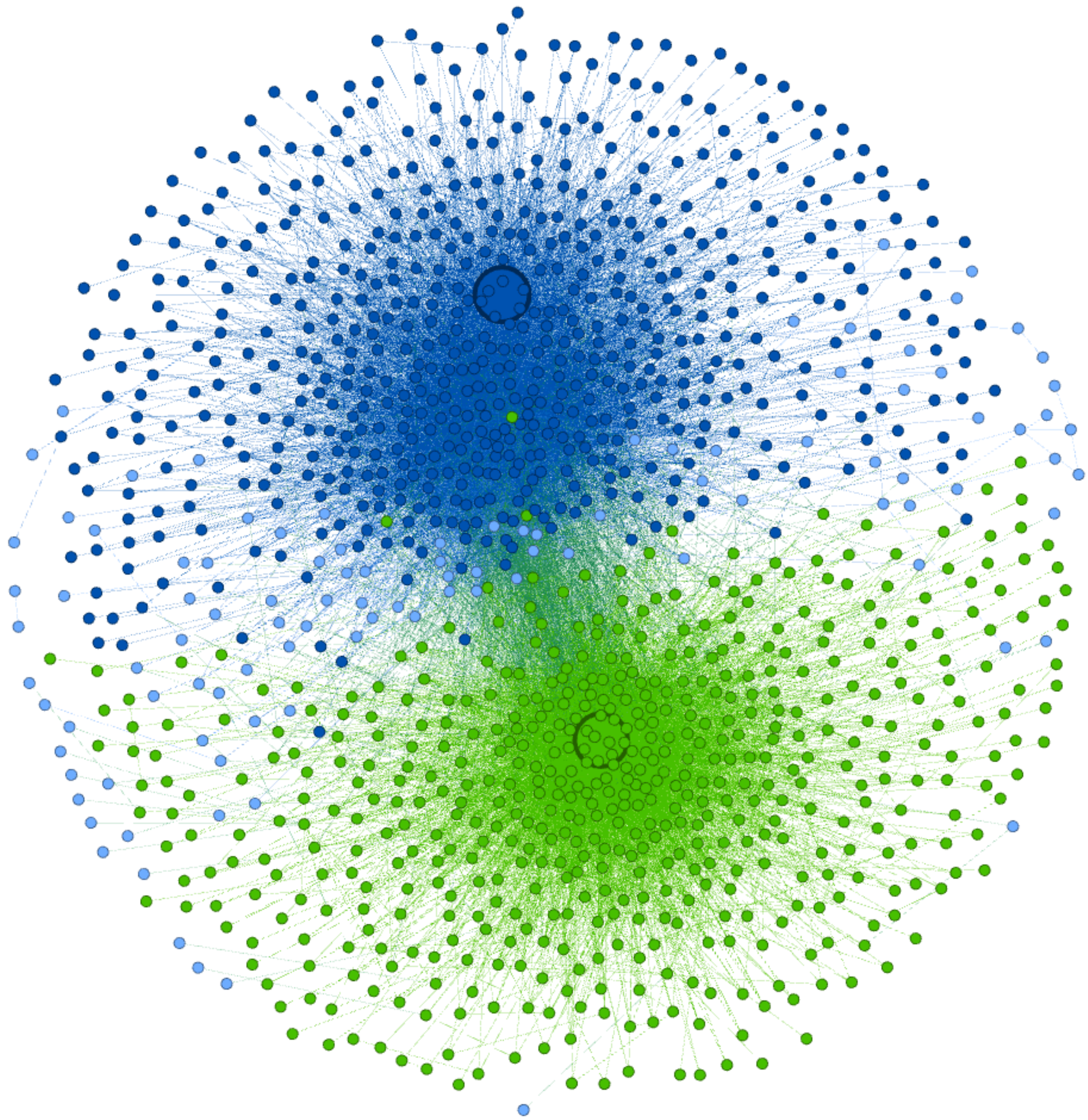
Q4:

Because $pr(\alpha, r) = pr(\alpha, r - r_u) + pr(\alpha, r_u)$ and $pr(\alpha, s) = \alpha s + (1-\alpha)pr(\alpha, sW)$

$$\begin{aligned} pr(\alpha,\ r) &= pr(\alpha,\ r - r_u) + \alpha r_u + (1-\alpha)\ pr(\alpha,\ r_u W) \\ &= pr(\alpha,\ r - r_u) + \alpha r_u + pr(\alpha,\ (1-\alpha) r_u W) \\ &= pr(\alpha,\ r - r_u + (1-\alpha) r_u W) + \alpha r_u \\ &= pr(\alpha,\ r') + p' - p \end{aligned}$$

So: $p' + pr(\alpha, r') = p + pr(\alpha, r)$

Q5:



Q6:

• Did you receive any help whatsoever from anyone in solving this assignment? Yes / No. If you answered ‘yes’, give full details:
No.

• Did you give any help whatsoever to anyone in solving this assignment? Yes / No. If you answered ‘yes’, give full details:
No.