Math and Medicine: Homework Assignment 2
Due on Sept 8

1. Draw the UPGMA tree for the alternative data

	den	lc1	lc5	ptb	ptc	ptd
den	0	71	38	25	16	45
lc1	71	0	95	58	73	85
lc5	38	95	0	30	44	37
ptb	25	58	30	0	21	43
ptc	16	73	44	21	0	44
ptd	45	85	37	43	44	0

   Would the interpretation differ from the case we studied in class?

2. People often approximate the number of genetic changes between individuals with the **Poisson distribution**. With this distribution, we observe k differences with probability

$$\Pr(k|\Lambda) = \frac{\Lambda^k e^{-\Lambda}}{k!}$$

   where Λ is the unknown parameter.

   a. Suppose $k = 10$. Find the likelihood function, the log likelihood (or support) as functions of Λ, and the maximum likelihood estimator of Λ.

   b. Suppose we have the same data as in class, where D is the dentist, P is the patient, and C is the control.

Sample 1	Sample 2	Number of differences
D	P	$k_{DP} = 15$
D	C	$k_{DC} = 38$
P	C	$k_{BC} = 39$

   Assume that the number of differences follows a Poisson distribution, and find the likelihood functions for the three possible phylogenetic trees (the idea is that there will be two values of Λ, one for the pair that is the closest, and one for the other two pairs that are far apart). Find the maximum likelihood in each case. Is the pairing of D with P is the best supported model?