

## Solution 4: Using Needleman Wunsch Algorithm

$S3 = \{P1, P6, P1, P4\}$

$S4 = \{P5, P4, P1, P6, P7\}$

Similarity of (P4, P6) = (P5, P7) = 0.9

gap  $d = -10$

The range of score is between -10 to 20

The range of page similarity is between 0 to 1

so we need to scale the Similarity of page P4 and P6 in the range of -10 ~20

so after scaling we get 17

i.e  $30 * 0.9 - 10 = 17$

so now the  $S(X_i, Y_j)$  i.e  $S(P4, P6) = S(P6, P4) = 17$

$A(i, j)$	$A(i-1, j-1) + S(X_i, Y_j)$	$A(i, j-1) + d$	$A(i-1, j) + d$	$\max((A(i-1, j-1) + S(X_i, Y_j)), (A(i, j-1) + d), (A(i-1, j) + d))$
P1, P5	$0 + 0 = 0$	$-10 - 10 = -20$	$-10 - 10 = -20$	0
P1, P4	$-10 + 0 = -10$	$0 - 10 = -10$	$-20 - 10 = -30$	-10
P1, P1	$-20 + 1 = -19$	$-10 - 10 = -20$	$-30 - 10 = -40$	-19
P1, P6	$-30 + 0 = -30$	$-19 - 10 = -29$	$-40 - 10 = -50$	-29
P1, P7	$-40 + 0 = -40$	$-29 - 10 = -39$	$-50 - 10 = -60$	-39
P6, P5	$-10 + 0 = -10$	$-20 - 10 = -30$	$0 - 10 = -10$	-10
P6, P4	$0 + 17 = 17$	$-10 - 10 = -20$	$-10 - 10 = -20$	17
P6, P1	$-10 + 0 = -10$	$17 - 10 = 7$	$-19 - 10 = -29$	7
P6, P6	$-19 + 1 = -18$	$7 - 10 = -3$	$-29 - 10 = -39$	-3
P6, P7	$-29 + 0 = -29$	$-3 - 10 = -13$	$-39 - 10 = -49$	-13
P1, P5	$-20 + 0 = -20$	$-30 - 10 = -40$	$-10 - 10 = -20$	-20
P1, P4	$-10 + 0 = -10$	$-20 - 10 = -30$	$17 - 10 = 7$	7
P1, P1	$17 + 1 = 18$	$7 - 10 = -3$	$7 - 10 = -3$	18
P1, P6	$7 + 0 = 7$	$18 - 10 = 8$	$-3 - 10 = -13$	8
P1, P7	$-3 + 0 = -3$	$8 - 10 = -2$	$-13 - 10 = -23$	-2
P4, P5	$-30 + 0 = -30$	$-40 - 10 = -50$	$-20 - 10 = -30$	-30
P4, P4	$-20 + 1 = -19$	$-30 - 10 = -40$	$7 - 10 = -3$	-3
P4, P1	$7 + 0 = 7$	$-3 - 10 = -13$	$18 - 10 = 8$	8
P4, P6	$18 + 17 = 35$	$8 - 10 = -2$	$8 - 10 = -2$	35
P4, P7	$8 + 0 = 8$	$35 - 10 = 25$	$-2 - 10 = -12$	25

		P5	P4	P1	P6	P7
	0	-10	-20	-30	-40	-50
P1	-10	0	-10	-19	-29	-39
P6	-20	-10	17	7	-3	-13
P1	-30	-20	7	18	8	-2
P4	-40	-30	-3	8	35	25

**Optimal alignment score is 35**

Session similarity = optimal alignment score /length of longer session =35/5 =7

**Session similarity = 7**