INT102 Assignment 2 Submission

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1 Question 1

1.1 1)

A	G	C	T
1	2	5	3

1.2 2)

The process is shown below:

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

The total number of comparisons is 3 (C $\neq$ G) + 1 (T $\neq$ A) + 5 (match found) = 9.

2 Question 2

2.1 1)

The process is shown below, assuming that each iteration goes through the edges in the order from e_1 to e_6.

iteration	a	b	c	d	e
before	(a, 0)	(-, ∞)	(-, ∞)	(-, ∞)	(-, ∞)
1 finish	(a, 0)	(a, 4)	(a, 5)	(-, ∞)	(-, ∞)
2 until e_3	(a, 0)	(a, 4)	(a, 5)	(b, 14)	(-, ∞)
2 until e_4	(a, 0)	(a, 4)	(a, 5)	(b, 14)	(c, -2)
2 finish	(a, 0)	(e, -5)	(a, 5)	(b, 14)	(c, -2)
3 until e_3	(a, 0)	(e, -5)	(a, 5)	(b, 5)	(c, -2)
3 finish	(a, 0)	(e, -5)	(a, 5)	(b, 5)	(c, -2)
4 finish	(a, 0)	(e, -5)	(a, 5)	(b, 5)	(c, -2)
5 finish	(a, 0)	(e, -5)	(a, 5)	(b, 5)	(c, -2)

The shortest path from a to a is {(a,a)}. From a to b is {(a,c), (c,e) (e,b)}. From a to c is {(a,c)}. From a to d is {(a,c), (c,e), (e,b), (b,d)}. From a to e is {(a,c), (c,e)}.

3 Question 3

3.1 1)

The table is shown below:

	-	A	G	C	C	C	T
-	0	0	0	0	0	0	0
G	0	0↑	1↖	1←	1←	1←	1←
A	0	1↖	1↑	1↑	1↑	1↑	1↑
G	0	1↑	2↖	2←	2←	2←	2←
T	0	1↑	2↑	2↑	2↑	2↑	3↖

3.2 2)

According to the table, the longest subsequence is AGT.

4 Question 4

4.1 1)

4.1.1 a)

The table is shown below:

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

4.1.2 b)

According to the table, an optimal global alignments is:

$$\begin{array}{ccccccc} A & G & A & C & C & \_ & T \\ \_ & G & A & \_ & \_ & G & T \end{array}$$

4.2 2)

4.2.1 a)

The table is shown below:

	-	A	G	A	C	C	T
-	0	0	0	0	0	0	0
G	0	0	1↖	0←	0	0	0
A	0	1↖	0←	2↖	1←	0←	0
G	0	0↑	2↖	1←	0←↑	0	0
T	0	0	1↑	0←↑	0	0	1↖

4.2.2 b)

According to the table, an optimal local alignment is: $\begin{array}{cc} G & A \\ G & A \end{array}$

5 Question 5

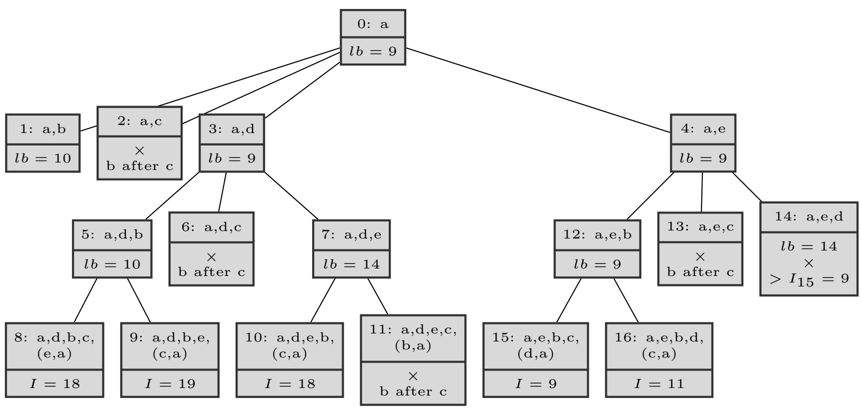
First fill in the matrix:

	a	b	c	d	e
a	0	4	5	2	1
b	4	0	4	3	1
c	5	4	0	1	8
d	2	3	1	0	6
e	1	1	8	6	0

At the beginning, the lower bound is

$$\lceil \frac{1+2}{2} + \frac{1+3}{2} + \frac{1+4}{2} + \frac{1+2}{2} + \frac{1+1}{2} \rceil = 9$$

It is sufficient to only consider tours starting from vertex a. In addition, since it is an undirected graph, a requirement is made that b must be travelled before c, under which it will still be enough to get the correct result. The calculation process is shown below:



According to the process, the optimal tour is: $a \to e \to b \to c \to d \to a$.

6 Question 6

1. Contradicts to the knowledge as NP $\neq$ NPC.
2. Although currently most computer scientists believe that P $\neq$ NP, it is still possible.
3. It is not clear whether NP $=$ P $\cup$ NPC or not.
4. Contradicts to the knowledge. If P $\cap$ NPC $\neq \{\}$, then for some problem $p \in$ NPC, p is solvable in polynomial time. However, as every problem in NP can be polynomially reduced to some problem in NPC, then every problem in it has to be polynomially solvable, which means P $=$ NP, a contradiction.

5. It is possible.

7 Question 7

Yes, I completed the coursework individually.