CENG 465

Introduction to Bioinformatics

Spring '2019-2020

Homework 1

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Submission: via ODTUCLASS

Student Information

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Problem 1

	-	M	I	M	A	G	E	D	I	L
-	0	0	0	0	0	0	0	0	0	0
G	0	0	0	0	0	7	3	0	0	0
A	0	0	0	0	7	3	1	0	0	0
M	0	7	3	7	3	1	0	0	0	0
A	0	3	1	3	14	10	6	2	0	0
E	0	0	0	0	10	8	17	13	9	5
D	0	0	0	0	6	4	13	24	20	16
K	0	0	0	0	2	0	9	20	18	14

Figure 1: Table for Problem 1

$$\text{Match score} = 7$$
$$\text{Mismatch penalty} = -6$$
$$\text{Gap penalty} = -4$$
$$\text{Score of local alignment} = 24$$

If we look at intersection of the second row and the sixth column, namely the intersection of Gs, it became 7 from 0 as a result of a match. Thus, a match score is 7.

If we look at the cell at immediately right of that cell, the intersection of G and E, we see a score of 3. Since G and E does not match, this must be a result of a gap. The score became 3 from 7. Thus, the gap penalty is -4.

If we look at the cell at immediately under the previous cell, the intersection of A and E, we see a score of 1. Since A and E does not match, this must be coming from either a mismatch or a gap. The adjacent cells have the value 3. So, if it would have been a gap, the score should be -1 and as a result 0 because we use local alignment and $0 > -1$. So the score must be coming from a mismatch. The previous cell is a 7 and thus a mismatch penalty is -6.

Since the greatest value of the table is 24, the score of the local alignment is 24.

The best local alignments is:

```
MAGED
MA-ED
```

If we calculate the alignment, there are four matches (4×7) and one gap (-4), resulting in $4 \times 7 - 4 = 24$. Thus, we get the same value as the traceback of cells from the table.

Problem 2

	-	M	C	G	M	G	C	M	E	L
-	0	-4	-8	-12	-16	-20	-24	-28	-32	-36
G	-4	-3	-7	-2	-6	-10	-14	-18	-22	-26
M	-8	1	-3	-6	3	-1	-5	-9	-13	-17
C	-12	-3	10	6	2	0	8	4	0	-4
M	-16	-7	6	7	11	7	4	13	9	5
E	-20	-11	2	4	7	9	5	9	18	14
D	-24	-15	-2	1	3	6	6	5	14	14
L	-28	-19	-6	-3	3	2	5	8	10	18

Figure 2: Table for Problem 2

The best alignment is:

```
MCGMGCME-L
--GM-CMEDL
```

If we calculate the scores in the final alignment, we get four gaps (4×-4) and the scores from the table (GG= 6, MM= 5, CC= 9, MM= 5, EE= 5, LL= 4).

Total score is $6 + 5 + 9 + 5 + 5 + 4 + 4 \times -4 = 18$, which is the same value as the table we created.