Cornerstone of Engineering
Spring 2020
Northeastern University
College of Engineering
Programming Lab 6
Due: December 2, 2020

Programming Homework (need m-files)

1. **Amino Acids**

The amino acids in proteins contain molecules of oxygen (O), carbon (C), nitrogen (N), sulfur (S), and hydrogen (H), as shown in the table below. The molecular weights for oxygen, carbon, nitrogen, sulfur, and hydrogen are

Oxygen	15.9994
Carbon	12.011
Nitrogen	14.00674
Sulfur	32.066
Hydrogen	1.00794

Amino Acid	O	C	N	S	H
Alanine	2	3	1	0	7
Arginine	2	6	4	0	15
Asparagine	3	4	2	0	8
Aspartic	4	4	1	0	6
Cysteine	2	3	1	1	7
Glutamic	4	5	1	0	8
Glutamine	3	5	2	0	10
Glycine	2	2	1	0	5
Histidine	2	6	3	0	10
Isoleucine	2	6	1	0	13
Leucine	2	6	1	0	13
Lysine	2	6	2	0	15
Methionine	2	5	1	1	11
Phenylanlanine	2	9	1	0	11
Proline	2	5	1	0	10
Serine	3	3	1	0	7
Threonine	3	4	1	0	9
Tryptophan	2	11	2	0	11
Tyrosin	3	9	1	0	11
Valine	2	5	1	0	11

a) Write a program in which the user enters the number of oxygen atoms, carbon atoms, nitrogen atoms, sulfur atoms, and hydrogen atoms in an amino acid. Compute and print the corresponding molecular weight. Use a dot product to compute the molecular weight.

b) Write a program that computes the molecular weight of each amino acid in the table, assuming that the numeric information in this table in contained in a data file named elements.dat. Generate a new data file named weights.dat that contains the molecular weights of the amino acids. Use matrix multiplication to compute the molecular weights.

2. **Mesh and Contour Plots**

Consider the following function $f(r) = \frac{c}{r}$ where c is a constant. For c = 50

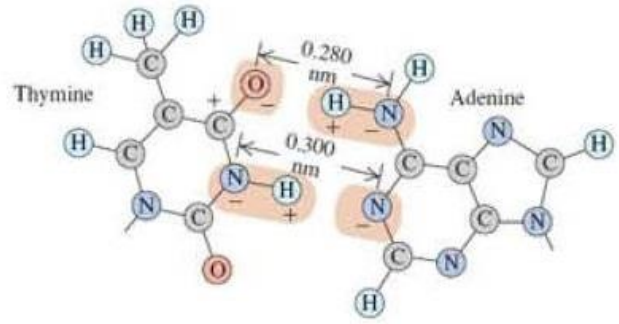
a) Plot $f(r)$ in a 3D mesh plot in the x-y plane with the domain $0.05 \le r \le 0.5$ and $0 \le \theta \le 360$.

b) Plot contours of constant $f(r)$ values.

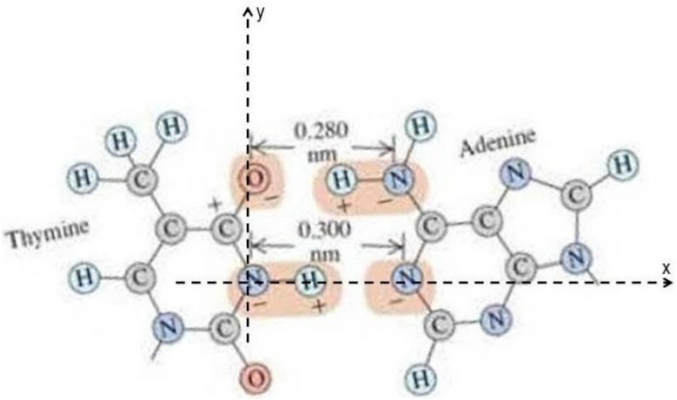
c) Repeat parts a and b, for c = -50

3. **Electric Potential of the DNA**

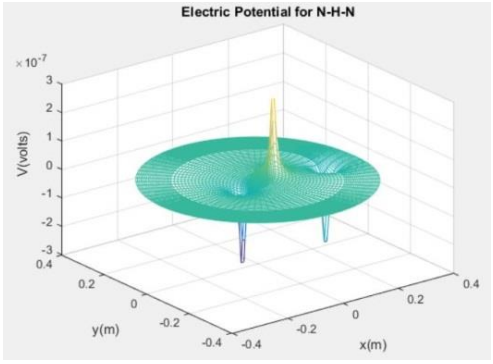
The two sides of the DNA double helix are cone connected by pairs of bases (adenine, thymine, cytosine and guanine). Because of the geometric shape of these molecules, adenine bonds with thymine and cytosine bonds guanine. The figure shows the thymine-adenine bond. Each charge shown is $\pm e = \pm 1.6\times10^{-16}$ C and the H – N distance is 0.11 nm.



(a) Map the electric potential in 3D of the adenine-thymine bond. To keep the calculation simple, yet reasonable consider only the electric potential due to O - H – N or the N - H – N combination, assuming these two combinations are parallel to each other. Use the following reoriented diagram (see below)



Sample Plot:



(b) Map the electric potential in 3D of the adenine-thymine bond due to O - H – N and the N - H – N combination.

To Turn In via Blackboard:

1. Word file with Cover page, outputs, answers to any questions, and Results and Discussion
2. Source code e-file (upload to the blackboard, the source code should be saved as phw61_xxx.m, phw62_xxx.m, …etc., where xxx is your initial)