

term	D1	D2	D3	D4	D5	D6	D7	D8	Q
Jack	1	0	1	0	1	0	0	0	1
and	1	0	1	1	1	0	0	1	0
Jill	1	0	0	1	0	0	0	0	0
went	1	0	0	0	0	0	0	0	0
UP	1	0	0	0	1	0	0	0	0
the	1	0	0	0	0	0	0	0	0
hill	1	0	0	0	0	0	0	0	0
to	0	1	0	0	0	0	1	0	0
fetch	0	1	0	0	0	0	0	0	0
a	0	1	0	0	0	0	0	0	0
pail	0	1	0	0	0	0	0	0	0
of	0	1	0	0	0	0	0	0	0
water	0	1	0	0	0	0	0	0	0
fell	0	0	1	0	0	0	0	0	0
down	0	0	1	0	0	0	0	0	0
broke	0	0	1	0	0	0	0	0	0
his	0	0	1	0	0	0	1	0	0
crown	0	0	1	0	0	0	0	0	0
came	0	0	0	1	0	0	0	0	0
tumbling	0	0	0	1	0	0	0	0	0
after	0	0	0	1	0	0	0	0	0
get	0	0	0	0	1	0	0	0	0
home	0	0	0	0	1	0	0	0	0
did	0	0	0	0	1	0	0	0	0

trot	0	0	0	0	1	0	0	0	0
as	0	0	0	0	0	1	0	0	0
fast	0	0	0	0	0	1	0	0	0
he	0	0	0	0	0	1	0	0	0
could	0	0	0	0	0	1	0	0	0
cafer	0	0	0	0	0	1	0	0	0
old	0	0	0	0	0	0	1	0	0
dame	0	0	0	0	0	0	1	0	0
dob	0	0	0	0	0	0	1	0	0
who	0	0	0	0	0	0	1	0	0
patch	0	0	0	0	0	0	1	0	0
nob	0	0	0	0	0	0	1	0	0
with	0	0	0	0	0	0	0	1	0
vinegar	0	0	0	0	0	0	0	1	0
brown	0	0	0	0	0	0	0	1	0
Paper	0	0	0	0	0	0	0	1	0

(1) Inner-Product:

$$D1: 1 \times 1 + 1 \times 0 + 1 \times 0 + 1 \times 0 + 1 \times 0 + 1 \times 0 + 1 \times 0 + 0 \times 0 + \dots + 0 \times 0 = 1$$

$$D2: 0 \times 1 + 0 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 0$$

$$D3: 1 \times 1 + 1 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 1$$

$$D4: 0 \times 1 + 1 \times 0 + 1 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 0$$

$$D5: 1 \times 1 + 1 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 1$$

$$D6: 0 \times 1 + 0 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 0$$

$$D7: 0 \times 1 + 0 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 0 \times 0 + 0 \times 0 + 0 \times 0 = 0$$

$$D8: 0 \times 1 + 1 \times 0 + 0 \times 0 + 0 \times 0 + \dots + 1 \times 0 + 1 \times 0 + 1 \times 0 = 0$$

(2) cosine Similarity

$$D1: \text{CosSim}(q, d_1) = \frac{1}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = \frac{1}{\sqrt{7}}$$

$$D2: \text{CosSim}(q, d_2) = \frac{0}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = 0$$

$$D3: \text{CosSim}(q, d_3) = \frac{1}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = \frac{1}{\sqrt{7}}$$

$$D4: \text{CosSim}(q, d_4) = \frac{0}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = 0$$

$$D5: \text{CosSim}(q, d_5) = \frac{1}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = \frac{1}{\sqrt{7}}$$

$$D6: \text{CosSim}(q, d_6) = \frac{0}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = 0$$

$$D7: \text{CosSim}(q, d_7) = \frac{0}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = 0$$

$$D8: \text{CosSim}(q, d_8) = \frac{0}{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2} \cdot \sqrt{1^2}} = 0$$

(3) The result is equal in rank because document 1, 3, 5 have the same length

(4) query: jill

Inner-Product: | Cosine Similarity

$$D_1 = 1$$

$$D_2 = 0$$

$$D_3 = 0$$

$$D_4 = 1$$

$$D_5 = 0$$

$$D_6 = 0$$

$$D_7 = 0$$

$$D_8 = 0$$

$$\cos \text{Sim}(q, d_1) = \frac{1}{\sqrt{7}}$$

$$\cos \text{Sim}(q, d_2) = 0$$

$$\cos \text{Sim}(q, d_3) = 0$$

$$\cos \text{Sim}(q, d_4) = \frac{1}{\sqrt{5}}$$

$$\cos \text{Sim}(q, d_5) = 0$$

$$\cos \text{Sim}(q, d_6) = 0$$

$$\cos \text{Sim}(q, d_7) = 0$$

$$\cos \text{Sim}(q, d_8) = 0$$

(5) D1 tf-idf

term	tf	idf	tf-idf
Jack	$\frac{1}{7}$	$\log_2 \left( \frac{8}{3} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{3} \right) = 0.20$
and	$\frac{1}{7}$	$\log_2 \left( \frac{8}{5} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{5} \right) = 0.10$
jill	$\frac{1}{7}$	$\log_2 \left( \frac{8}{2} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{2} \right) = 0.29$
went	$\frac{1}{7}$	$\log_2 \left( \frac{8}{1} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{1} \right) = 0.43$
up	$\frac{1}{7}$	$\log_2 \left( \frac{8}{2} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{2} \right) = 0.29$
the	$\frac{1}{7}$	$\log_2 \left( \frac{8}{1} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{1} \right) = 0.43$
hill	$\frac{1}{7}$	$\log_2 \left( \frac{8}{1} \right)$	$\frac{1}{7} \log_2 \left( \frac{8}{1} \right) = 0.43$