Week 10 Assignment

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Playing with PageRank

Bullet 1

Form the A Matrix.

```
A <- matrix(c(0, 0, .33, 0, 0, 0, .5, 0, .33, 0, 0, 0, .5, 0, 0, 0 ,0 ,0, 0, 0, 0, 0,
              .5, 1, 0, 0, .33, .5, 0 ,0, 0, 0, 0, .5, .5, 0), nrow=6,ncol=6)

A
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,] 0.00 0.50  0.5  0.0 0.00  0.0
## [2,] 0.00 0.00  0.0  0.0 0.00  0.0
## [3,] 0.33 0.33  0.0  0.0 0.33  0.0
## [4,] 0.00 0.00  0.0  0.0 0.50  0.5
## [5,] 0.00 0.00  0.0  0.5 0.00  0.5
## [6,] 0.00 0.00  0.0  1.0 0.00  0.0
```

Introduce Decay and form the B Matrix.

```
n <- 6 #chose 6 because there are 6 pages in the notes
B = 0.85*A+(0.15/n)

B
```

```
##        [,1]   [,2]  [,3]  [,4]   [,5]  [,6]
## [1,] 0.0250 0.4500 0.450 0.025 0.0250 0.025
## [2,] 0.0250 0.0250 0.025 0.025 0.0250 0.025
## [3,] 0.3055 0.3055 0.025 0.025 0.3055 0.025
## [4,] 0.0250 0.0250 0.025 0.025 0.4500 0.450
## [5,] 0.0250 0.0250 0.025 0.450 0.0250 0.450
## [6,] 0.0250 0.0250 0.025 0.875 0.0250 0.025
```

Bullet 2

Start uniform rank r and perform power iterations on B til convergence.

```
r <- matrix(c(.167, .167, .167, .167, .167, .167), nrow=6, ncol=1)
r
```

```
##       [,1]
## [1,] 0.167
## [2,] 0.167
## [3,] 0.167
## [4,] 0.167
## [5,] 0.167
## [6,] 0.167
```

```
r_solve1 = (B^10)%*%r
r_solve2 = (B^100)%*%r
r_solve3 = (B^1000)%*%r
```

Bullet 3 Compute the Eigendecomposition of B. Found this website to be able to do it: https://stat.ethz.ch/R-manual/R-devel/library/base/html/eigen.html

```
e_decomp <- eigen(B)

e_decomp
```

```
## $values
## [1]  0.95144614+0i -0.42500000+0i -0.42500000-0i  0.41284482+0i
## [5] -0.34563163+0i -0.01865934+0i
##
## $vectors
##               [,1]                         [,2]                         [,3]
## [1,] 0.21474933+0i -5.276118e-01-1.156583e-07i -5.276118e-01+1.156583e-07i
## [2,] 0.05719614+0i  0.000000e+00+1.169753e-09i  0.000000e+00-1.169753e-09i
## [3,] 0.29551769+0i  5.276118e-01+1.009896e-07i  5.276118e-01-1.009896e-07i
## [4,] 0.53643286+0i -2.718000e-01+0.000000e+00i -2.718000e-01-0.000000e+00i
## [5,] 0.53643286+0i -2.718000e-01-0.000000e+00i -2.718000e-01+0.000000e+00i
## [6,] 0.53643286+0i  5.436001e-01+0.000000e+00i  5.436001e-01+0.000000e+00i
##                [,4]            [,5]           [,6]
## [1,]  0.78010934+0i -0.776640715+0i  0.55007763+0i
## [2,]  0.07569051+0i  0.009353752+0i -0.61532089+0i
## [3,]  0.60858164+0i  0.629856947+0i  0.56415486+0i
## [4,] -0.07148134+0i  0.002703970+0i -0.01321747+0i
## [5,] -0.07148134+0i  0.002703970+0i -0.01321747+0i
## [6,] -0.07148134+0i  0.002703970+0i -0.01321747+0i
```

Bullet 4

```
require(igraph)
```

```
## Loading required package: igraph
```

Use the graph package in R and its page.rank method to compute the Page Rank of the graph as given in A.

```
A
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,] 0.00 0.50  0.5  0.0 0.00  0.0
## [2,] 0.00 0.00  0.0  0.0 0.00  0.0
## [3,] 0.33 0.33  0.0  0.0 0.33  0.0
## [4,] 0.00 0.00  0.0  0.0 0.50  0.5
## [5,] 0.00 0.00  0.0  0.5 0.00  0.5
## [6,] 0.00 0.00  0.0  1.0 0.00  0.0
```

```
net = graph.adjacency(A, mode="directed")
A_page_rank = page.rank(net, directed=TRUE)$vector
```