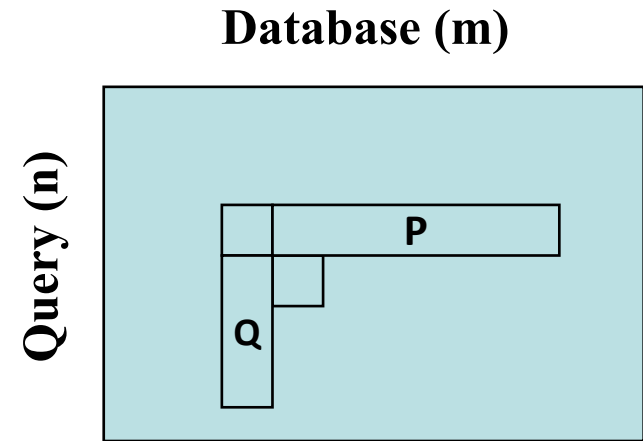


# Doing it yourself

$$D_{m,n} = \text{Max} \left\{ \begin{array}{l} D_{m+1,n+1} + d(m,n), \text{match} \\ P_{m,n}, \text{gap in query} \\ Q_{m,n}, \text{gap in database} \\ 0 \text{ (for local alignment)} \end{array} \right.$$

$$P_{m,n} = \text{Max} [D_{m+1,n} + w_1, P_{m+1,n} + u]$$

$$Q_{m,n} = \text{Max} [D_{m,n+1} + w_1, Q_{m,n+1} + u]$$



- eij = 1 match
- eij = 2 gap-opening database (insertion query)
- eij = 3 gap-extension database (insertion query)
- eij = 4 gap-opening query (insertion database)
- eij = 5 gap-extension query (insertion database)

- D is highest
- Q is highest, gap open
- Q is highest, gap extension
- P is highest, gap open
- P is highest, gap extension

# Blosum50 scoring matrix

	A	R	N	D	C	Q	E	G	H	I	L	K	M	F	P	S	T	W	Y	V
A	5	-2	-1	-2	-1	-1	-1	0	-2	-1	-2	-1	-1	-3	-1	1	0	-3	-2	0
R	-2	7	-1	-2	-4	1	0	-3	0	-4	-3	3	-2	-3	-3	-1	-1	-3	-1	-3
N	-1	-1	7	2	-2	0	0	0	1	-3	-4	0	-2	-4	-2	1	0	-4	-2	-3
D	-2	-2	2	8	-4	0	2	-1	-1	-4	-4	-1	-4	-5	-1	0	-1	-5	-3	-4
C	-1	-4	-2	-4	13	-3	-3	-3	-3	-2	-2	-3	-2	-2	-4	-1	-1	-5	-3	-1
Q	-1	1	0	0	-3	7	2	-2	1	-3	-2	2	0	-4	-1	0	-1	-1	-1	-3
E	-1	0	0	2	-3	2	6	-3	0	-4	-3	1	-2	-3	-1	-1	-1	-3	-2	-3
G	0	-3	0	-1	-3	-2	-3	8	-2	-4	-4	-2	-3	-4	-2	0	-2	-3	-3	-4
H	-2	0	1	-1	-3	1	0	-2	10	-4	-3	0	-1	-1	-2	-1	-2	-3	2	-4
I	-1	-4	-3	-4	-2	-3	-4	-4	-4	5	2	-3	2	0	-3	-3	-1	-3	-1	4
L	-2	-3	-4	-4	-2	-2	-3	-4	-3	2	5	-3	3	1	-4	-3	-1	-2	-1	1
K	-1	3	0	-1	-3	2	1	-2	0	-3	-3	6	-2	-4	-1	0	-1	-3	-2	-3
M	-1	-2	-2	-4	-2	0	-2	-3	-1	2	3	-2	7	0	-3	-2	-1	-1	0	1
F	-3	-3	-4	-5	-2	-4	-3	-4	-1	0	1	-4	0	8	-4	-3	-2	1	4	-1
P	-1	-3	-2	-1	-4	-1	-1	-2	-2	-3	-4	-1	-3	-4	10	-1	-1	-4	-3	-3
S	1	-1	1	0	-1	0	-1	0	-1	-3	-3	0	-2	-3	-1	5	2	-4	-2	-2
T	0	-1	0	-1	-1	-1	-1	-2	-2	-1	-1	-1	-1	-2	-1	2	5	-3	-2	0
W	-3	-3	-4	-5	-5	-1	-3	-3	-3	-3	-2	-3	-1	1	-4	-4	-3	15	2	-3
Y	-2	-1	-2	-3	-3	-1	-2	-3	2	-1	-1	-2	0	4	-3	-2	-2	2	8	-1
V	0	-3	-3	-4	-1	-3	-3	-4	-4	4	1	-3	1	-1	-3	-2	0	-3	-1	5

$$W_1 = -2$$
$$U = -1$$

# How does it work (score matrix d)

	V	L	L	P	V	L	L	P	
V	5	1	1	-3	5	1	1	-3	
L	1	5	5	-4	1	5	5	-4	
P			-4		-3		-4	10	
V	5	1	1	-3	5	1	1	-3	n
L	1	5	5	-4	1	5	5	-4	
I	4		2	-3		2	2	-3	
L	1	5	5	-4	1	5		-4	
P	-3	-4	-4	10	-3	-4	-4	10	
				m					

**D**

	V	L	L	P	V	L	L	P	
V	41	39	36	30	20	16	13	7	0
L	35	36	38	31	20	15	15	8	0
P	29	30		33	21	15	10	10	0
V	24	21	20	21	23	16		5	0
L	18	19	20	16	18	18	12	6	0
I	17	17		15	17	17	13	7	0
L	12	13	15	11	12	13		8	0
P	6	7	8	10	6	7	8	10	0
	0	0	0	0	0	0	0	0	0

**Q**

	V	L	L	P	V	L	L	P	
V	33	34		30	19	13	13	7	0
L	27	28	29	31	20	14	9	8	0
P	22	19	18	19	21		10	4	0
V	16	17	18	14	16	16	11	5	0
L	15		12	13	15	15	12	6	0
I	10	11	13	9	10		13	7	0
L	4	5	6	8	4	5	6	8	0
P	-1	-1	-1	-1	-1	-1	-1	-1	0
	0	0	0	0	0	0	0	0	0

**P**

	V	L	L	P	V	L	L	P	
V	37	34	28	18	14	11	5	-1	0
L		36	29	18	13	13	6	-1	0
P	29	30	31	19	13		8	-1	0
V	19	19	20	21	14	9	3	-1	0
L	17		15	16	16	10	4	-1	0
I	15	13	14	15	15	11	5	-1	0
L	12	13	10	11	12	13	6	-1	0
P	6	7		5	6	7	8	-1	0
	0	0	0	0	0	0	0	0	0

**E**

	V	L	L	P	V	L	L	P	
V	1	1	2	3	1	1	2	3	0
L	5	1	1	2	3	1	1	2	0
P	5	5		1	2	3	3	1	0
V	1	1	5	4	1	2		3	0
L	1	1	1	4	1	1	1	3	0
I	1	1		4	1	1		3	0
L	5	1	1	5	5	1	1	2	0
P	5	5	4	1	5	5	4	1	0
	0	0	0	0	0	0	0	0	0

$$W_1 = -2$$

$$U = -1$$

eij = 1 match  
 eij = 2 gap-opening database  
 eij = 3 gap-extension database  
 eij = 4 gap-opening query  
 eij = 5 gap-extension query

# The alignment

**ALN score:**

**QAL**

**DAL**

# How does it work (score matrix D)

	V	L	L	P	V	L	L	P	
V	41	39	36	30	20	16	13	7	0
L	35	36	38	31	20	15	15	8	0
P	29	30		33	21	15	10	10	0
V	24	21	20	21	23	16		5	0
L	18	19	20	16	18	18	12	6	0
I	17	17		15	17	17	13	7	0
L	12	13	15	11	12	13		8	0
P	6	7	7	10	6	7	8	10	0
	0	0	0	0	0	0	0	0	0

$$W_1 = -2$$

$$U = -1$$

n

m

# How does it work (score matrix Q)

	V	L	L	P	V	L	L	P	
V	33	34		30	19	13	13	7	0
L	27	28	29	31	20	14	9	8	0
P	22	19	18	19	21		10	4	0
V	16	17	18	14	16	16	11	5	0
L	15		12	13	15	15	12	6	0
I	10	11	13	9	10		13	7	0
L	4	5	6	8	4	5	6	8	0
P	-1	-1	-1	-1	-1	-1	-1	-1	0
	0	0	0	0	0	0	0	0	0

$$W_1 = -2$$

$$U = -1$$

n

m

# How does it work (score matrix P)

	V	L	L	P	V	L	L	P	
V	37	34	28	18	14	11	5	-1	0
L		36	29	18	13	13	6	-1	0
P	29	30	31	19	13		8	-1	0
V	19	19	20	21	14	9	3	-1	0
L	17		15	16	16	10	4	-1	0
I	15	13	14	15	15	11	5	-1	0
L	12	13	10	11	12	13	6	-1	0
P	6	7		5	6	7	8	-1	0
	0	0	0	0	0	0	0	0	0

$$W_1 = -2$$

$$U = -1$$

n

m



# How does it work (score matrix E)

	V	L	L	P	V	L	L	P	
V	1	1	2	3	1	1	2	3	0
L	5	1	1	2	3	1	1	2	0
P	5	5		1	2	3	3	1	0
V	1	1	5	4	1	2		3	0
L	1	1	1	4	1	1	1	3	0
I	1	1		4	1	1		3	0
L	5	1	1	5	5	1	1	2	0
P	5	5	4	1	5	5	4	1	0
	0	0	0	0	0	0	0	0	0

$e_{ij} = 1$  match

$e_{ij} = 2$  gap-opening database

$e_{ij} = 3$  gap-extension database

$e_{ij} = 4$  gap-opening query

$e_{ij} = 5$  gap-extension query