

COT5405: Programming Assignment 2 (Spring 2015)

For all programming questions, you should generate the corresponding code in any one of the following language (c, c++, Java, Python) that can be executed under the Eustis2 Unix machine. How to log in to this Unix machine in our Computer Science Division is introduced on 2/12 lecture and slides. For code execution result, you should show the *screenshot image* of your SSH client window containing the code printout in your report.

Submission: (1). Answering report document; (2). Corresponding program source codes (and explanation words on how they can be run on eustis2 machine).

1. **(RNA Secondary Structure)** Given the following RNA molecule

B = **AUGGCUACCGGUCGAUUGAGCGCCAAUGUAAUCAUU**

find a secondary structure S that maximizes the number of base pairs.

- (1). Show the value of the number of base pairs for the above molecule derived from the algorithm explained in '06dynamic-programming.ppt' slides.
- (2). Show (or draw by hand) the RNA secondary structure graph, in the similar way as the graph on Page 31 of slides '06dynamic-programming.ppt'.

2. **(Sequence Alignment):** Consider the following two strings:

AGGCTATCACCTGACCTCCAGCCGATGCC

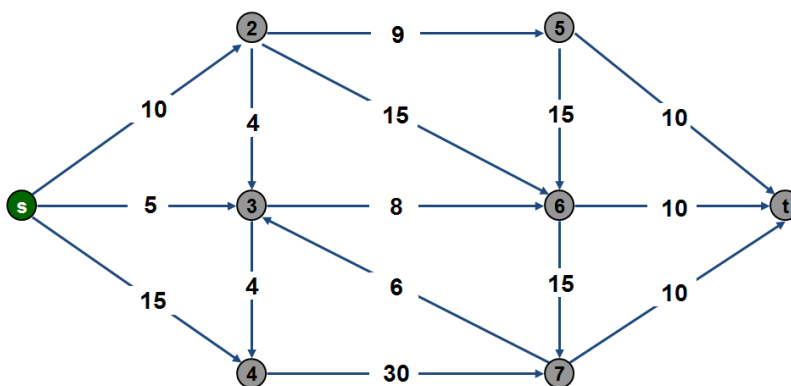
TAGCTATCACGACCGCGGTCGATTTGCCGAC

For alignment, assume that each 'mismatch' penalty is $\alpha=2$, each 'gap' penalty is $\delta=1$. Please find the alignment with minimum penalty cost. Please refer to Page 40-45 in lecture slides '06dynamic-programming.ppt' to solve this problem.

- (1). Show the final penalty cost of the alignment you have found.
- (2). Show the alignment of these two strings, in the similar format as the alignment example on Page 42 of the lecture slides.

Hint: Remember that you can know which alignment of the symbol x_i and y_j takes by checking which equation has been used on Page 44's equation set of the lecture slides.

3. **(Max Flow: Ford–Fulkerson algorithm):** For the following directed graph (link capacity values are shown on the graph).



- (1). What is the maximum flow value from the source node s to the target node t?
- (2). Show the flow values on each link on this directed graph for the maximum flow scenario.