

IQB ASSIGNMENT - 1

Q1.

a)

| Dyanammic Programming matrix | | | | | | | | | | |
|------------------------------|----|----|----|----|----|----|----|----|----|----|
| | | A | T | C | A | G | A | G | T | A |
| | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 | -8 | -9 |
| T | -1 | -1 | 1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 |
| T | -2 | -2 | 1 | 0 | -1 | -2 | -3 | -4 | -2 | -3 |
| C | -3 | -3 | 0 | 3 | 2 | 1 | 0 | -1 | -2 | -3 |
| A | -4 | -1 | -1 | 2 | 5 | 4 | 3 | 2 | 1 | 0 |
| G | -5 | -2 | -2 | 1 | 4 | 7 | 6 | 5 | 4 | 3 |
| T | -6 | -3 | 0 | 0 | 3 | 6 | 6 | 5 | 7 | 6 |
| A | -7 | -4 | -1 | -1 | 2 | 5 | 8 | 7 | 6 | 9 |

b)

Yes, there is more than one possibility of optimally aligning the given sequences.

c)

```
Optimal Alignments

Score : 9

ATCAGAGTA
||||  ||
TTCAG--TA

Score : 9

ATCAGAGTA
|||  |||
TTCA--GTA

Score : 9

ATCAGAGTA
||  ||||
TTC--AGTA
```

Q2.

a)

| Dyanammic Programming matrix | | | | | | | | | | |
|------------------------------|---|---|---|---|---|---|---|---|---|----|
| | | A | T | C | A | G | A | G | T | A |
| T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| T | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 1 |
| C | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 1 |
| A | 0 | 0 | 1 | 4 | 3 | 2 | 1 | 0 | 1 | 1 |
| A | 0 | 2 | 1 | 3 | 6 | 5 | 4 | 3 | 2 | 3 |
| G | 0 | 1 | 1 | 2 | 5 | 8 | 7 | 6 | 5 | 4 |
| T | 0 | 0 | 3 | 2 | 4 | 7 | 7 | 6 | 8 | 7 |
| A | 0 | 2 | 2 | 2 | 4 | 6 | 9 | 8 | 7 | 10 |

b)

```
Optimal Alignment

Score : 10

TCAGAGTA
||  |||
TC--AGTA
```

Q3)

Following changes were required in the program to perform local rather global alignment

1. The 0th column and 0th row in DP matrix in global were filled with value = (row number/ column number * gap value) which is negative and since negative values were not allowed in DP matrix in local alignment so we replace those values with 0.
2. The values in a cell in DP matrix of local alignment cannot be negative but in global alignment negative values were allowed so in local alignment the value of a cell was changed to 0 if the best value in that cell would come out to be negative so in the program maximum of all the possible values that could come in that cell and 0 was taken for assigning the best value in that cell in local alignment.
3. In global alignment we start the traceback from the cell in last row and last column while in local alignment we keep a variable for storing the coordinates of the cell in which we get the best score and start the traceback from that cell.
4. In traceback in local alignment we stop as soon as we reach a cell with value 0 while in global alignment, we continue till we reach the (0, 0) cell even we encounter a cell with value less than or equal to 0.
5. In global alignment all the optimal alignments were required to be generated using recursion during traceback but in case of local alignment only the best alignment was required so that alignment was directly traced back from the DP matrix linearly.

Q4)

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//////////////////////////////////// QUESTION 4 //////////////////////////////////////
//////////////////////////////////// GLOBAL ALIGNMENT //////////////////////////////////////

Dyanammic Programming matrix

      A  T  C  A  G  A  G  T  A
    0 -2 -4 -6 -8 -10 -12 -14 -16 -18
T  -2 -1  0 -2 -4 -6 -8 -10 -12 -14
T  -4 -3  1 -1 -3 -5 -7 -9 -8 -10
C  -6 -5 -1  3  1 -1 -3 -5 -7 -9
A  -8 -4 -3  1  5  3  1 -1 -3 -5
G -10 -6 -5 -1  3  7  5  3  1 -1
T -12 -8 -4 -3  1  5  6  4  5  3
A -14 -10 -6 -5 -1  3  7  5  3  7

Optimal Score = 7

Optimal Alignments

Score : 7

ATCAGAGTA
||||  ||
TTCAG--TA

Score : 7

ATCAGAGTA
|||  |||
TTCA--GTA

Score : 7

ATCAGAGTA
||  ||||
TTC--AGTA
```

```
//////////////////////////////////// QUESTION 4 //////////////////////////////////////
//////////////////////////////////// LOCAL ALIGNMENT //////////////////////////////////////

Dyanammic Programming matrix

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

Optimal Score = 8

Optimal Alignment

Score : 8

AGTA
||||
AGTA
```

In case of Global alignment:

The scoring matrix has changed since the gap value has decreased.

Score has decreased from 9 to 7.

The optimal alignments remained the same.

In case of local alignment:

The scoring matrix has changed since the gap value has decreased.

Score has decreased from 10 to 8.

The optimal alignments have changed.

Since the scoring matrix depends on the scoring values so the scoring matrix may change on changing the scoring values. Also, the optimal score and the trace backing of optimal alignments depend on the scoring matrix so as the scoring matrix changes the optimal alignment and the optimal score may or may not change.