**Lab 4 – Amit Upadhyay**

**Questions Part I**

Q1: What is the probability (in %) that amino acid K (Lys) will be replaced by amino acid T (Ths) after 1 PAM evolutionary interval?

Ans 0.08%

Q2: Is it the same as probability of T being replaced by K after 1 PAM evolutionary interval? If not what is the probability of T being replaced by K?

Ans. 0.11%

Q3: What does “9867” in the top left corner of the matrix stand for in plain English?

It is the probability of A being unchanged and is given by

(Num of occurrences of A- Num of changes) /(Num of occurrences)

It also reflects the evolutionary distance. Since this is a PAM 1 matrix, the diagonal values are very close to 1.

**PART II**

Q1: What is the probability (in %) that amino acid K (Lys) will be replaced by amino acid T (Thr) after 10 PAM evolutionary intervals?

0.0085 i.e.0.85%

Q2: What is the probability (in %) that amino acid K (Lys) will be replaced by amino acid T (Ths) after 250 PAM evolutionary intervals?

0.0631 ie 6.31%

Q3: Which one of these two events is more probable?

10 PAM represents evolutionary distance of 10 substitution per 100 residues as against 250 substitutions per 100 residues in case of 250 PAM and hence 10 PAM would be more probable.

**Part III**

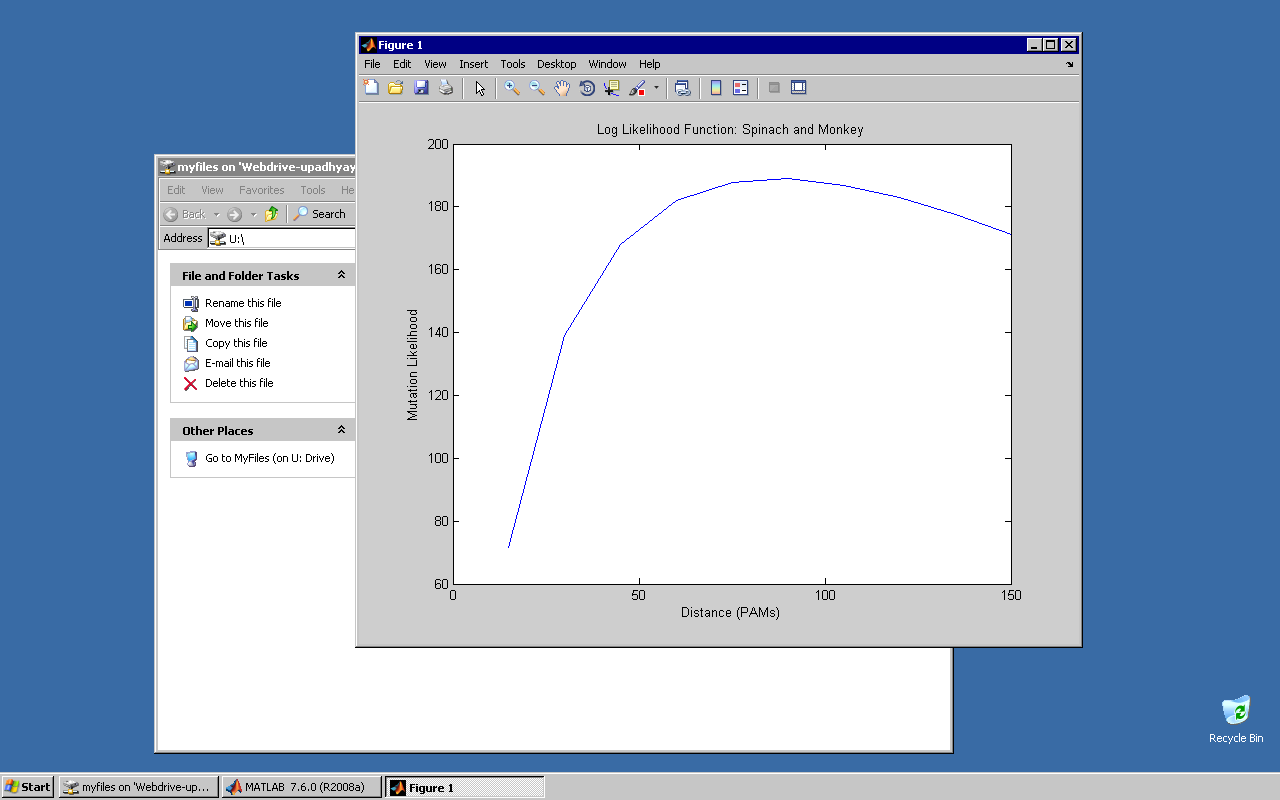
Q1. Making changes to Step 1 of the above code only, find the MLE for the following two sequences:

Spinach: NGTKESITKLVSDLNSATLEADVDVVVAPPFVYIDQVKSSLTGRVEISAQNCW   
Monkey: NGRKQNLGELIGTLNAAKVPADTEVVCAPPTAYIDFARQKLDPKIAVAAQNCY

Print out (or copy) the “Mutation Likelihood” Chart. Locate on the chart maximum score and corresponding MLE PAM-distance. State exact values for both.

MLE\_Score = 189.0052

MLE\_PAM\_Distance = 87



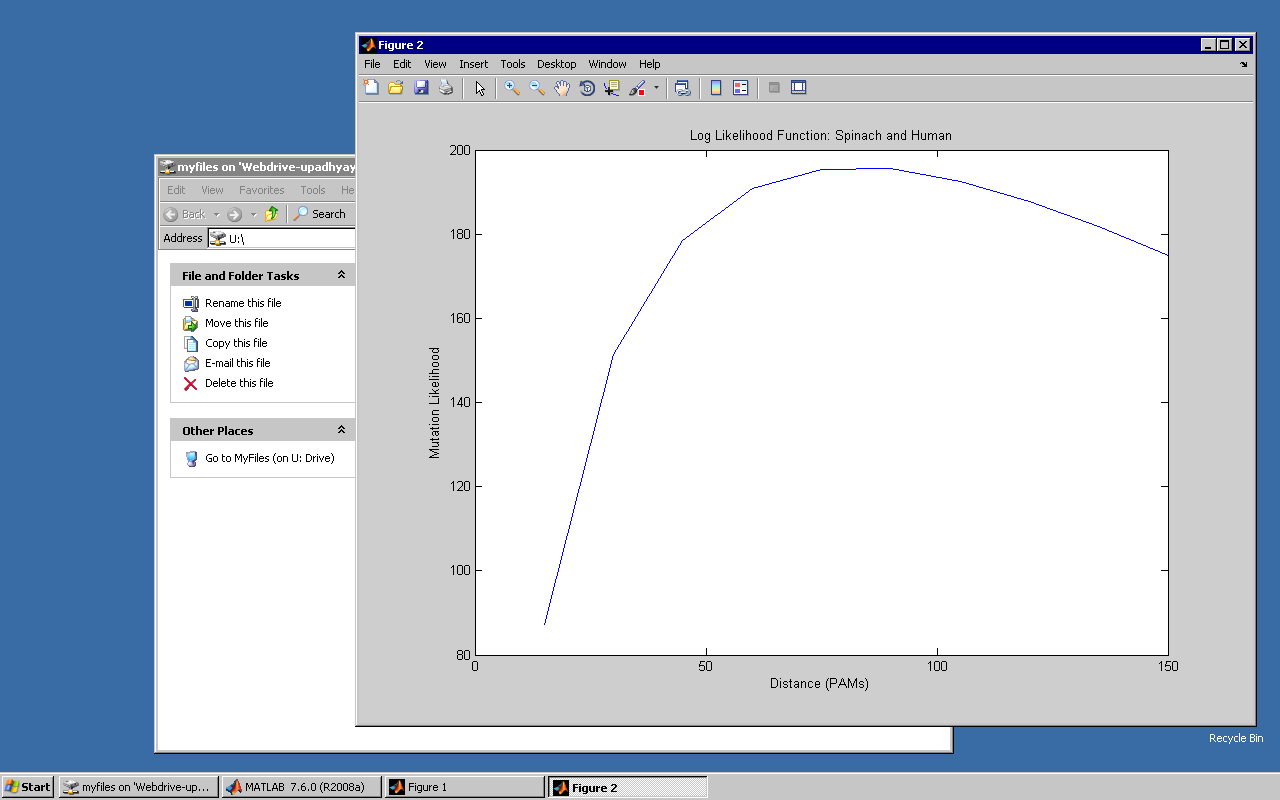
Q2. Making changes to Step 1 of the above code only, find the MLE for the following two sequences:

Spinach: NGTKESITKLVSDLNSATLEADVDVVVAPPFVYIDQVKSSLTGRVEISAQNCW   
Human: NGRKQSLGELIGTLNAAKVPADTEVVCAPPTAYIDFARQKLDPKIAVAAQNCY

Print out (or copy) the “Mutation Likelihood” Chart. Locate on the chart maximum score and corresponding MLE PAM-distance. State exact values for both.

MLE\_Score = 195.9259

MLE\_PAM\_Distance = 82



Q3. According to the results, which two sequences are evolutionary closer to each other: spinach and monkey, or spinach and human?

Spinach and Human are closer.