COE 205 Computer Organization & Assembly Language – Fall 2005

Assignment 6: Procedures and Matrices

Professor: Muhamed Mudawar

Due Date: Monday, December 19, 2005

Write an assembly language program to perform the following:

1. (2 pts) Read an $n \times n$ matrix of **signed 16-bit integers** where each element occupies a word in memory.
2. (3 pts) Compute and display the row index and the column index of the maximum element in the matrix **A**. The first element in the matrix starts at row index 0 and column index 0.
3. (3 pts) Compute and display the transpose **B** of the matrix **A**. The transpose is obtained by copying rows to columns (or columns to rows). Each row of the matrix becomes a column in the transpose and each column becomes a row.
4. (5 pts) Compute and display the multiplication of matrix **A** with itself: **A** × **A**.

   You will need many procedures to solve this assignment. One procedure reads a signed integer in ASCII format from the keyboard and converts it into binary format. A second procedure reads the complete matrix. A third procedure displays a signed integer, and a fourth one displays a complete matrix. A fifth one computes the location of the maximum element. A sixth one computes the transpose, and a seventh one computes the multiplication of two square matrices. Parameters should be passed on the stack either by value or by reference depending on need.

   A sample run should be as follows:

```
Enter size of square matrix (between 2 and 9): 4
Enter 4 x 4 matrix of signed integers:
-13   4   0  -1
 21   0  -1   0
  0  -5   1   7
 50   0  10  -2
```

   Input characters should be filtered, so that only the character digits '**0**' to '**9**', the minus character '**–**' and the space character are allowed. All other characters will not be accepted nor echoed on the screen. When read, a signed integer can have optional spaces at the beginning, which are simply echoed on the screen, an optional minus followed by one or more decimal digits, and terminated with a space character. The space character is used to mark the end of the number. After reading an entire row, the carriage return and line feed control characters should be automatically inserted, so that input can proceed automatically on the next line.

   After reading the input, the program should produce the following outputs:

```
Index of maximum element: [3,0]
Transpose of matrix:
    -13     21      0     50
      4      0     -5      0
      0     -1      1     10
     -1      0      7     -2
```

```
Multiplication of matrix with itself:
    203    -52    -14     15
   -273     89     -1    -28
    245     -5     76     -7
   -750    150    -10     24
```

Documentation and Grading

Make sure to document your code and make it as readable as possible. 3 points will go to documentation and readability, and 4 points will go to coding and writing of procedures. Write your name, your id, the date, the objective, the input, and the output at the beginning of each program. Add documentation also at the beginning of each procedure and throughout your code.

Submitting Programming Assignments

- **All submissions should be made through WebCT on the due date by 11 pm.** Submit the source and executable files.
- **Late programming assignments will be accepted, but 10% of the grade will be deducted for each late day for a maximum of 5 late days**. Assignments submitted after 5 late days will NOT be graded.
- **A program can be submitted ONCE. Multiple submissions are NOT allowed.** So, make sure to test your program fully using many inputs before submitting it. A small programming error might cost you a lot in program correctness. If your program is not running properly, then consider fixing it and submitting it late by one day losing only 10% of the grade rather than submitting it incorrectly and loosing more points on correctness.
- **Cheating on programming assignments will NOT be tolerated.** All detected cheating cases will receive zeros, including those students who made the effort and wrote the program. So, make sure that you do NOT give a copy of your program to your friends, because then you might loose your mark.