Question 1

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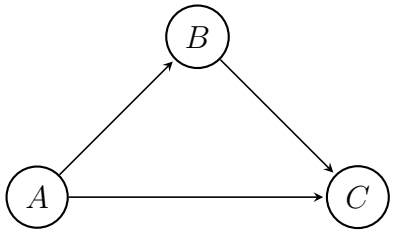
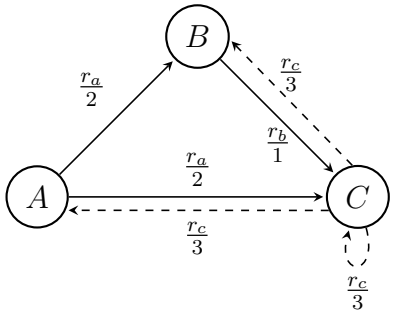
1 Question

1. (25/25 points) Consider the following web pages and the set of web pages that they link to: Page A points to pages B and C. Page B points to page C. All other pages have no outgoing links. Apply the PageRank algorithm to this subgraph of pages. Assume $\alpha = 0.15$. Simulate the algorithm for three iterations.

Web Graph



Corrected Web Graph



Flow Equations

$$r_a = \frac{r_c}{3} \tag{1}$$

$$r_b = \frac{r_a}{2} + \frac{r_c}{3} \tag{2}$$

$$r_c = \frac{r_a}{2} + \frac{r_b}{1} + \frac{r_c}{3} \tag{3}$$

Flow Equations have no unique solution. 3 equations with 3 unknowns. Add additional constraint.

$$r_a + r_b + r_c = 1 \tag{4}$$

Therefore if $alpha = 0$,

$$r_a = \frac{2}{11},\ r_b = \frac{3}{11},\ r_c = \frac{6}{11}$$

Which would correspond to the maximum right eigenvector of the matrix P below.

Link Matrix,

$$\begin{array}{c} \begin{matrix} a & b & c \end{matrix} \\ \begin{pmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} \begin{matrix} a \\ b \\ c \end{matrix} \end{array}$$

Row/Right Stochastic Transition Probability Matrix, P,

$$P = (0.85)\begin{pmatrix} 0 & \frac{1}{2} & \frac{1}{2} \\ 0 & 0 & 1 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix} + (0.15)\begin{pmatrix} \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix} = \begin{pmatrix} 0.05 & 0.475 & 0.475 \\ 0.05 & 0.05 & 0.09 \\ 0.33\ldots & 0.33\ldots & 0.33\ldots \end{pmatrix}$$