is605_pagerank

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Import Requisite Libraries

```
library(igraph)
```

1) Form Matrix A and B. Introduce decay for B.

```
# 1a) Matrix A
A=matrix(c(0,.5,.5,0,0,0,0,0,1,0,0,0,.25,.25,0,0,.25,.25,0,0,0,0,.5,.5,0,0,0,.5,0,.5,0,0,.5,.5,0,0),
A
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,]  0.0    0 0.25  0.0  0.0  0.0
## [2,]  0.5    0 0.25  0.0  0.0  0.0
## [3,]  0.5    1 0.00  0.0  0.0  0.5
## [4,]  0.0    0 0.00  0.0  0.5  0.5
## [5,]  0.0    0 0.25  0.5  0.0  0.0
## [6,]  0.0    0 0.25  0.5  0.5  0.0
```

```
# set initial rank (length of uniform vector)
ri <- c(rep(1/6, 6))
ri
```

```
## [1] 0.1667 0.1667 0.1667 0.1667 0.1667 0.1667
```

```
# 1b) Matrix B (w/ decay)
n <- length(ri)
ATrans <- t(A)
B = 0.85*A+(.15/n)


B
```

```
##       [,1]  [,2]   [,3]  [,4]  [,5]  [,6]
## [1,] 0.025 0.025 0.2375 0.025 0.025 0.025
## [2,] 0.450 0.025 0.2375 0.025 0.025 0.025
## [3,] 0.450 0.875 0.0250 0.025 0.025 0.450
## [4,] 0.025 0.025 0.0250 0.025 0.450 0.450
## [5,] 0.025 0.025 0.2375 0.450 0.025 0.025
## [6,] 0.025 0.025 0.2375 0.450 0.450 0.025
```

2) Create uniform rank vector and perform power iterations until convergence. Compute solution r <- Aˆn * r.

```r
# 2) Initial Rank Vector

# compute solution until convergence
# set n


rf <- B^1 %*% ri

rf
```

```
##         [,1]
## [1,] 0.06042
## [2,] 0.13125
## [3,] 0.30833
## [4,] 0.16667
## [5,] 0.13125
## [6,] 0.20208
```

3) Compute eigen decomposition of B and verify that there is an eigenvalue of 1

```r
# perform eigen decomposition and find eigen values and vectors
e <- eigen(B)

# There is an eigenvalue of 1
evalB <- e$values
evalB
```

```
## [1]  1.0000+0.0000i  0.5064+0.0000i -0.4250+0.0000i -0.4250+0.0000i
## [5] -0.2532+0.1081i -0.2532-0.1081i
```

```r
# All the values of of the eigen vector corresponding to the eigenvalue 1 are positive.
evecB <- e$vectors
evecB[,1]
```

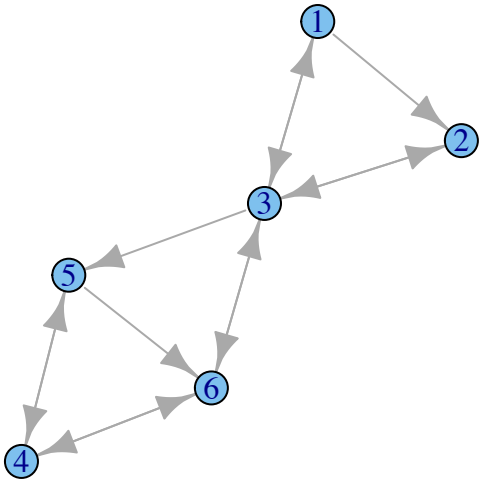
```
## [1] 0.1785+0i 0.2543+0i 0.5685+0i 0.4300+0i 0.3612+0i 0.5147+0i
```

```r
# The sum of the values of the eigenvector corresponding to the eigenvalue 1
sum(evecB[,1])
```

```
## [1] 2.307+0i
```

4) The solution using the igraph package.

```r
# create a directed graph
g <- graph.adjacency(t(A), mode="directed", weighted=TRUE)
# plot graph
plot(g)
```




```
# compute page rank
prt = page.rank (g, directed = TRUE, damping = .85, weights = NULL)$vector
# print solution
prt
```

```
## [1] 0.07736 0.11024 0.24639 0.18635 0.15656 0.22310
```

Results:

The page rank vector that I get after calling the page.rank function in the igraph library is:

0.07735886 0.11023638 0.24639464 0.18635389 0.15655927 0.22309696

The results I get from the iterative solution is:

0.06041667.13125000 .30833333 .16666667 .13125000 .13125000 .20208333

These results are approximately the same.

After performing the eigen decomposition of B I do find an eigen value of 1 which is the largest eigen value of B:

1.0000000+0.000000i 0.5063824+0.000000i -0.4250000+0.000000i -0.4250000+0.000000i [5] -0.2531912+0.108131i -0.2531912-0.108131i

Furthermore the components of the eigenvector corresponding to the eigenvalue of 1 are positive:

0.1784825+0i 0.2543376+0i 0.5684822+0i 0.4299561+0i 0.3612138+0i 0.5147297+0i

However, these results are not matching the results from the iterative solution and the built-in page.rank function from the igraph library. Finally, these components do not sum to 1.

sum(evecB[,1]) [1] 2.307202+0i