EE360 Project and Assignment Problems

1. **PROJECT-1:** Familiarization with Kile and do the following:
    a. Find the maximum number in an array of integers (program must be written in both Embedded C and Assembly)
    b. Reverse the entered string. Fine tune the program w.r.t. size of the string (from a small fix size to a large size). Program may be developed in Embedded C or Assembly.
    c. Check if given number is a palindrome. e.g. 0xFAAF; Program should be developed in Assembly.

2. **PROJECT-2:** Write a program in Embedded C to determine the following:
    a. Multiplication of the matrix A x B where dimensions of matrix A and matrix B are **m x n** and **n x p,** respectively. In this program you need to optimize the program for optimal use of processor-memory bandwidth. Also, there are various ways such as i-j-k or j-k-i or block-multiplication schemes to multiply two matrices. You need to figure out the best method (we trust your choice!) for an underlying embedded hardware and write a program to achieve the best possible performance. It is to be noted that the performance depends on the scheme chosen for multiplication and optimizing program for processor-memory bandwidth. Generate a comparison chart (in the form of a graph) to study performance of matrix multiplication on embedded processor and generic processor for various matrix sizes (you can choose).
    b. In the second step, if a matrix structure, ABCDE, is given in which dimensions of matrices A, B, C, D and E are **m x n, n x p, p x q, q x r** and **r x s,** respectively, find the best possible scheme for multiplying this structure for the optimized performance. To achieve this, it is suggested to apply dynamic programming method to find a suitable pattern to minimize total number of computations in this series multiplication of matrices. While achieving the optimum performance, it is strongly advised to use multiplication code developed in (a) to be used in (b). This will also validate your matrix multiplication program for performance. Generate a comparison chart (in the form of a graph) to study performance of matrix multiplication on the embedded processor and generic processor for this system of matrices for various matrix sizes (you can choose).
    NOTE: This should also be demonstrable using an embedded processor kit shared with you.

3. **PROJECT-3:** Write a program in Embedded C to find the inverse of a matrix. The inverse of a matrix is to be achieved using Gaussian Elimination method as compared to standard methods. You can use the method discussed in the class for the same. (Hint: $\mathbf{AA}^{-1} = \mathbf{I}$; Apply elementary row operations on **A** on LHS to convert it to an Identity matrix.

Each row operation being applied on **A** will also be applied to **I,** given on RHS. In this process, after $\mathbf{O(n^3)}$ steps, where **n** is the order of matrix, **A** will be converted to an Identity matrix **I** and the Identity matrix on RHS, **I** will be formulated to $\mathbf{A^{-1}}$). It is to be noted that the performance depends on the correct ways to optimize processor-memory bandwidth while writing and implementing the program on the given hardware. Generate a comparison chart (in the form of a graph) to study performance of matrix inversion on the embedded processor and generic processor for various matrix sizes (you can choose).
NOTE: This should also be demonstrable using an embedded processor kit shared with you.

4. **ASSIGNMENT:** You can choose any one of the given problem and submit it as an assignment to EE360 TAs by **07 May 2018 till 05:00PM.**
    a. For a given PN junction diode, solve Poisson's equation for a given doping concentration. In order to achieve this, entire PN junction may be divided into a set of fixed size rectangular meshes. For each of the mesh point, one has to solve Poisson's equation using neighbouring nodes' information and boundary conditions. This solution will lead to generate an I-V characteristic of a PN junction diode numerically. This is the objective to meet in this problem. For different doping profiles, you have to generate different I-V characteristics to showcase comparison.
    NOTE: This should also be demonstrable using an embedded processor kit shared with you.

    b. For a given image, using the given Embedded Processor Hardware, it is expected to detect edges of different objects. There are many methods to achieve the same, you are advised to use Sobel Edge Detector. On the other hand, enthusiastic people may choose other known methods for the implementation of edge detection algorithm on the given hardware.
    NOTE: This should also be demonstrable using an embedded processor kit shared with you.

<u>NOTE:</u> If someone impresses the course instructors by doing state-of-the-art implementation of the given problems on the hardware provided, he/she may be considered for grade jump.