

Advanced Algorithmic Techniques for Bioinformatics

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Exercise sheet no. 1 - 24 Oct. 2007

1. In an undirected graph G on n vertices (i.e., $|V| = n$), how many edges are there at most? At least? (Hint: A directed graph has at most n^2 edges.)
2. Show that a tree on n vertices has $n - 1$ edges.
3. Enumerate all rooted and all unrooted phylogenetic trees on 1, 2, 3, 4 vertices. (Hint: Check that their numbers agree with the theorem from the lecture.)
4. Given the following ultrametric matrix M , compute the (unique) ultrametric tree that corresponds to M using the algorithm UPGMA. Write down each step separately, with the new matrix and the current tree.

	a	b	c	d	e
a	0	8	8	12	8
b		0	2	12	4
c			0	12	4
d				0	12
e					0