CSE 206B: Final Exam

Notes

There are 2 questions. Email your solutions to the instructors by Tuesday evening. You may not discuss the problems with anyone other than the instructors, but are otherwise free to use any resource. Disclose all sources you have consulted.

Problems

1. Look up the paper *Jaillon et al., Nature 431, 2004, 946–*, on whole genome duplication in *Tetraodon*. In Figures 9 and 10, the authors describe a model for the ancestral karyotype based on pairing of human and (duplicated) Tetraodon chromosomes.

   (a) Explain the reasoning used by the authors to reconstruct the ancestral karyotype, and how they came up with ten major rearrangements that led to the present day tetraodon genome. If you feel that unsufficient reasoning has been provided, describe in your own terms, how such analysis could be done. (Note: you can make use of supplementary data, including Figure S12). Alternatively, criticize the authors' reasoning by providing alternative scenarios.

   (b) Describe a high level algorithm for automating this analyses.

   Your solution should be around 2 pages.

2. Let π_1 and π_2 be two permutations on elements $\{1, \ldots, n\}$. A set of elements from $\{1, \ldots, n\}$ is called a (π_1, π_2)-increasing subsequence, if it can be written as

$$\sigma_1 \cup \sigma_2$$

   where σ_1 and σ_2 are increasing subsequences of π_1 and π_2 correspondingly.

   As an example, $1, 2, 3, 4$ and $5, 6, 7$ are increasing subsequences of $\pi_1 = 81526374$ and $\pi_2 = 85162734$ forming a (π_1, π_2)-increasing subsequence $1, 2, 3, 4, 5, 6, 7$ consisting of 7 elements. Finding longest (π_1, π_2)-increasing subsequence is a difficult problem that cannot be reduced to combining the longest increasing subsequences in π_1 and π_2. For example, $\sigma = 1234$ is the longest increasing subsequence in both π_1 and π_2. Choosing $\sigma_1 = \sigma_2 = \sigma$ results in a (π_1, π_2)-increasing subsequence of length 4 that is not the longest (π_1, π_2)-increasing subsequence. Given permutations π_1 and π_2, devise an efficient algorithm to compute a longest π_1, π_2-increasing subsequence.