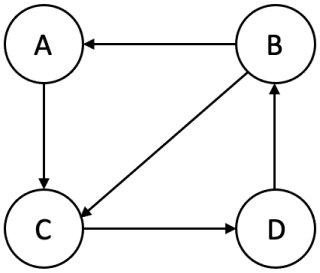
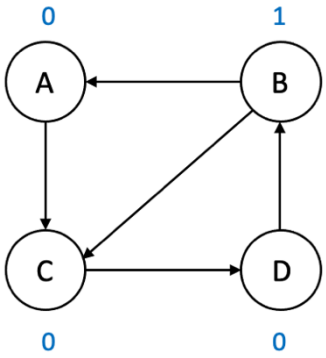
Exercise on PageRank (Second midterm 2022/23)

Let's apply basic PageRank update rule for the first 2 iterations to the graph below, starting with page B having PageRank equal to 1 and all the other pages (A, C and D) with PageRank equal to 0.



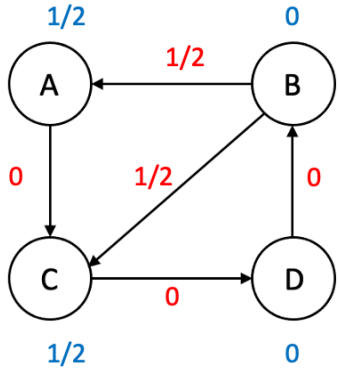
$R_0(A) = 0$
$R_0(B) = 1$
$R_0(C) = 0$
$R_0(D) = 0$

The PageRank values are shown in blue.



First iteration
$R_1(A) = R_0(B)/2 = 1/2$
$R_1(B) = R_0(D) = 0$
$R_1(C) = R_0(A) + R_0(B)/2 = 0 + 1/2 = 1/2$
$R_1(D) = R_0(C) = 0$

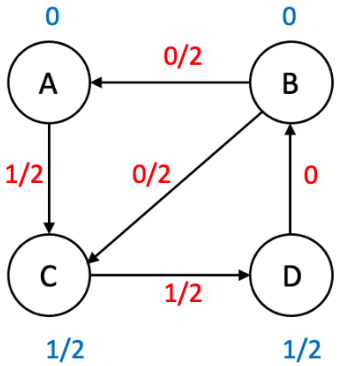
Let's show in red how the PageRank is reassigned according to the basic PageRank update rule, in blue the new values. Observe that the sum of the PageRank values is equal to 1.



Second iteration
$R_2(A) = R_1(B)/2 = 0$
$R_2(B) = R_1(D) = 0$

$R_2(C) = R_1(A) + R_1(B)/2 = 1/2 + 0/2 = 1/2$
$R_2(D) = R_1(C) = 1/2$

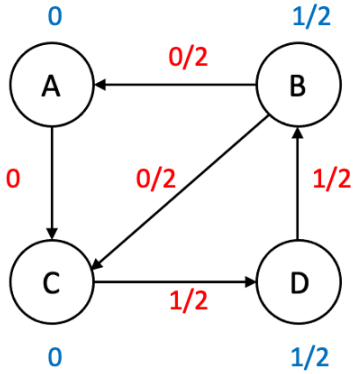
Let's show in red how the PageRank is reassigned according to the basic PageRank update rule, in blue the new values.



Let's consider also the third and fourth iterations.

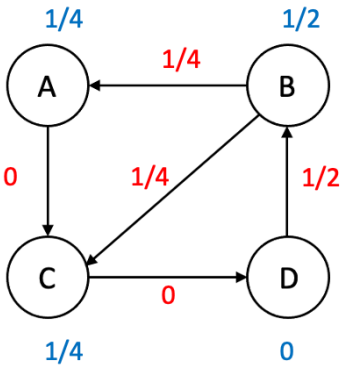
Third iteration
$R_3(A) = R_2(B)/2 = 0$
$R_3(B) = R_2(D) = 1/2$
$R_3(C) = R_2(A) + R_2(B)/2 = 0 + 0/2 = 0$
$R_3(D) = R_2(C) = 1/2$

Let's show in red how the PageRank is reassigned according to the basic PageRank update rule, in blue the new values.



Fourth iteration
$R_4(A) = R_3(B)/2 = 1/4$
$R_4(B) = R_3(D) = 1/2$
$R_4(C) = R_3(A) + R_3(B)/2 = 0 + 1/4 = 1/4$
$R_4(D) = R_3(C) = 0$

Let's show in red how the PageRank is reassigned according to the basic PageRank update rule, in blue the new values.


1/4
1/2
A
1/4
B
0
1/4
1/2
C
0
D
1/4
0