PAGERANK ALGORITHM

Student Booklet

Name: _____ Class: _____ Date: _____

Learning objectives

- Explain what PageRank is and why Google needed it.
- Work out the starting page score of every page (1 ÷ N).
- Split a page's score across the links it sends, and add up the shares a page receives.
- Work out the base amount using the damping factor d.
- Calculate PR(X) for one round using PR(X) = base amount + d × (shares coming in).

Key ideas

Page score	1 ÷ N, where N is the number of pages. Every page starts with the same score.
Share	page's score ÷ number of links it sends. A page shares its score equally between all its links.
Shares coming in	Add up the shares from every page that links to the page you are scoring.
Base amount	(1 − d) ÷ N. A small score every page gets for free. d is the damping factor, usually 0.85.
PageRank	PR(X) = base amount + d × (shares coming in)

Section 1 – Page score

Page score = 1 ÷ number of pages (N). Every page starts with this score.

I DO

A web has 5 pages. Work out the page score that each page starts with.

Working out: 1 ÷ N = 1 ÷ _____ = _____

Page score = _____

WE DO

A web has 4 pages. Work out the page score that each page starts with.

Working out: 1 ÷ N = 1 ÷ _____ = _____

Page score = _____

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YOU DO

A web has 10 pages. Work out the page score that each page starts with.

Working out: 1 ÷ N = 1 ÷ _____ = _____

Page score = _____

Section 2 – Quick-fire: splitting and adding shares

A page shares its score equally between the links it sends: share = score ÷ number of links. A page's new total is all the shares it receives added together.

No.	Question	Working out	Answer
1	Page A has a score of 0.25 and sends 2 links. What does each linked page receive?		
2	Page A has a score of 0.25 and sends 4 links. What does each linked page receive?		
3	Page A has a score of 1.0 and sends 2 links. What does each linked page receive?		
4	Page A has a score of 1.0 and sends 10 links. What does each linked page receive?		
5	Page X has a score of 1.2 and sends 3 links. What does each linked page receive?		
6	Page C has a score of 0.2 and sends 4 links. What does each linked page receive?		
7	Page D has a score of 0.2 and sends 1 link. What does the linked page receive?		
8	Page A has a score of 0.125 and sends 2 links. What does each linked page receive?		
9	Website B receives shares of 0.5, 0.3 and 0.4. What is its new total?		
10	Page B receives shares of 0.1, 0.05, 0.2 and 0.1. What is its total?		

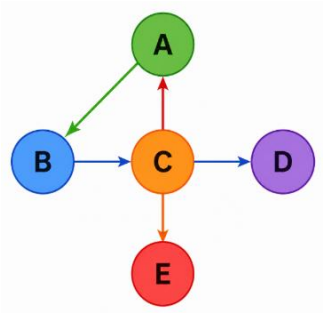
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Section 3 – Base amount

Base amount = (1 – d) ÷ N, where d is the damping factor and N is the number of pages.

I DO

Work out the base amount when N = 5 and d = 0.85.

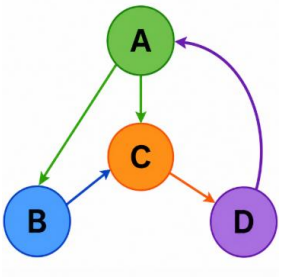


Working out: (1 – d) ÷ N = (1 – _____) ÷ _____ = _____ ÷ _____ = _____

Base amount = _____

WE DO

Work out the base amount when N = 4 and d = 0.28.

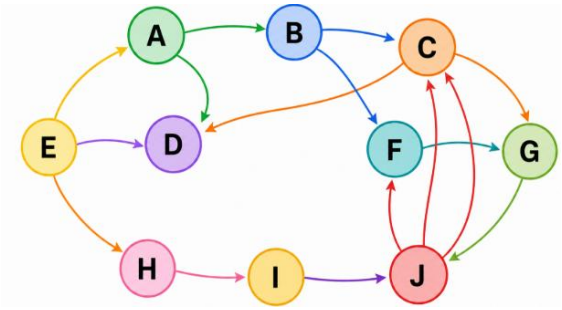


Working out: (1 – d) ÷ N = (1 – _____) ÷ _____ = _____ ÷ _____ = _____

Base amount = _____

YOU DO

Work out the base amount when N = 10 and d = 0.75.



Working out: (1 – d) ÷ N = (1 – _____) ÷ _____ = _____ ÷ _____ = _____

Base amount = _____

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Section 4 – The damping factor d

1. **What does the damping factor d describe, and what value does Google usually use?**

2. **What happens when d is high (close to 1)?**

3. **What happens when d = 0?**

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Section 5 – Working out a PageRank

Follow the six steps every time. Look carefully at how many links each page sends — it is not always 2!

Worked example – Work out PR(C)

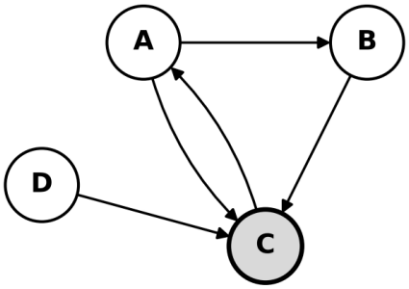
I DO

A web has 4 pages: A, B, C and D.

The links are:

$A \rightarrow B$ $A \rightarrow C$ $B \rightarrow C$

$C \rightarrow A$ $D \rightarrow C$



The damping factor is d = 0.85.

Work out PR(C) for one round.

Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to C?

_____

Step 3 Work out the share each of those pages sends to C

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into C

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(C) = base amount + d × (shares coming in)

PR(C) = _____ + 0.85 × _____ = _____ + _____

PR(C) = _____

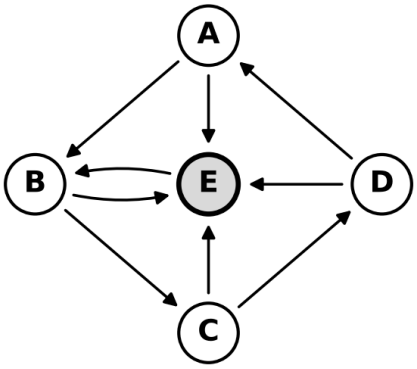
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Task 1 – Work out PR(E)

A web has 5 pages: A, B, C, D and E.

The links are:

A → B A → E B → C
B → E C → D C → E
D → A D → E E → B



The damping factor is d = 0.85.

Work out PR(E) for one round.

Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to E?

_____

Step 3 Work out the share each of those pages sends to E

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into E

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(E) = base amount + d × (shares coming in)

PR(E) = _____ + 0.85 × _____ = _____ + _____

PR(E) = _____

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Task 2 – Work out PR(H)

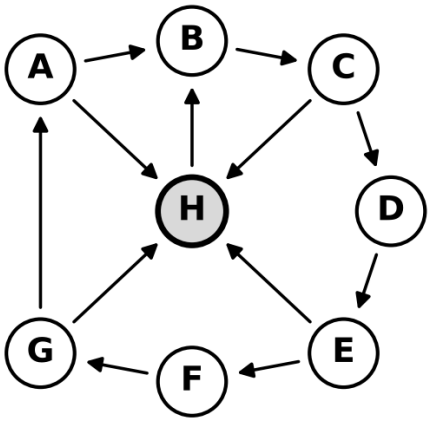
A web has 8 pages: A, B, C, D, E, F, G and H.

The links are:

A → B A → H B → C
C → D C → H D → E
E → F E → H F → G
G → A G → H H → B

The damping factor is d = 0.85.

Work out PR(H) for one round.



Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to H?

_____

Step 3 Work out the share each of those pages sends to H

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into H

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(H) = base amount + d × (shares coming in)

PR(H) = _____ + 0.85 × _____ = _____ + _____

PR(H) = _____

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Task 3 – Work out PR(D)

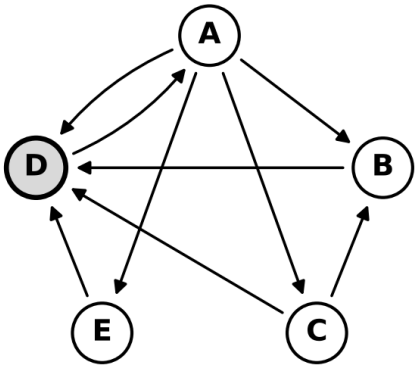
A web has 5 pages: A, B, C, D and E.

The links are:

A → B A → C A → D
A → E B → D C → B
C → D D → A E → D

The damping factor is d = 0.85.

Work out PR(D) for one round.



Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to D?

_____

Step 3 Work out the share each of those pages sends to D

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into D

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(D) = base amount + d × (shares coming in)

PR(D) = _____ + 0.85 × _____ = _____ + _____

PR(D) = _____

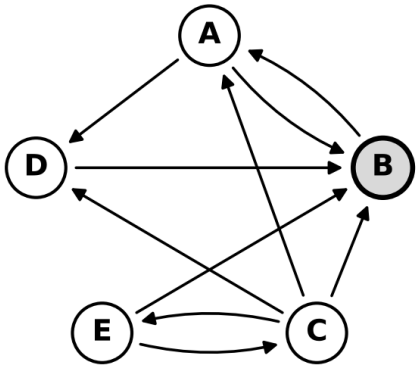
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Task 4 – Work out PR(B)

A web has 5 pages: A, B, C, D and E.

The links are:

A → B A → D B → A
C → A C → B C → D
C → E D → B E → B
E → C



The damping factor is d = 0.85.

Work out PR(B) for one round.

Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to B?

_____

Step 3 Work out the share each of those pages sends to B

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into B

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(B) = base amount + d × (shares coming in)

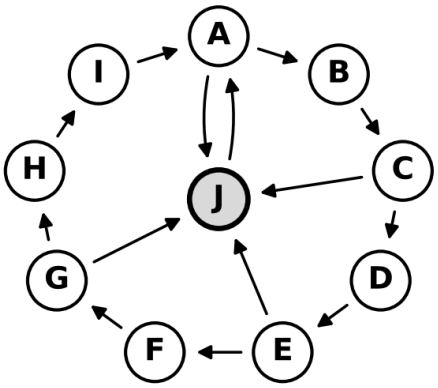
PR(B) = _____ + 0.85 × _____ = _____ + _____

PR(B) = _____

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Extension – Work out PR(J)

A web has 10 pages: A, B, C, D, E, F, G, H, I and J.



The links are:

A → B	A → J	B → C
C → D	C → J	D → E
E → F	E → J	F → G
G → H	G → J	H → I
I → A	J → A	

The damping factor is d = 0.85.

Work out PR(J) for one round.

Step 1 Page score

1 ÷ N = 1 ÷ _____ = _____

Step 2 Which pages link to J?

_____

Step 3 Work out the share each of those pages sends to J

Page	Its score	Links it sends	Share = score ÷ links

Step 4 Add the shares coming into J

Total shares coming in = _____

Step 5 Base amount

(1 – d) ÷ N = (1 – _____) ÷ _____ = _____

Step 6 PR(J) = base amount + d × (shares coming in)

PR(J) = _____ + 0.85 × _____ = _____ + _____

PR(J) = _____