Boğaziçi University
Department of Physics

Phys 496/68N — Fall 2011

Problem Set 3

Due on November 11th, 2011

Problem 1

Write a code that solves a set of linear equations read from an input file. The solution should be performed in a function with the following prototype:

```
int le(double **A, double *b, int N);
```

Where A and b contains the coefficients as described in the classroom. The answer should be returned by b array on successful operation. The function should return 0 indicating successful solution, and it should return -1 if it encounters with a singular system.

i) Create an input file reflecting the following set of equations, and show your output:

$$\begin{array}{rcrcrcrcr} & & x_2 & - & 2x_3 & - & x_4 & = & 12 \\ 5x_1 & + & 3x_2 & - & x_3 & + & 2x_4 & = & 1 \\ x_1 & + & 2x_2 & + & 2x_3 & + & 5x_4 & = & 10 \\ 3x_1 & + & x_2 & - & 3x_3 & + & x_4 & = & 5 \end{array}$$

ii) Create an input file reflecting the following set of equations, and show your output:

$$\begin{array}{rcrcrcr} x_1 & + & x_2 & - & 3x_3 & = & 12 \\ 5x_1 & + & 3x_2 & - & x_3 & = & 2 \\ 3x_1 & + & 2x_2 & - & 2x_3 & = & 7 \end{array}$$

Problem 2

Modify your `le` function such that it evaluates inverse of a given matrix. Call your new function `inv`. Use the following prototype:

```
int inv(double **A, int N);
```

The inverse of the matrix should be returned by A. Write a code to use this function. Read the coefficients from a file. Show that it works for the following matrix:

$$M = \begin{pmatrix} 3 & 2 & 3 & -1 & 0 \\ 2 & -5 & 2 & -1 & -1 \\ -1 & -2 & -2 & 3 & 1 \\ 2 & -5 & 5 & 3 & 2 \\ -3 & -4 & -5 & -3 & 3 \end{pmatrix}$$

Flip the page for more...

Problem 3 – [*Optional for Phys 496 - mandatory for Phys 68N students*]
Consider the following function (same as given in Problem Set 1)

$$f(x) = x\,\sin(10\,x) + 2\,x^3\,\ln(x+4)\,.$$

Evaluate

$$\int_{-1}^{1} f(x)\,dx$$

using Gauss–Legendre quadrature for $N = 16, 32, 48, 64, 96$ points. Compare your results with the results found in Problem Set 1.

Problem 4 – [*Optional for Phys 496 - mandatory for Phys 68N students*]
Consider a disk of radius $R = 1$ m with a charge density $\sigma = \alpha r$, where $\alpha = 1\ \mathrm{nC/m^3}$ is a constant, as shown in the figure. Find the potential at point P located at $x = 3$ m using multi dimensional numerical integration with Gauss–Legendre quadrature with about 10,000 points in total.