CSC 106 Assignment 3: I think I can visualize that graph -- but can I play with it?

Due: Oct 31, 2012 at 11:55 pm

Marks: **35 marks.**

Learning Goals:
At the end of this assignment you will be able to:

- Determine the least cost path through an undirected graph
- Use Fitch's Algorithm to create the most parsimonious tree given a DNA sequence.

Submission: This assignment is to be done individually. The submitted assignment can be either a .doc, .docx, .pdf, .rft, or .pages file. It should be attached to the CSC106 Assignment 3 submission page on Connex.

A few reminders:

-- Please make sure that you include the Task number/section you are answering above your response. This makes it easier for your marker to stay with the flow of your answers.

-- Make sure that your file is attached before you click the final submission button on Assignment 3 in Connex. There is a bug in the Connex submission attachment, so you only get one chance to submit you work. Make sure it is all there before you press the final submit.

Resources:

Travelling Salesman Problem: A great story behind one of the first NP Complete competitions: **The Proctor and Gamble 1962 Travelling Salesman Problem**.(This is a long download, but very well written - I think you'll enjoy it. Good discussion about NP-complete problems.)

Fitch's Algorithm: Your notes from Dr. Stege's lecture, Lab notes from the week of Feb 6th.

TASK 1: Travelling Salesman (please ... "person") (15 marks)

In this task you explore the classic Travelling Salesman Problem (TSP). This problem belongs to the class of NP-complete problems that Dr. Stege spoke of on Monday and Thursday (Feb 6 and 9).

Assume we have a undirected graph defined as follows:

G= (V, E)

V={1, 2, 3, 4, 5, 6}

E={(1, 2), (1, 3), (1, 6), (2, 3), (2,6), (2,5), (2, 4), (3, 4), (4, 5), (5, 6)}

1) **(3 Marks).** Draw the graph, labelling each vertex (node) with its number. Do your best to make it an easy to read graph (e.g. don't have lines crossing one another).

2) **(2 Marks)**. Now, assume that each of the edges have the following lengths (you could also consider these lengths to be a weighting of each edge):

(1, 2) length 2

(1, 3) length 2

(1, 6) length 3

(2, 3) length 1

(2,6) length 1

(2,5) length 3

(2, 4) length 1

(3, 4) length 4

(4, 5) length 2

(5, 6) length 2

Re-draw your graph below, this time including the length (weight) of each edge.

3). **(5 marks)** Now, imagine that each of the vertices (nodes) is a city. Further imagine that a travelling salesperson needs to visit all of these cities on her sales route. If the length of each edge in the graph represents kilometers, what is the shortest possible route (or tour) that the salesperson would need to travel such that she visits each city exactly once and returns to her starting point? Enter the distance below.
Minimum : _____

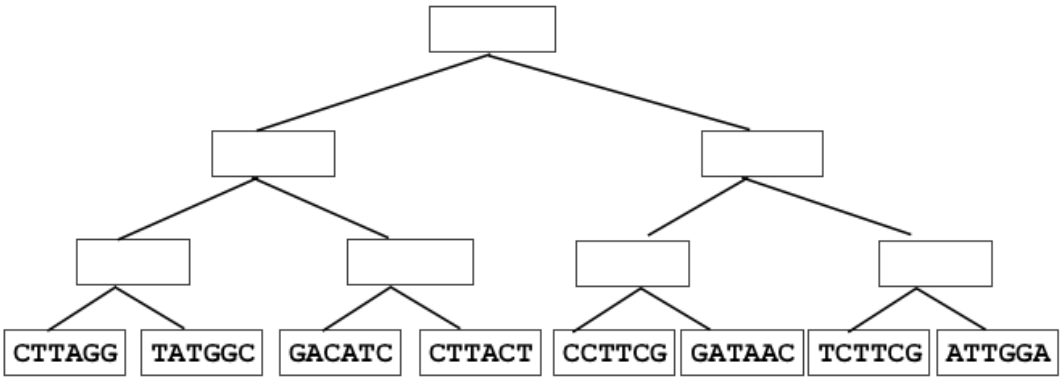
Draw the graph again, this time highlighting the route you selected. Use a different colour for the line, or use a thicker line -- anything to clearly indicate the route.

4). **(5 marks)** In point form describe how you went about solving the TSP.

TASK 1 DELIVERABLES:
Using the same word processed document as you created for Task 1 make a new Task 2 heading. This task will have three graph diagrams, the answer to the shortest route, and your point form description of how you solved the problem. **(This Task is worth 15 marks).**

TASK 2: Fitch and his Algorithm (15 marks)

Use Fitch's Algorithm to find the most parsimonious tree given the following DNA sequence and tree structure.



Present your answer in two trees:
1). **(5 marks)** One containing the result of the post order traversal
2). **(5 marks)** One containing the result of the pre order traversal with the tree's final labelling.

3). What is the parsimony score of the final tree? Show the parsimony value at each level of the tree.

TASK 2 DELIVERABLES:

Two trees, the second of which contains the final labelling for the tree and has an indication of the parsimony values at each level of the tree. A total parsimony score for the entire tree is also included below the tree diagrams.

OVERALL ASSESSMENT (5 Marks):
Five marks are set aside for overall assessment. 4 to 5 marks are given for outstanding work. The assessment proceeds as follows:

5 marks given for an outstanding assignment - original thought, outstanding organization, well demonstrated analysis and synthesis capabilities, excellent grasp of subject matter with sound critical evaluations throughout.

4 marks given for strong evidence of original thinking; excellent organization; capacity to analyze and synthesize; superior grasp of subject matter with sound critical evaluations. All other material in the assignment is correctly completed in an exemplary manner.

1-3 marks given for evidence of grasp of subject matter, some evidence of critical capacity and analytic ability; reasonable understanding of relevant issues; evidence of familiarity with the concepts. All other material in the assignment is correctly completed.