# Solutions to Homework 1: Pairwise Sequence Alignment

BCH4300B, Winter 2014
Assigned: March 5, 2014
Due: March 12, 2014

**1.** (i) If you put $X$ = GCGTC along the rows of the dynamic programming table and $Y$ = ACGAC along the columns, then you get the table below. If you did it the other way around, then of course you get the flipped table.

| | | A | C | G | A | C |
|---|---|---|---|---|---|---|
| | 0 ← | -1 ← | -2 ← | -3 ← | -4 ← | -5 |
| | ↑ ↖ | | | ↖ | | |
| G | -1 | -1 ← | -2 | 1 ← | 0 ← | -1 |
| | ↑ | ↑ ↖ | | | ↖ | |
| C | -2 | -2 | 2 ← | 1 ← | 0 | 3 |
| | ↑ ↖ | ↑ | ↑ ↖ | | | |
| G | -3 | -3 | 1 | 5 ← | 4 ← | 3 |
| | ↑ | ↑ | ↑ | ↑ | ↑ ↖ | |
| T | -4 | -4 | 0 | 4 ← | 3 | 3 |
| | ↑ | ↑ ↖ | ↑ | ↑ | ↑ ↖ | |
| C | -5 | -5 | -1 | 3 ← | 2 | 6 |

(ii) The score of the best alignment (found in the lower right hand corner) is 6.

(iii) There tare wo alignments with that same score of 6:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | C | G | – | A | C | | A | C | G | A | – | C |
| \| | \| | \| | \| | \| | \| | | \| | \| | \| | \| | \| | \| |
| G | C | G | T | – | C | | G | C | G | – | T | C |

**2.** (i) Aligning the sequences $X$ = FKHM and $Y$ = FMDT we get the dynamic programming table:

| | | F | M | D | T |
|---|---|---|---|---|---|
| | 0 ← | -1 ← | -2 ← | -3 ← | -4 |
| | ↑ ↖ | | | | |
| F | -1 | 6 ← | 5 ← | 4 ← | 3 |
| | ↑ | ↑ ↖ | ↖ | ↖ | |
| K | -2 | 5 | 5 ← | 4 ← | 3 |
| | ↑ | ↑ | ↑ ↖ | | |
| H | -3 | 4 | 4 | 4 ← | 3 |
| | ↑ | ↑ ↖ | | | |
| M | -4 | 3 | 9 ← | 8 ← | 7 |

(ii) The score of the best alignment is 7.

(iii) Only one possible alignment achieves that score:

| | | | | | |
|---|---|---|---|---|---|
| F | K | H | M | – | – |
| \| | \| | \| | \| | \| | \| |
| F | – | – | M | D | T |