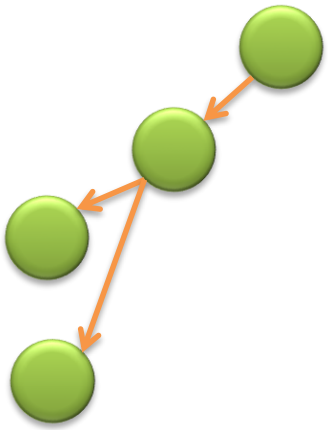
Bioinformatics Lectures 03

Needleman & Wunsch Algorithm



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2.5.2017

What is the problem?

We want to compare two DNA sequences and find the best way to align one to the other. This is easy when only a few bases differ:

```
ACGGTAGGGATATACCTACGAGCTCACAT
|||||||| || ||||||||||| ||||||
ACGGTAGGCATTTACCTACGAGGTCACAT
```

Here only three bases are different and the sequences are identical at 26 positions.

What is the problem?

We want to compare two DNA sequences and find the best way to align one to the other. When the two sequences differ more the optimal alignment is not easy to find:

```
ACGGTAGGGATATACCTACGAGCTCACAT
||  ||  |       |||         |     |  |
ACCGTCGACCCGTACGACTCTGACGTCCT
```

In this comparison 11 bases are identical and 18 are different.

What is the problem?

We want to compare two DNA sequences and find the best way to align one to the other. When the two sequences differ more the optimal alignment is not easy to find:

```
ACGGTAGGGATATACCTACGAG-CTCACAT---
||  ||  |      |   | |||||   ||  ||  |
ACCGTCG----ACCCGTACGACTCTGACGTCCT
```

Another possibility is to add a gap in each sequence and thereby increase the number of identities to 17.

What is the problem?

We want to compare two DNA sequences and find the best way to align one to the other. When the two sequences differ more the optimal alignment is not easy to find:

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT
||  ||   |        |    ||  |||| |  |||    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Yet another possibility is to add five gaps in both sequences and thereby increase the number of identities to 19.

What is the best alignment?

1. How many different alignments exist?

2. How to measure the quality of an alignment?

3. How to find and choose the best one?

How many different alignments exist?

The number of possible aligments has been given in a paper by Angela Torres, Alberto Cabada and Juan J. Nieto: DNA Sequence 2003, 1-4.

Let f(n,m) be the number of alignments of two sequences of length n and m, then we have the following recursive formula:

$$f(n,m) = f(n-1,m) + f(n,m-1)+f(n-1,m-1)$$

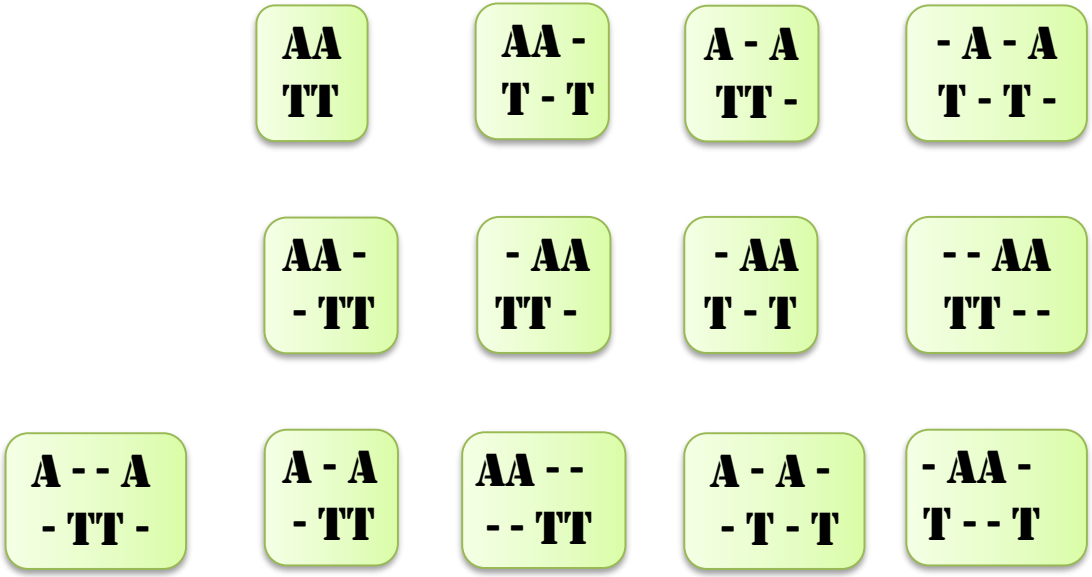
since there are three possibilities to elongate an alignment from n-1 and m-1 to length n and m.

What is the number of different possible alignments?

Starting with f(0,m) = f(n,0) = f(0,0) = 1 for all n,m > 0

We obtain:

f(1,1) = 3
f(2,2) = 13
f(3,3) = 63
...
f(10,10) = 8097453
f(100,100) = $2*10^{74}$



All 13 alignments of two sequences of length 2

How to measure the quality of an alignment?

Two sequences of realistic length can have a multitude of different possible alignments which differ in quality.

We have to find a measure (a metric) for the quality of an alignment.

And we have to find method to search through all possible alignments to be able to choose the optimal one.

How to measure the quality of an alignment?

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT - - -
||  ||   |        |    ||  |||| |  |||    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Count the number of identical/similar bases:
19

How to measure the quality of an alignment?

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT - - -
||  ||   |        |    ||  |||| |  |||    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Count the number of different bases or mismatches: 4

G/C = 1x

A/C = 1x

T/A = 1x

A/G = 1x

How to measure the quality of an alignment?

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT - - -
||  ||   |        |    ||  | | | | |  | | |    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Count the number of gaps:

6

How to measure the quality of an alignment?

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT - - -
||  ||   |        |    ||  |||| |  |||    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Count the gaps of different sizes:

3x 1 base

1x 2 bases

1x 4 bases

1x 3 bases end gap

Simple similarity matrix for DNA

1 if bases are the same
0 when different
= Identity matrix

Base in sequence 1

Base in sequence 2

	A	C	G	T
A	1	0	0	0
C	0	1	0	0
G	0	0	1	0
T	0	0	0	1

Similarity matrix CDNAFULL for DNA with ambiguous bases

Base in sequence 1

Base in sequence 2

	A	T	G	C	S	W	R	Y	K	M	B	V	H	D	N	U
A	5	-4	-4	-4	-4	1	1	-4	-4	1	-4	-1	-1	-1	-2	-4
T	-4	5	-4	-4	-4	1	-4	1	1	-4	-1	-4	-1	-1	-2	5
G	-4	-4	5	-4	1	-4	1	-4	1	-4	-1	-1	-4	-1	-2	-4
C	-4	-4	-4	5	1	-4	-4	1	-4	1	-1	-1	-1	-4	-2	-4
S	-4	-4	1	1	-1	-4	-2	-2	-2	-2	-1	-1	-3	-3	-1	-4
W	1	1	-4	-4	-4	-1	-2	-2	-2	-2	-3	-3	-1	-1	-1	1
R	1	-4	1	-4	-2	-2	-1	-4	-2	-2	-3	-1	-3	-1	-1	-4
Y	-4	1	-4	1	-2	-2	-4	-1	-2	-2	-1	-3	-1	-3	-1	1
K	-4	1	1	-4	-2	-2	-2	-2	-1	-4	-1	-3	-3	-1	-1	1
M	1	-4	-4	1	-2	-2	-2	-2	-4	-1	-3	-1	-1	-3	-1	-4
B	-4	-1	-1	-1	-1	-3	-3	-1	-1	-3	-1	-2	-2	-2	-1	-1
V	-1	-4	-1	-1	-1	-3	-1	-3	-3	-1	-2	-1	-2	-2	-1	-4
H	-1	-1	-4	-1	-3	-1	-3	-1	-3	1	-2	-2	-1	-2	-1	-1
D	-1	-1	-1	-4	-3	-1	-1	-3	-1	-3	-2	-2	-2	1	-1	-1
N	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2

Similarity matrix CDNAFULL for DNA with ambiguous bases

Base in sequence 1

Base in sequence 2

	A	T	G	C	S	W	R	Y	K	M	B	V	H	D	N	U
A	5	-4	-4	-4	-4	1	1	-4	-4	1	-4	-1	-1	-1	-2	-4
T	-4	5	-4	-4	-4	1	-4	1	1	-4	-1	-4	-1	-1	-2	5
G	-4	-4	5	-4	1	-4	1	-4	1	-4	-1	-1	-4	-1	-2	-4
C	-4	-4	-4	5	1	-4	-4	1	-4	1	-1	-1	-1	-4	-2	-4
S	-4	-4	1	1	-1	-4	-2	-2	-2	-2	-1	-1	-3	-3	-1	-4
W	1	1	-4	-4	-4	-1	-3	-3	-1	-3	-1	-3	-3	-1	-1	1
R	1	-4	1	-4	-2	-2	-1	-4	-2	-2	-3	-3	-1	-1	-1	-4
Y	-4	1	-4	1	-2	-2	-4	-1	-2	-2	-1	-3	-1	-3	-1	1
K	-4	1	1	-4	-2	-2	-2	-2	-1	-4	-1	-3	-3	-1	-1	1
M	1	-4	-4	1	-2	-2	-2	-2	-4	-1	-3	-1	-1	-3	-1	-4
B	-4	-1	-1	-1	-1	-3	-3	-1	-1	-3	-1	-2	-2	-2	-1	-1
V	-1	-4	-1	-1	-1	-3	-1	-3	-3	-1	-2	-1	-2	-2	-1	-4
H	-1	-1	-4	-1	-3	-1	-3	-1	-3	1	-2	-2	-1	-2	-1	-1
D	-1	-1	-1	-4	-3	-1	-1	-3	-1	-3	-2	-2	-2	1	-1	-1
N	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2

This matrix was created by
Todd Lowe 12/10/92
Uses ambiguous nucleotide codes,
probabilities rounded to nearest integer.

Lowest score = -4, Highest score = 5

BLOSUM62 similarity matrix for protein sequence comparisons

	A	R	N	D	C	Q	E	G	H	I	L	K	M	F	P	S	T	W	Y	V	B	Z	X	*
A	4	-1	-2	-2	0	-1	-1	0	-2	-1	-1	-1	-1	-2	-1	1	0	-3	-2	0	-2	-1	0	-4
R	-1	5	0	-2	-3	1	0	-2	0	-3	-2	2	-1	-3	-2	-1	-1	-3	-2	-3	-1	0	-1	-4
N	-2	0	6	1	-3	0	0	0	1	-3	-3	0	-2	-3	-2	1	0	-4	-2	-3	3	0	-1	-4
D	-2	-2	1	6	-3	0	2	-1	-1	-3	-4	-1	-3	-3	-1	0	-1	-4	-3	-3	4	1	-1	-4
C	0	-3	-3	-3	9	-3	-4	-3	-3	-1	-1	-3	-1	-2	-3	-1	-1	-2	-2	-1	-3	-3	-2	-4
Q	-1	1	0	0	-3	5	2	-2	0	-3	-2	1	0	-3	-1	0	-1	-2	-1	-2	0	3	-1	-4
E	-1	0	0	2	-4	2	5	-2	0	-3	-3	1	-2	-3	-1	0	-1	-3	-2	-2	1	4	-1	-4
G	0	-2	0	-1	-3	-2	-2	6	-2	-4	-4	-2	-3	-3	-2	0	-2	-2	-3	-3	-1	-2	-1	-4
H	-2	0	1	-1	-3	0	0	-2	8	-3	-3	-1	-2	-1	-2	-1	-2	-2	2	-3	0	0	-1	-4
I	-1	-3	-3	-3	-1	-3	-3	-4	-3	4	2	-3	1	0	-3	-2	-1	-3	-1	3	-3	-3	-1	-4
L	-1	-2	-3	-4	-1	-2	-3	-4	-3	2	4	-2	2	0	-3	-2	-1	-2	-1	1	-4	-3	-1	-4
K	-1	2	0	-1	-3	1	1	-2	-1	-3	-2	5	-1	-3	-1	0	-1	-3	-2	-2	0	1	-1	-4
M	-1	-1	-2	-3	-1	0	-2	-3	-2	1	2	-1	5	0	-2	-1	-1	-1	-1	1	-3	-1	-1	-4
F	-2	-3	-3	-3	-2	-3	-3	-3	-1	0	0	-3	0	6	-4	-2	-2	1	3	-1	-3	-3	-1	-4
P	-1	-2	-2	-1	-3	-1	-1	-2	-2	-3	-3	-1	-2	-4	7	-1	-1	-4	-3	-2	-2	-1	-2	-4
S	1	-1	1	0	-1	0	0	0	-1	-2	-2	0	-1	-2	-1	4	1	-3	-2	-2	0	0	0	-4
T	0	-1	0	-1	-1	-1	-1	-2	-2	-1	-1	-1	-1	-2	-1	1	5	-2	-2	0	-1	-1	0	-4
W	-3	-3	-4	-4	-2	-2	-3	-2	-2	-3	-2	-3	-1	1	-4	-3	-2	11	2	-3	-4	-3	-2	-4
Y	-2	-2	-2	-3	-2	-1	-2	-3	2	-1	-1	-2	-1	3	-3	-2	-2	2	7	-1	-3	-2	-1	-4
V	0	-3	-3	-3	-1	-2	-2	-3	-3	3	1	-2	1	-1	-2	-2	0	-3	-1	4	-3	-2	-1	-4
B	-2	-1	3	4	-3	0	1	-1	0	-3	-4	0	-3	-3	-2	0	-1	-4	-3	-3	4	1	-1	-4
Z	-1	0	0	1	-3	3	4	-2	0	-3	-3	1	-1	-3	-1	0	-1	-3	-2	-2	1	4	-1	-4
X	0	-1	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	0	0	-2	-1	-1	-1	-1	-1	-4
*	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	1

BLOSUM62 similarity matrix for protein sequence comparisons

	A	R	N	D	C	Q	E	G	H	I	L	K	M	F	P	S	T	W	Y	V	B	Z	X	*
A	4	-1	-2	-2	0	-1	-1	0	-2	-1	-1	-1	-1	-2	-1	1	0	-3	-2	0	-2	-1	0	-4
R	-1	5	0	-2	-3	1	0	-2	0	-3	-2	2	-1	-3	-2	-1	-1	-3	-2	-3	-1	0	-1	-4
N	-2	0	6	1	-3	0	0	0	1	-3	-3	0	-2	-3	-2	1	0	-4	-2	-3	3	0	-1	-4
D	-2	-2	1	6	-3	0	2	-1	-1	-3	-4	-1	-3	-3	-1	0	-1	-4	-3	-3	4	1	-1	-4
C	0	-3	-3	-3	9	-3	-4	-3	-3	-1	-1	-3	-1	-2	-3	-1	-1	-2	-2	-1	-3	-3	-2	-4
Q	-1	1	0	0	-3	5	2	-2	0	-3	-2	1	0	-3	-1	0	-1	-2	-1	-2	0	3	-1	-4
E	-1	0	0	2	-4	2	5	-2	0	-3	-3	1	-2	-3	-1	0	-1	-3	-2	-2	1	4	-1	-4
G	0	-2	0	-1	-3	-2	-2	6	-2	-4	-4	-2	-3	-3	-2	0	-2	-2	-3	-3	-1	-2	-1	-4
H	-2	0	1	-1	-3	0	0	-2	8	-3	-3	-1	-2	-1	-2	-1	-2	-2	2	-3	0	0	-1	-4
I	-1	-3	-3	-3	-1	-3	-3	-4	-3	4	2	-3	1	0	-3	-2	-1	-3	-1	3	-3	-3	-1	-4
L	-1	-2	-3	-4	-1	-2	-3	-4	-3	2	4	-2	2	0	-3	-2	-1	-2	-1	1	-4	-3	-1	-4
K	-1	2	0	-1	-3	1	1	-2	-1	-3	-2	5	-1	-3	-1	0	-1	-3	-2	-2	0	1	-1	-4
M	-1	-1	-2	-3	-1	0	-2	-3	-2	1	2	-1	5	0	-2	-1	-1	-1	-1	1	-3	-1	-1	-4
F	-2	-3	-3	-3	-2	-3	-3	-3	-1	0	0	-3	0	6	-4	-2	-2	1	3	-1	-3	-3	-1	-4
P	-1	-2	-2	-1	-3	-1	-1	-2	-2	-3	-3	-1	-2	-4	7	-1	-1	-4	-3	-2	-2	-1	-2	-4
S	1	-1	1	0	-1	0	0	0	-1	-2	-2	0	-1	-2	-1	4	1	-3	-2	-2	0	0	0	-4
T	0	-1	0	-1	-1	-1	-1	-2	-2	-1	-1	-1	-1	-2	-1	1	5	-2	-2	0	-1	-1	0	-4
W	-3	-3	-4	-4	-2	-2	-3	-2	-2	-3	-2	-3	-1	1	-4	-3	-2	11	2	-3	-4	-3	-2	-4
Y	-2	-2	-2	-3	-2	-1	-2	-3	2	-1	-1	-2	-1	3	-3	-2	-2	2	7	-1	-3	-2	-1	-4
V	0	-3	-3	-3	-1	-2	-2	-3	-3	3	1	-2	1	-1	-2	-2	0	-3	-1	4	-3	-2	-1	-4
B	-2	-1	3	4	-3	0	1	-1	0	-3	-4	0	-3	-3	-2	0	-1	-4	-3	-3	4	1	-1	-4
Z	-1	0	0	1	-3	3	4	-2	0	-3	-3	1	-1	-3	-1	0	-1	-3	-2	-2	1	4	-1	-4
X	0	-1	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	0	0	-2	-1	-1	-1	-1	-1	-4
*	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	1

This matrix was created by Henikoff and Henikoff, 1992

Based on local conserved ‚Block‘ regions in protein alignments

Lowest score = -4, Highest score = 11

Penalties

Gap opening penalty:	-5
Gap length penalty	-1
End gap penalty	0

1 base gap:	-5
2 base gap:	-6
3 base gap:	-7

etc.

Alignment score

```
ACGGTAGGGATATACC - TACGAGCTC - - ACAT - - -
||  ||   |        |    ||  |||| |  |||    ||   |
ACCGTCG  - - - - AC - CCGTACGA - CTCTGACGTCCT
```

Matches: +19

Mismatches: 0

Gaps: -25

Gap-length: -4

End gap: 0

Sum: -10

Alignment score

```
ACGGTAGGGATATACCTACGAGCTCACAT
||  || |       |||       |     | |
ACCGTCGACCCGTACGACTCTGACGTCCT
```

Matches: +11

Mismatches: 0

Gaps: 0

Gap-length: 0

End gap: 0

Sum: +11

Needleman and Wunsch

Needleman and Wunsch algorithm:

Stepwise search

Example with identity matrix only (no accounting for gaps and mismatches)
Optimizes number of identities.

Needleman and Wunsch

Recursive formula for the calculation of the best score of an alignment:

$$F_{ij} = \max_{h<i,k<j} \{ F_{h,j-1} + S(A_i, B_j), F_{i-1,k} + S(A_i, B_j) \}$$

Where:
A_i is the sequence symbol in the first sequence at position *i*
B_j is the sequence symbol in the second sequence at position *j*
$S(A_i, B_j)$ is the similarity matrix value comparing symbol A_i with B_j
F_{ij} is the optimal alignment score comparing subsequence A_1 to A_i with the subsequence B_1 to B_j.

Comparison matrix filled with values from similarity matrix

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: 0
Gap extension: 0
End gap: 0

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	1	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	0	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	0	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	0	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	0	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	0	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	0	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	1	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	1	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	0
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	1	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	0	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	0	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	0	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	0	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	0	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	0	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	0	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	1
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	0	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	0	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	0	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	1	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	0	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	1	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	1	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	0	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	0	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	0
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	0	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	1	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	1	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	0	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	0	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	0
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	0	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	0	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	1	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	0	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	1	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	1	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	0	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	0	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	0
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	0	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	0	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	0	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	0	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	1	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	0	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	0	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	0	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	0	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	0
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	0	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	0	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	1	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	1	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	0	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	1	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	1	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	0	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	0	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	0
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	0	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	1	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	0	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	0	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	0	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	0	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	0	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	0	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	1	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	1	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	0
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	1	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	0	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	0	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	0	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	0	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	0	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	0	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	1	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	1	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	0
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	1	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	0	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	1	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	0	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	0	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	0	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	0	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	7	0	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	7	8	0	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	7	8	8	0	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	1
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Start filling the comparison matrix from lower left to upper right by noting in each cell the best possible score of any alignment from lower left to this cell.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

„High road“.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

„Low road“

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

GC
| |
GC

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

GGC
| | |
GGC

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

```
A - GGC
|   | | |
AAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

```
TA-GGC
||  |||
TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
	1													13

```
AATA-GGC
|  ||  |||
A-TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
AAATA-GGC
||  ||  |||
AA-TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
CAAATA-GGC
|||  ||  |||
CAA-TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
GCAAATA-GGC
|||| || |||
GCAA-TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
CGCAAATA-GGC
|||||  ||  |||
CGCAA-TAAGGC
```

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
A - CGCAAATA - GGC
|  | | | | |  | |  | | |
ACCGCAA - TAAGGC
```

This an alignment with exactly 11 matches.

Use backtracking to find the actual alignment.

12	C	0	2	3	3	5	4	5	6	7	8	8	9	11
	G	0	1	2	4	4	4	5	6	7	8	9	10	9
	G	0	1	2	4	3	4	5	6	7	8	9	9	8
	A	1	1	2	3	3	5	6	6	8	8	7	7	7
	T	0	1	2	3	3	4	5	7	6	7	7	7	7
	A	1	1	2	3	3	5	6	6	7	7	6	6	6
	A	1	1	2	3	3	5	6	5	6	6	5	5	5
	A	1	1	2	3	3	5	5	4	5	5	4	4	4
	C	0	2	3	2	4	3	3	3	3	3	3	3	4
	G	0	1	2	3	2	2	2	2	2	2	3	3	2
	C	0	2	2	1	2	1	1	1	1	1	1	1	2
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

```
A-CGCAAAT-AGGC
| |||||  |  ||||
ACCGCAA-TAAGGC
```

Another path results in another alignment. Also with 11 matches.

All 14 different alignments with 11 matches:

```
A-CGCAAAT-AGGC
|  |||||  |  ||||
ACCGCAA-TAAGGC

A-CGCAAATA-GGC
|  |||||  ||  |||
ACCGCAA-TAAGGC

AC-GCAAAT-AGGC
||  ||||  |  ||||
ACCGCAA-TAAGGC

AC-GCAAATA-GGC
||  ||||  ||  |||
ACCGCAA-TAAGGC

AC-GCAA-ATAGGC
||  ||||  |  ||||
ACCGCAATA-AGGC

A-CGCAAAT-AGGC
|  ||||  ||  ||||
ACCGCA-ATAAGGC

A-CGCAAATA-GGC
|  ||||  |||  |||
ACCGCA-ATAAGGC

AC-GCAAAT-AGGC
||  |||  ||  ||||
ACCGCA-ATAAGGC

AC-GCAAATA-GGC
||  |||  |||  |||
ACCGCA-ATAAGGC

A-CGCAA-ATAGGC
|  |||||  |  ||||
ACCGCAATA-AGGC

A-CGCAAAT-AGGC
|  |||  |||  ||||
ACCGC-AATAAGGC

A-CGCAAATA-GGC
|  |||  ||||  |||
ACCGC-AATAAGGC

AC-GCAAAT-AGGC
||  ||  |||  ||||
ACCGC-AATAAGGC

AC-GCAAATA-GGC
||  ||  ||||  |||
ACCGC-AATAAGGC
```

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -3

Gap extension: -1

End gap: 0

The best alignment has 9 matches

12	C	0	1	1	1	2	2	1	1	2	2	3	7	9
	G	0	0	1	1	2	1	1	2	2	3	7	8	4
	G	0	1	0	2	1	1	2	2	2	6	7	3	3
	A	1	0	1	1	1	2	2	2	6	6	2	3	2
	T	0	1	1	1	1	1	2	5	5	2	3	2	2
	A	1	1	1	1	1	2	4	5	2	3	2	2	1
	A	1	1	0	1	1	3	5	1	2	2	2	1	1
	A	1	0	1	1	2	4	1	1	1	2	1	1	2
	C	0	1	1	2	3	0	1	0	1	1	1	2	3
	G	0	0	2	2	0	1	0	1	1	1	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -3
Gap extension: -1
End gap: 0

Backtracing

12	C	0	1	1	1	2	2	1	1	2	2	3	7	9
	G	0	0	1	1	2	1	1	2	2	3	7	8	4
	G	0	1	0	2	1	1	2	2	2	6	7	3	3
	A	1	0	1	1	1	2	2	2	6	6	2	3	2
	T	0	1	1	1	1	1	2	5	5	2	3	2	2
	A	1	1	1	1	1	2	4	5	2	3	2	2	1
	A	1	1	0	1	1	3	5	1	2	2	2	1	1
	A	1	0	1	1	2	4	1	1	1	2	1	1	2
	C	0	1	1	2	3	0	1	0	1	1	1	2	3
	G	0	0	2	2	0	1	0	1	1	1	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Gap opening: -3
Gap extension: -1
End gap: 0

No gaps are introduced because of penalties.

The best alignment with 9 matches:

```
-ACGCAAATAGGC
 |||||   ||||
ACCGCAATAAGGC
```

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	1	0	1	0	0	0	0	0	0	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	0	0	0	0	0	0	1	0	0	0	0	0
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	0	0	0	1	1	0	1	1	0	0	0
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	A	1	0	1	1	1	1.5	3	3.5	6	6	5	4.5	3.5
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1

Gap extension: -0.5

End gap: 0

Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	0	1	0	0	0	0	0	0	1	1	0
	G	0	1	0	2	1	1	1.5	3	4	6	7	6	4.5
	A	1	0	1	1	1	1.5	3	3.5	6	6	5	4.5	3.5
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1
Gap extension: -0.5
End gap: 0
Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	0	1	0	0	0	0	0	0	0	1
	G	0	0	1	1	2	1	1	2	3	5	7	8	6
	G	0	1	0	2	1	1	1.5	3	4	6	7	6	4.5
	A	1	0	1	1	1	1.5	3	3.5	6	6	5	4.5	3.5
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1
Gap extension: -0.5
End gap: 0
Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	1	2	2	1	1	2	4.5	5	7	9
	G	0	0	1	1	2	1	1	2	3	5	7	8	6
	G	0	1	0	2	1	1	1.5	3	4	6	7	6	4.5
	A	1	0	1	1	1	1.5	3	3.5	6	6	5	4.5	3.5
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C
		1												13

Gap opening: -1
Gap extension: -0.5
End gap: 0
Mismatches: 0

Calculation of the best alignment using gap penalties

12	C	0	1	1	1	2	2	1	1	2	4.5	5	7	9
	G	0	0	1	1	2	1	1	2	3	5	7	8	6
	G	0	1	0	2	1	1	1.5	3	4	6	7	6	4.5
	A	1	0	1	1	1	1.5	3	3.5	6	6	5	4.5	3.5
	T	0	1	1	1	0	1	3	5	5	5	4.5	3.5	3
	A	1	1	1	0	1	3	4	5	5	4.5	3	2	1
	A	1	1	0	1	2	3	5	3	3	3	2	1	1
	A	1	0	1	2	2	4	3	1.5	2	2	1	1	2
	C	0	1	2	2	3	1	1	0	1	1	0	2	3
	G	0	0	2	2	0	1	0	1	1	0	2	2	0
	C	0	2	1	0	1	0	1	1	0	1	1	0	1
1	A	1	0	0	0	0	1	1	0	1	1	0	0	0
		A	C	C	G	C	A	A	T	A	A	G	G	C

1 13

Gap opening: -1
Gap extension: -0.5
End gap: 0
Mismatches: 0

The 3 best alignments with 9 or 10 matches (and score=9):

```
-ACGCAAATAGGC
  |||||   ||||
ACCGCAATAAGGC

A-CGCAAATAGGC
|  |||||   ||||
ACCGCAATAAGGC

AC-GCAAATAGGC
||  ||||   ||||
ACCGCAATAAGGC
```

Summary

The Needleman-Wunsch algorithm finds an optimal alignment.

This alignment is not always unique.

Choose the right penalty parameters to reflect the biology of your sequences.

Literature

This algorithm was first published by Saul. B. Needleman and Christian D. Wunsch in 1970, for the comparison of two protein sequences:

A General Method Applicable to the Search for Similarities in the Amino Acid Sequence of Two Proteins

SAUL B. NEEDLEMAN AND CHRISTIAN D. WUNSCH

Department of Biochemistry, Northwestern University, and Nuclear Medicine Service, V. A. Research Hospital Chicago, Ill. 60611, U.S.A.

(*Received 21 July 1969*)

J. Mol. Biol., 48 (1970), pp. 443–453

Links

An extensive explanation of the algorithm can also be found in Wikipedia:

https://de.wikipedia.org/wiki/Needleman-Wunsch-Algorithmus

The EMBOSS sequence analysis package **needle** program does Needleman-Wunsch alignments online:

For protein comparisons:
http://www.ebi.ac.uk/Tools/psa/emboss_needle/
For nucleic acid comparisons:
http://www.ebi.ac.uk/Tools/psa/emboss_needle/nucleotide.html

Exercises

Compare these two protein sequences using the Needleman and Wunsch algorithm. Change the gap open and gap extension penalties.

```
>NP_001315822.1 alcohol dehydrogenase [Malus domestica]
MSNTAGQVIRCRAAVAWEAGKPLVIEEVEVAPPQANEVRIKILFTSLCHTD
VYFWEAKGQNPLFPRIYGH EAGGIVESVGEGVTDLKAGDHVLPVFTGECK
DCAHCKSEESNMCDLLRINTDRGVMLSDGKSRFSIKGKPIYHFVGTSTFSE
YTVVHVGCLAKINPSAPLDKVCLLSCGISTGLGATLNVAKPKKGSTVAVFG
LGAVGLAAAEGARLSGASRIIGVDLHSDRFEEAKKFGVTEFVNPKAHEKPV
QEVIAELTNRGVDRSIECTGSTEAMISAFECVHDGWGVAVLVGVPHKDAVF
KTHPVNFLNERTLKGTFFGNYKTRTDIPSVVEKYMNKELELEKFITHKVPF
SEINKAFEYMLKGEGLRCIIRMEE
>NP_001189342.1| alcohol dehydrogenase [Homo sapiens]
MAASCVLLHTGQKMPLIGLGTWKSEPGQVKAAVKYALSVGYRHIDCAAIYG
NEPEIGEALKEDVGPGKAVPREELFVTSKLWNTKHHPEDVEPALRKTLADL
QLEYLDLYLMHWPYAFERGDNPFPKNADGTICYDSTHYKETWKALEALVAK
GLVQALGLSNFNSRQIDDILSVASVRPAVLQVECHPYLAQNELIAHCQARG
LEVTAYSPLGSSDRAWRDPDEPVLLEEPVVLALAEKYGRSPAQILLRWQVQ
RKVICIPKSITPSRILQNIKVFDFTFSPEEMKQLNALNKNWRYIVPMLTVD
GKRVPRDAGHPLYPFNDPY
```