

Quiz for CS/BioE 598AGB

Do three of the following four problems (each should take no more than 5 minutes).

1. Sketch the proof for why UPGMA is not statistically consistent under the Jukes-Cantor model.
2. Describe a polynomial time and statistically consistent method for estimating a species tree from a collection of rooted gene trees, under the assumption that the rooted gene trees are drawn from the distribution defined by the multi-species coalescent model. Sketch the proof for why your algorithm is statistically consistent.
3. Give a polynomial time and statistically consistent method for estimating an unrooted gene tree from a collection of sequences that evolve down the gene tree under the Jukes-Cantor model of sequence evolution. Sketch the proof for why your algorithm is statistically consistent.
4. Give a polynomial time dynamic programming (DP) algorithm to figure out which player has a winning strategy for the following two person game. The starting position is two piles of rocks, where at least one pile has at least one rock. The player that makes both piles empty by removing one or more rocks wins. When it is a player's turn, they have three options – they can remove two rocks off one pile, one rock off each of two piles, or one rock off one pile. Your DP algorithm should let us know who has a winning strategy – player 1 or player 2 – as a function of the number of rocks on each pile.