

1. The (edit) distance matrix  $\delta$  for 5 sequences,  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$  is shown below. Perform UPGMA to find a hierarchical clustering relating these sequences.

$\delta$	$a$	$b$	$c$	$d$	$e$
$a$	0	4	6	5	5
$b$		0	3	5	4
$c$			0	2	1
$d$				0	3
$e$					0

2. Use the resulting tree (including branch lengths) to find the *induced* metric  $\delta'$  on this dataset. It should also be in the form of a pair-wise distance matrix.