

1.
 - a. The transcription and translation go from left to right for both the top and the bottom strand
 - b. GCAGTTACT**ATG**TATGCGGCATA**ATG**CACCCGACATCCGCGCTG**TGA**GAACCGA**TAGC**
 - c. CGTCA**ATG**ATACATAGCCGTATTACGTGGGCTG**TAG**GGCGCGACACTCTGGCTATCG

(1) ACTCTC

(2) ACTTTGA

	-	A	C	T	T	T	G	A
Q	-1	-2	-3	-4	-5	-6	-7	
A	-1	1	0	-1	-2	-3	-4	-5
C	-2	0	2	1	0	-1	-2	-3
T	-3	-1	1	3	2	1	0	-1
C	-4	-2	0	2	2	1	0	-1
T	-5	-3	-1	1	3	2	1	1
C	-6	-4	-2	0	2	2	2	1

ACTCTC - C
ACTTTG A

~~ACTCTC~~
~~ACTTTG A~~

on

~~ACTCTC~~
~~ACTTTG A~~

~~ACTCTC~~
~~ACTTTG A~~

(a) $\sigma = \text{ACTCTCA}$

$t = \text{ACTGTG} -$

This alignment has the scoring:

$$S(A,A) + S(C,C) + S(T,T) + S(C,G) + S(G,T) + S(C,G) + S(A,-)$$

$$1 + 1 + 1 + 1 + 1 + 1 - 1 - 1$$

= 1
Needleman-Wunsch global algorithm

alignment

~~- ACTCTG~~

M	-	A	C	T	G	T	G
-	C	-1	-2	-3	-4	-5	-6
A	-1	1	0	-1	-2	-3	-4
C	-2	0	2	1	0	-1	-2
T	-3	-1	1	3	2	1	0
C	-4	-2	0	2	2	1	0
T	-5	-3	-1	1	1	3	2
C	-6	-4	-2	0	0	2	1
A	-7	-5	-3	-1	-1	1	①

⇒ The optimal alignment is:

A C F C T C A
 ||| |
 C T G T - G
 A

b) $\sigma = CCAC$

$t = CTCACTAT$

⇒ The best alignment is:

- - C C A C - - -
 C T T C A C A T

Scoring:

$$S(C, C) + S(-, T) + S(C, T) + S(C, C) + S(A, A) + S(C, C) + S(-, A)$$

$$+ S(-, T)$$

$$= -1 - 1 - 1 + 1 + 1 + 1 - 1 - 1$$

$$= -2$$

c) $\sigma = AGCGTT$ ⇒ The best alignment is:

$t = ATTAGTTA$

A G C C G T T
 | | | | | |
 A T T A G T T A

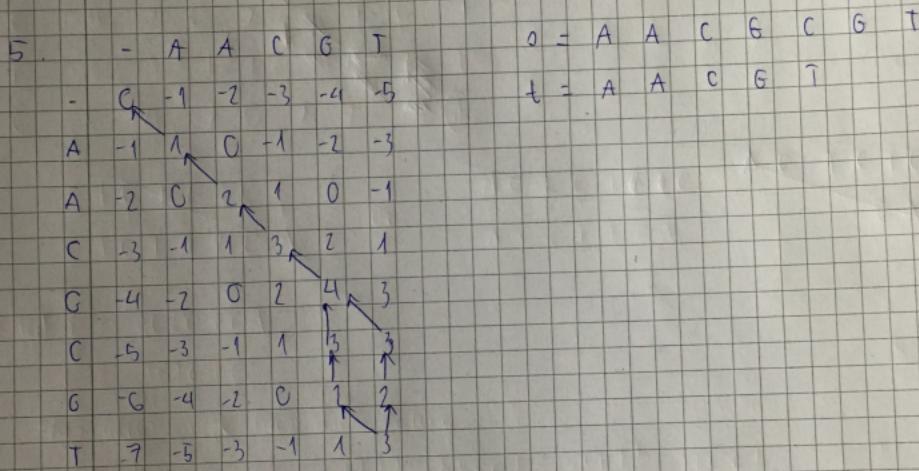
$$S(A, A) + S(C, T) + S(C, T) + S(A, A) + S(G, G) + S(T, T) + S(T, T) + S(A, A)$$

$$= 1 - 1 - 1 - 1 + 1 + 1 + 1 - 1 = 0$$

4. M Q L E A N A P T S V
 | | | | | | | | | |
 L Q E Q A E A Q G E N

Scoring:
 $S(M,L) + S(Q,Q) + S(L,E) + S(E,Q) + S(A,A) + S(N,E) + S(V,N)$
 $+ S(P,Q) + S(T,G) + S(S,E) + S(V,M)$

 $= 2 + 5 + -3 + 2 + 4 + 0 + 4 + -1 - 2$
 $- 0 + 1 = 12$



The two optimal alignment paths are:

$\sigma = A \ A \ C \ G \ C \ G \ T$

$\begin{matrix} A & A & C & G & C & G & T \\ | & | & | & | & | & | & | \\ A & A & C & G & - & T & \end{matrix}$ or $\begin{matrix} A & A & C & G & C & G & T \\ | & | & | & | & | & | & | \\ A & A & C & G & T & - & - \end{matrix}$