

CS 218

Homework, MIPS Asst. #3

Purpose: Become familiar with the MIPS Instruction Set, and the MIPS function calling convention, and indexing for multiple dimension arrays.
Due: Wednesday (7/06)
Points: 75

Assignment:

Write a simple assembly language function to check if a two-dimensional array is a *magic square*¹. The provided main calls the following functions as follows:

- Write a void function, ***chkMagicSqr(arr, order)***, that will check an (*n* by *n*) two-dimensional array to see if it is a magic square. In recreational mathematics, a magic square of order *n* is an arrangement of n^2 numbers, usually integers, in a square stored as a two-dimensional array, such that the *n* numbers in all rows, all columns, and both diagonals sum to the same value. A normal magic square contains the integers from 1 to n^2 .

For example:

2	7	6	→15
9	5	1	→15
4	3	8	→15
↙15	↓15	↓15	↘15

This function must call the ***prtMsg()*** function to display the sums (each row, each column, and each diagonal).

- Write a void function, ***prtMsg(str, num, sum)***, to display the row, column, or diagonal message, the row/col/diagonal number, and sum. Refer to the example execution for output formatting.
- Write a void function, ***prtSquare(arr, order)***, to display an (*n* by *n*) two-dimensional matrix. The numbers should be printed in a two-dimensional format (see example output). All numbers must be right justified (i.e., lined up on right side).

Array Implementation:

At the machine level, multi-dimension arrays are implemented as a large single dimension array. The formula for calculating two-dimensional array indexing is:

$$\text{addr}(\text{row}, \text{col}) = \text{base_address} + (\text{rowindex} * \text{col_size} + \text{colindex}) * \text{element_size}$$

You must use the formula to access matrix elements. **No score** will be provided for submissions that do not use this formula.

¹ For more information, refer to: https://en.wikipedia.org/wiki/Magic_square

Submission:

When complete, submit:

- A copy of the **source file** via the class web page by class time.
Assignments received after the start time of class will not be accepted.

Example Output:

The following is the example output for the first data set:

```
MIPS Assignment #3
Program to check a Magic Square.

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Possible Magic Square #1

  2    7    6
  9    5    1
  4    3    8

Row #0 Sum: 15
Row #1 Sum: 15
Row #2 Sum: 15
Col #0 Sum: 15
Col #1 Sum: 15
Col #2 Sum: 15
Diag #1 Sum: 15
Diag #2 Sum: 15

IS a Magic Square.

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[ ... output truncated for space ... ]

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Possible Magic Square #3

 16    3    2   13
  5   10   11    8
  9    5    7   12
  4   15   14    1

Row #0 Sum: 34
Row #1 Sum: 34
Row #2 Sum: 33
Row #3 Sum: 34
Col #0 Sum: 34
Col #1 Sum: 33
Col #2 Sum: 34
Col #3 Sum: 34
Diag #1 Sum: 34
Diag #2 Sum: 33

NOT a Magic Square.

[ ... output truncated for space ... ]
```

Note, not all data sets not shown.