Homework 2

Due: 2:00pm Feb. 11th, 2016

Each problem is worth 10 points.

Exercise 1 [Multivariate Newton]: Let the vector-valued function $\boldsymbol{f}$ be defined as

$$\boldsymbol{f}(x,y) = \begin{bmatrix} \cos x + \sin y \\ \sin x + \cos y \end{bmatrix}.$$

By hand, calculate one step of Newton's method using the initial point $(x_0, y_0) = (1, 1)$. Do you think Newton's method will converge? Why?

Exercise 2 [Optimization]: Let the function f be given as

$$f(x,y,z) = x \cdot \cos(x - 0.5) \cdot \sin^2 y + z^2.$$

Write out Newton's method for the optimization problem

$$\max_{(x,y,z)\in[0,2]^3} f(x,y,z)$$

Write a Matlab code to find the local maximum value of f nearest to the point $(1, 1, 1)$. Turn in your code, as well as a print-out of the solution you obtained.

Exercise 3 [IEEE floating point]: Write each of the following numbers in binary, octal, and hexadecimal. In order to receive full credit, you must show your work.

- 4268
- 3.65
- $\frac{1}{3}$

Which of the above numbers can be written exactly in IEEE double precision floating-point format?

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Exercise 4: In the 1991 Gulf War, the Patriot missile defense system failed due to roundoff error. The troubles stemmed from a computer that performed the tracking calculations with an internal clock whose integer values in tenths of a second were converted to seconds by multiplying by a 24-bit binary approximation to one tenth:

$$(0.1)_{10} \approx (0.00011001100110011001100)_2$$

1. Convert $(0.00011001100110011001100)_2$ to a fraction. Call it x.
2. What is the absolute error in this number? That is, what is the absolute value of the difference between $1/10$ and x?
3. What is the time error in seconds after 100 hours of operations? (I.e., the value of $|360,000 - 3,600,000x|$.)
4. During the 1991 war, a Scud missile traveled at approximately Mach 5 (3750 mph). Find the distance that a Scud missile would travel during the time error computed in the last part.

On Feb. 25, 1991, a Patriot battery system, which was to protect the Dhahran Air Base, had been operating for over 100 consecutive hours. The roundoff error caused the system not to track an incoming Scud missile, which slipped through the defense system and detonated on US Army barracks.