CS 202 – Assignment #4

Purpose: Learn class inheritance, dynamic allocation, pointers, and make utility.
Points: 100

Assignment:

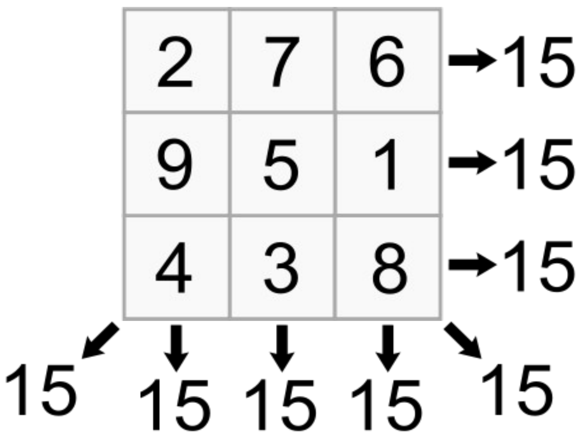
WHY ARE YOU COMING TO ME NOW?
BECAUSE THE HOMEWORK IS DUE NOW.
I MEAN, WHY DID YOU WAIT UNTIL NOW TO GET HELP??
BECAUSE I JUST STARTED WORKING ON IT.
WHY DIDN'T YOU START WORKING ON IT EARLIER?
LIKE, THIS MORNING?
NO, I MEAN DAYS AGO!
BECAUSE I NEEDED YOUR HELP!
SO WHY DIDN'T YOU COME SOONER?
JORGE CHAM ©2013
BECAUSE IT WASN'T DUE UNTIL NOW! AREN'T T.A.'S SUPPOSED TO BE SMART?
AAAAH!!!
WWW.PHDCOMICS.COM

In recreational mathematics, a Magic Square[1] is an arrangement of numbers (usually integers) in a square grid, where the numbers in each row, and in each column, and the numbers in the forward and backward main diagonals, all add up to the same number. A magic square has the same number of rows as it has columns, typically referred to as the *order*. A magic square that contains the integers from 1 to $\boldsymbol{n}^2$ is called a normal magic square.

Design and implement two C++ classes to provide a normal Magic Square creation program. The classes we will implement are as follows:

- **Board Class**
  - Implement a generic board class that can be used for any type of square application. Such applications include chess, checkers, bingo, and Sudoku. This class may be used in future assignments. The class will dynamically create a square two dimensional array based on the passed order. Functions will get and set various board locations and include error checking of the indexes based on the current board order.

- **Magic Square Class**
  - Implement a class that uses the board class and creates normal magic squares based on the specified order. A magic square is-a board (square) with special rules and added functionality. The algorithms for creating normal magic squares are provided. Understanding the algorithm is more challenging that coding.



For all implementation code, points will be deducted for poor or especially inefficient solutions.

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

Development and Testing

In order to simplify development and testing, the project is split into two (2) main parts; board class and magic square class.

- The board class must be developed and fully operational before attempting the magic square class. The board class can be developed and tested independently of the other class. An independent main, *brdMain*, that uses and tests only the board class is provided and it can be built independently using the provided main file (see next section).
- The magic square class uses the board class and will implement the normal magic square algorithms based on the order (odd, singly even, or doubly even). It is suggested to to develop and test one algorithm at a time. For example, develop and test the even algorithm before attempting the other algorithms. The example output can help in checking the intermediate results.
    - The provided main, *magicSqr*, will perform a series of tests on the magic square object. If some command line arguments are provided, it just create a normal magic square of the specified order. For example;

      ```
      ./magicSqr -o 5
      ```

      will create and display a magic square of order 5. If no command line arguments are provided, it will execute a series of predefined tests (including invalid values).

Make File:

The provided make file assumes the source file names include (*brdMain.cpp*, *boardType.h*, *boardTypeImp.cpp*, *magicSqr.cpp*, *magicSquareType.h*, *magicSquareImp.cpp*). To build the provided main for board testing;

```
make brdMain
```

And to build the provided main for the magic square class;

```
make
```

Which will create the *brdMain* (for *boardType* Class) or the *magicSqr* executable.

Submission:

- It is **strongly** suggested that you submit each part of the program for testing as they are developed. For example, when the board class is completed, it can be submitted which will allow testing of that portion of the project. This will ensure it is fully working before moving on to the next part.
    - If you find any issues, they can be corrected and resubmitted for testing and unlimited number of times (before the due date/time).
- All files must compile and execute on Ubuntu and compiler with C++11.
- Submit source files
    - *Note*, do ***not*** submit the provided mains (we have them).
- Once you submit, the system will score the project and provide feedback.
    - If you do not get full score, you can (and should) correct and resubmit.
    - You can re-submit an unlimited number of times before the due date/time.
- Late submissions will be accepted for a period of 24 hours after the due date/time for any given lab. Late submissions will be subject to a ~2% reduction in points per an hour late. If you submit 1 minute - 1 hour late -2%, 1-2 hours late -4%, … , 23-24 hours late -50%. This means after 24 hours late submissions will receive an automatic 0.

Program Header Block
All program and header files must include your name, section number, assignment, NSHE number, input and output summary. The required format is as follows:

```
/*
Name: MY_NAME, NSHE, CLASS-SECTION, ASSIGNMENT
Description: <per assignment>
Input: <per assignment>
Output: <per assignment>
*/
```

Failure to include your name in this format will result in a loss of up to 5%.

Code Quality Checks
A C++ linter[2] is used to perform some basic checks on code quality. These checks include, but are not limited to, the following:

- Unnecessary 'else' statements should not be used.
- Identifier naming style should be either camelCase or snake_case (consistently chosen).
- Named constants should be used in place of literals.
- Correct indentation should be used.
- Redundant return/continue statements should not be used.
- Selection conditions should be in the simplest form possible.
- Function prototypes should be free of top level *const*.

Not all of these items will apply to every program. Failure to to address these guidelines will result in a loss of up to 5%.

Scoring Rubric
Scoring will include functionality, code quality, and documentation. Below is a summary of the scoring rubric for this assignment.

Criteria	Weight	Summary
Compilation	-	Failure to compile will result in a score of 0.
Program Header	5%	Must include header block in the required format (see above).
General Comments	10%	Must include an appropriate level of program documentation.
Line Length	5%	No lines should exceed more than eighty (80) characters.
Code Quality	5%	Must meet some basic code quality checks (see above)
Program Functionality		Program must meet the functional requirements as outlined in the assignment. Must be submitted on time for full score.
• Board Type	30%	
• Magic Square	45%	

2 For more information, refer to: https://en.wikipedia.org/wiki/Lint_(software)

<u>Board Class</u>
Create a board class, *boardType*, to provide basic square board functionality.

boardType
`#size: int`
`#**board: int`
`-BRD_SIZE_MIN=3: static constexpr int`
`-BRD_SIZE_MAX=30: static constexpr int`
`+boardType(int)`
`+~boardType()`
`+setCell(int, int, int): void`
`+getCell(int, int) const: int`
`+getOrder() const: int`
`+printGrid() const: void`

Your implementation and header files should be fully commented. This class may be used on a future assignment.

<u>Function Descriptions</u>
The following are more detailed descriptions of the required functions.

- The constructor *boardType(int)* should verify the passed size (between SIZE_MIN and SIZE_MAX, inclusive). If the size is valid, an integer two-dimensional array, *size* x *size*, should be dynamically created and all values set to 0. If the size is invalid, a message should be displayed (e.g., "Error, invalid board size." and "No board created.") and the *board* class variable set to NULL and the *bSize* set to 0. Refer to the example executions for output formatting.
- The destructor *~boardType()* should delete the dynamically allocated memory (if any). The destructor is called automatically when the object goes out of scope.
- The *getCell(int, int)* function should return the cell contents at the passed row and column location (in that order). The passed row and column must be validated to ensure invalid locations in the array are not accessed. If an invalid location is passed, an error message should be displayed (e.g., "Error, invalid board location.") and a 0 returned.
- The *setCell(int, int, int)* function should set the cell contents at the passed row and column location. The arguments are row, column, and value (in that order). The passed row and column must be validated to ensure invalid locations in the array are not accessed. If an invalid location is passed, an error message should be displayed (e.g., "Error, invalid board location.") and the current value left as is.
- The *getOrder()* function should return the board size.
- The *printGrid()* function should print the grid in a formatted manner (with each value in a small text box). An empty grid should not print anything. Refer to the example executions for output formatting.

Use the provided main, *bMain.cpp*, to demonstrate that the *boardType* class functions correctly. The main and provided makefile reference files *bMain,.cpp*, *boardTypeImp.cpp* and *boardType.h*. Your implementation and header files should be fully commented.

Magic Square Class

A magic square will require an ***n*x*n*** board so the *magicSquareType* class will inherit the basic grid functionality from the *boardType* class. Create a *magicSquareType* class to provide magic square creation functionality.

magicSquareType
`-title: string`
`+magicSquareType(int, string)`
`+createMagicSquare(): void`
`+printMagicSquare() const: void`
`+readMagicSquare(): void`
`+validateMagicSquare() const: bool`
`+clearMagicSquare(): void`
`+magicNumber() const: int`
`+getTitle() const: string`
`+setTitle(string): void`

Function Descriptions

The following are more detailed descriptions of the required functions.

- The *magicSquareType(int)* constructor should set the title and use the base class constructor to allow the base class to create the grid.
- The *magicNumber()* function should return the magic number or sum based on the board size or order. The magic number or sum for a normal magic square is computed as follows:

$$\boldsymbol{magicNumber = n\left(\frac{n^2+1}{2}\right)}$$

- The *validateMagicSquare()* function should validate a magic square by ensuring the sum of each column, each row, and each of the two main diagonals sum to the magic number.
- The *getTitle()* function should return the current title value.
- The *setTitle(string)* function should set the title to the passed value.
- The *clearMagicSqaure()* function should reset each cell entry to 0 and clear the title string.
- The *readMagicSquare()* function should prompt the user for a title (ensuring it is not empty). The title may be multiple words. Then read integers, one row at a time (based on the board size for the current object).
- The *printMagicSquare()* function should display some header information ("CS 202 – Magic Squares", the title, order, and magic number. The headers should be displayed in bold when printed to the screen. The function should use the base class print function (and thus not repeat the same code). Refer to the example executions for output formatting.
- The *createMagicSquare()* should create a magic square based on the current order using one of the provided algorithms.

Expected Output

This section provides some additional information regarding the expected formatting.

The formatted board includes an *order* x *order* boxed board. The first line (|) should be 3 spaces from the edge. Each box should be line (|), 5 characters, and then line (|). The value should be right justified with one space after the value and the right line (|). The spaces preceding the value will depend on the size of the value. With a maximum order of 30, all values will be at most three (3) digits. Each row should have a top and bottom consisting of three (3) spaces, then order number of groups of one space and five (5) dashes. Refer to the example below.

```
ed-vm% ./magicSqr -o 5

************************************************************

CS 202 - Magic Squares
  Title: Test
  Magic Square, order: 5
  Magic Number: 65
    _____ _____ _____ _____ _____
   |     |     |     |     |     |
   |  17 |  24 |   1 |   8 |  15 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  23 |   5 |   7 |  14 |  16 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |   4 |   6 |  13 |  20 |  22 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  10 |  12 |  19 |  21 |   3 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  11 |  18 |  25 |   2 |   9 |
   |_____|_____|_____|_____|_____|


Valid Magic Square.

ed-vm%
```

The magic square print function uses the base class as described above with some additional headers. The colored text is performed by the provided main. The headers use some boding which can be done as follows;

```
const char* bold = "\033[1m";
const char* unbold = "\033[0m";

cout << bold << "CS 202 - Magic Squares" << endl;
cout << " Title: " << title << endl;
cout << " Magic Square, order: " << bSize << endl;
cout << " Magic Number: " << magicNumber() << unbold << endl;
```

The read magic square function prompting is done as follows;

```
cout << "Enter " << bSize << "x" <<bSize << " Magic Square."
                        << endl << endl;
cout << endl << "Enter Magic Square Values (" << bSize << "x"
                        << bSize << ")" << endl;
```

<u>Magic Square Creation Algorithms:</u>
There are different algorithms for creating magic squares based on the given order.

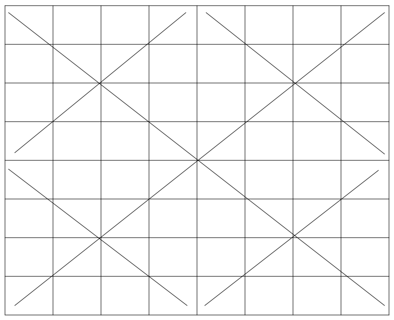
- **Odd Order → odd order (i.e., 3, 5, 7, …)**
  - Siamese method.
  - Reference: http://en.wikipedia.org/wiki/Siamese_method

  - Algorithm for constructing an ***n*x*n*** odd ordered Magic Square:
    - First, place a 1 in the middle of the top row.
    - After placing an integer, *k*, move up one row and one column to the right to place the next integer, *k*+1, unless the following occurs:
      - If a move takes you above the top row in the j^{th} column, move to the bottom of the j^{th} column and place the integer there.
      - If a move takes you outside to the right of the square in the ith row, place the integer in the i^{th} row at the left side.
      - If a move takes you to an already filled square or if you move out of the square at the upper right hand corner, place *k*+1 immediately below *k*.

    Starting from the central column of the first row with the number 1, the fundamental movement for filling the squares is diagonally up and right, one step at a time. If a filled square is encountered, one moves vertically down one square instead, then continuing as before. When a move would leave the square, it is wrapped around to the last row or first column, respectively.

- **Doubly Even Order → multiple of 4 (i.e., 4, 8, 12, 16, …).**
  - Diagonals Method
  - Reference: http://www.math.wichita.edu/~richardson/mathematics/magic%20squares/order4nmagicsquares.html

  - Algorithm for creating an ***n*x*n*** doubly even ordered Magic Square:
    - Mark all diagonals in each 4x4 sub-grid of the overall grid. For example:



- Start in the upper left corner and enter the numbers from 1 to n^2, unless the number falls on a cell marked as a diagonal. Cells marked as diagonals should be skipped, however the number count should increase anyway. For example:

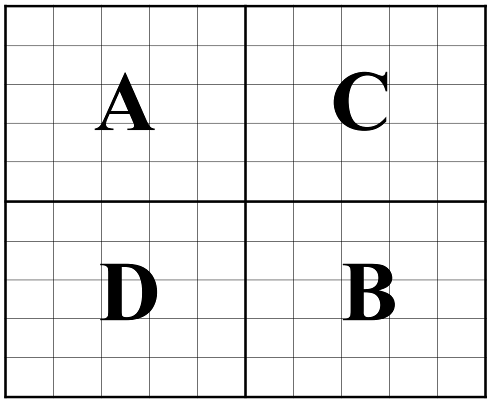
	2	3			6	7	
9			12	13			16
17			20	21			24
	26	27			30	31	
	34	35			38	39	
41			44	45			48
49			52	53			56
	58	59			62	63	

- Then, begin at the lower right corner and work back starting from 1 placing the number only in the cells marked as diagonals.

64	2	3	61	60	6	7	57
9	55	54	12	13	51	50	16
17	47	46	20	21	43	42	24
40	26	27	37	36	30	31	33
32	34	35	29	28	38	39	25
41	23	22	44	45	19	18	48
49	15	14	52	53	11	10	56
8	58	59	5	4	62	63	1

- **Singly Even Order → multiple of 2, but not 4 (i.e., 6, 10, 14, 18, …).**
  - Strachey Method
  - Reference: http://en.wikipedia.org/wiki/Strachey_method_for_magic_squares
  - Reference: http://www.math.wichita.edu/~richardson/mathematics/magic%20squares/even-ordermagicsquares.html

  - Algorithm for creating an ***n***x***n*** singly even ordered Magic Square:
    - Divide the grid into 4 sub-grids, designated **A**, **B**, **C**, **D**. Each grid will be of board size divide by 2 (integer division). For example:



    - Using the Siamese method, complete the individual magics squares **A**, **B**, **C**, and **D** (which are of odd order). Sub-grid **A** is filled starting from 1 (to 25 in this example). Sub-grid **B** starts numbering where **A** left off (26 in this example).

Sub-grid **C** starts numbering where **B** left off (51 in this example). Sub-grid **D** starts numbering where **C** left off (76 in this example). Thus, the numbers are 1 to $\boldsymbol{n}^2$.

17	24	1	8	15	67	74	51	58	65
23	5	7	14	16	73	55	57	64	66
4	6	13	20	22	54	56	63	70	72
10	12	19	21	3	60	62	69	71	53
11	18	23	2	9	61	68	75	52	59
92	99	76	83	90	42	49	26	33	40
98	80	82	89	91	48	30	32	39	41
79	81	88	95	97	29	31	38	45	47
85	87	94	96	78	35	37	44	46	28
86	93	100	77	84	36	43	50	27	34

- Calculate ***nCols*** based on the size of the sub-grid divided by 2 (integer division). In this example, that is 5/2 which is 2. Exchange the leftmost ***nCols*** in sub-grid **A** with the corresponding columns in sub-grid **D**. For example, the exchanged values are highlighted.

92	**99**	1	8	15	67	74	51	58	65
98	**80**	7	14	16	73	55	57	64	66
79	**81**	13	20	22	54	56	63	70	72
85	**87**	19	21	3	60	62	69	71	53
86	**93**	23	2	9	61	68	75	52	59
17	**24**	76	83	90	42	49	26	33	40
23	**5**	82	89	91	48	30	32	39	41
4	**6**	88	95	97	29	31	38	45	47
10	**12**	94	96	78	35	37	44	46	28
11	**18**	100	77	84	36	43	50	27	34

- Exchange the rightmost (***nCols-1***) in sub-grid **A** with the corresponding columns in sub-grid **D**. From the previous set that would be 2-1 which is 1. If (***nCols-1***) is 0, this step can be skipped. For example, the exchanged values are highlighted.

92	99	1	8	15	67	74	51	58	**40**
98	80	7	14	16	73	55	57	64	**41**
79	81	13	20	22	54	56	63	70	**47**
85	87	19	21	3	60	62	69	71	**28**
86	93	23	2	9	61	68	75	52	**34**
17	24	76	83	90	42	49	26	33	**65**
23	5	82	89	91	48	30	32	39	**66**
4	6	88	95	97	29	31	38	45	**72**
10	12	94	96	78	35	37	44	46	**53**
11	18	100	77	84	36	43	50	27	**59**

- Exchange the middle cell of the leftmost column of sub-grid **A** with the corresponding middle cell of sub-grid **D**. Exchange the center cell of the sub-grid **A** with the corresponding center cell of sub-grid **D**.

92	99	1	8	15	67	74	51	58	40
98	80	7	14	16	73	55	57	64	41
4	81	**88**	20	22	54	56	63	70	47
85	87	19	21	3	60	62	69	71	28
86	93	23	2	9	61	68	75	52	34
17	24	76	83	90	42	49	26	33	65
23	5	82	89	91	48	30	32	39	66
79	6	**13**	95	97	29	31	38	45	72
10	12	94	96	78	35	37	44	46	53
11	18	100	77	84	36	43	50	27	59

You may refer to the provided references for further explanation and some additional examples. All routines must be written efficiently. A point reduction will be applied for poor or especially inefficient solutions.

Some test files will be provided. Additionally, you may create your own. Refer to the example executions for output formatting. Make sure your program includes the appropriate documentation.

<u>Example Executions:</u>
Below is an example output for the provided board main:

```
ed-vm% ./brdMain

*** Error Testing ************************************************************
 5 Declaration errors...

Error, invalid board size.
No board created.
Error, invalid board size.
No board created.
Error, invalid board size.
No board created.
Error, invalid board size.
No board created.
Error, invalid board size.
No board created.

*** Error Testing ************************************************************
 4 invalid board locations...

Error, invalid board location.
Error, invalid board location.
Error, invalid board location.
Error, invalid board location.

Output badBrd3 (should be empty):



*** Board #0 ************************************************************
 3 x 3 -> All zero's

    _____ _____ _____
   |     |     |     |
   |   0 |   0 |   0 |
   |_____|_____|_____|
   |     |     |     |
   |   0 |   0 |   0 |
   |_____|_____|_____|
   |     |     |     |
   |   0 |   0 |   0 |
   |_____|_____|_____|


*** Board #1 ************************************************************
 11 x 11 -> numbered

    _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |     |     |     |     |     |
   |   1 |   2 |   3 |   4 |   5 |   6 |   7 |   8 |   9 |  10 |  11 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  12 |  13 |  14 |  15 |  16 |  17 |  18 |  19 |  20 |  21 |  22 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  23 |  24 |  25 |  26 |  27 |  28 |  29 |  30 |  31 |  32 |  33 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  34 |  35 |  36 |  37 |  38 |  39 |  40 |  41 |  42 |  43 |  44 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  45 |  46 |  47 |  48 |  49 |  50 |  51 |  52 |  53 |  54 |  55 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  56 |  57 |  58 |  59 |  60 |  61 |  62 |  63 |  64 |  65 |  66 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  67 |  68 |  69 |  70 |  71 |  72 |  73 |  74 |  75 |  76 |  77 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  78 |  79 |  80 |  81 |  82 |  83 |  84 |  85 |  86 |  87 |  88 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  89 |  90 |  91 |  92 |  93 |  94 |  95 |  96 |  97 |  98 |  99 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|


*** Board #2 ************************************************************
 12 x 12 -> 1's in main diagonals, 0's otherwise.
 5 bad board location accesses...

Error, invalid board location.
Error, invalid board location.
Error, invalid board location.
Error, invalid board location.
Error, invalid board location.
    _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   1 |   0 |   0 |   0 |   0 |   1 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   0 |   1 |   0 |   0 |   1 |   0 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   0 |   0 |   1 |   1 |   0 |   0 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   0 |   0 |   1 |   1 |   0 |   0 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   0 |   1 |   0 |   0 |   1 |   0 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   0 |   1 |   0 |   0 |   0 |   0 |   1 |   0 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   0 |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |   0 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   0 |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |   0 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |     |
   |   1 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   0 |   1 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|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ed-vm%
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Below is an example output for the provided main (magicSqr):

```
ed-vm% ./magicSqr

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CS 202 - Magic Squares
  Title: Test, Order 3
  Magic Square, order: 3
  Magic Number: 15

    _____ _____ _____
   |     |     |     |
   |   8 |   1 |   6 |
   |_____|_____|_____|
   |     |     |     |
   |   3 |   5 |   7 |
   |_____|_____|_____|
   |     |     |     |
   |   4 |   9 |   2 |
   |_____|_____|_____|

Valid Magic Square.


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CS 202 - Magic Squares
  Title: Test, Order 4
  Magic Square, order: 4
  Magic Number: 34
    _____ _____ _____ _____
   |     |     |     |     |
   |  16 |   2 |   3 |  13 |
   |_____|_____|_____|_____|
   |     |     |     |     |
   |   5 |  11 |  10 |   8 |
   |_____|_____|_____|_____|
   |     |     |     |     |
   |   9 |   7 |   6 |  12 |
   |_____|_____|_____|_____|
   |     |     |     |     |
   |   4 |  14 |  15 |   1 |
   |_____|_____|_____|_____|

Valid Magic Square.


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CS 202 - Magic Squares
  Title: Test, Order 5
  Magic Square, order: 5
  Magic Number: 65
    _____ _____ _____ _____ _____
   |     |     |     |     |     |
   |  17 |  24 |   1 |   8 |  15 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  23 |   5 |   7 |  14 |  16 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |   4 |   6 |  13 |  20 |  22 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  10 |  12 |  19 |  21 |   3 |
   |_____|_____|_____|_____|_____|
   |     |     |     |     |     |
   |  11 |  18 |  25 |   2 |   9 |
   |_____|_____|_____|_____|_____|

Valid Magic Square.


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CS 202 - Magic Squares
  Title: Test, Order 6
  Magic Square, order: 6
  Magic Number: 111
    _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |
   |  35 |   1 |   6 |  26 |  19 |  24 |
   |_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |
   |   3 |  32 |   7 |  21 |  23 |  25 |
   |_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |
   |  31 |   9 |   2 |  22 |  27 |  20 |
   |_____|_____|_____|_____|_____|_____|
   |      |      |      |      |      |      |
   |   8  |  28  |  33  |  17  |  10  |  15  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |  30  |   5  |  34  |  12  |  14  |  16  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |   4  |  36  |  29  |  13  |  18  |  11  |
   |______|______|______|______|______|______|

Valid Magic Square.

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CS 202 - Magic Squares
  Title: Test, Order 8
  Magic Square, order: 8
  Magic Number: 260

    ______ ______ ______ ______ ______ ______ ______ ______
   |      |      |      |      |      |      |      |      |
   |  64  |   2  |   3  |  61  |  60  |   6  |   7  |  57  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |   9  |  55  |  54  |  12  |  13  |  51  |  50  |  16  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  17  |  47  |  46  |  20  |  21  |  43  |  42  |  24  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  40  |  26  |  27  |  37  |  36  |  30  |  31  |  33  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  32  |  34  |  35  |  29  |  28  |  38  |  39  |  25  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  41  |  23  |  22  |  44  |  45  |  19  |  18  |  48  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  49  |  15  |  14  |  52  |  53  |  11  |  10  |  56  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |   8  |  58  |  59  |   5  |   4  |  62  |  63  |   1  |
   |______|______|______|______|______|______|______|______|

Valid Magic Square.

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CS 202 - Magic Squares
  Title: Test, Order 9
  Magic Square, order: 9
  Magic Number: 369

    ______ ______ ______ ______ ______ ______ ______ ______ ______
   |      |      |      |      |      |      |      |      |      |
   |  47  |  58  |  69  |  80  |   1  |  12  |  23  |  34  |  45  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |  57  |  68  |  79  |   9  |  11  |  22  |  33  |  44  |  46  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |  67  |  78  |   8  |  10  |  21  |  32  |  43  |  54  |  56  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |  77  |   7  |  18  |  20  |  31  |  42  |  53  |  55  |  66  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |   6  |  17  |  19  |  30  |  41  |  52  |  63  |  65  |  76  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |  16  |  27  |  29  |  40  |  51  |  62  |  64  |  75  |   5  |
   |______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |
   |  26  |  28  |  39  |  50  |  61  |  72  |  74  |   4  |  15  |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |
    |  36 |  38 |  49 |  60 |  71 |  73 |   3 |  14 |  25 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |
    |  37 |  48 |  59 |  70 |  81 |   2 |  13 |  24 |  35 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|

Valid Magic Square.


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CS 202 - Magic Squares
  Title: Test, Order 10
  Magic Square, order: 10
  Magic Number: 505

     _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
    |     |     |     |     |     |     |     |     |     |     |
    |  92 |  99 |   1 |   8 |  15 |  67 |  74 |  51 |  58 |  40 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  98 |  80 |   7 |  14 |  16 |  73 |  55 |  57 |  64 |  41 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |   4 |  81 |  88 |  20 |  22 |  54 |  56 |  63 |  70 |  47 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  85 |  87 |  19 |  21 |   3 |  60 |  62 |  69 |  71 |  28 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  86 |  93 |  25 |   2 |   9 |  61 |  68 |  75 |  52 |  34 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  17 |  24 |  76 |  83 |  90 |  42 |  49 |  26 |  33 |  65 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  23 |   5 |  82 |  89 |  91 |  48 |  30 |  32 |  39 |  66 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  79 |   6 |  13 |  95 |  97 |  29 |  31 |  38 |  45 |  72 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  10 |  12 |  94 |  96 |  78 |  35 |  37 |  44 |  46 |  53 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |
    |  11 |  18 | 100 |  77 |  84 |  36 |  43 |  50 |  27 |  59 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|

Valid Magic Square.


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CS 202 - Magic Squares
  Title: Test, Order 12
  Magic Square, order: 12
  Magic Number: 870


     _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
    |     |     |     |     |     |     |     |     |     |     |     |     |
    | 144 |   2 |   3 | 141 | 140 |   6 |   7 | 137 | 136 |  10 |  11 | 133 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  13 | 131 | 130 |  16 |  17 | 127 | 126 |  20 |  21 | 123 | 122 |  24 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  25 | 119 | 118 |  28 |  29 | 115 | 114 |  32 |  33 | 111 | 110 |  36 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    | 108 |  38 |  39 | 105 | 104 |  42 |  43 | 101 | 100 |  46 |  47 |  97 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  96 |  50 |  51 |  93 |  92 |  54 |  55 |  89 |  88 |  58 |  59 |  85 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  61 |  83 |  82 |  64 |  65 |  79 |  78 |  68 |  69 |  75 |  74 |  72 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  73 |  71 |  70 |  76 |  77 |  67 |  66 |  80 |  81 |  63 |  62 |  84 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  60 |  86 |  87 |  57 |  56 |  90 |  91 |  53 |  52 |  94 |  95 |  49 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  48 |  98 |  99 |  45 |  44 | 102 | 103 |  41 |  40 | 106 | 107 |  37 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    | 109 |  35 |  34 | 112 | 113 |  31 |  30 | 116 | 117 |  27 |  26 | 120 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    | 121 |  23 |  22 | 124 | 125 |  19 |  18 | 128 | 129 |  15 |  14 | 132 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |
    |  12 | 134 | 135 |   9 |   8 | 138 | 139 |   5 |   4 | 142 | 143 |   1 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|

 Valid Magic Square.

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 CS 202 - Magic Squares
   Title: Test, Order 13
   Magic Square, order: 13
   Magic Number: 1105
     _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  93 | 108 | 123 | 138 | 153 | 168 |   1 |  16 |  31 |  46 |  61 |  76 |  91 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    | 107 | 122 | 137 | 152 | 167 |  13 |  15 |  30 |  45 |  60 |  75 |  90 |  92 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    | 121 | 136 | 151 | 166 |  12 |  14 |  29 |  44 |  59 |  74 |  89 | 104 | 106 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    | 135 | 150 | 165 |  11 |  26 |  28 |  43 |  58 |  73 |  88 | 103 | 105 | 120 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    | 149 | 164 |  10 |  25 |  27 |  42 |  57 |  72 |  87 | 102 | 117 | 119 | 134 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    | 163 |   9 |  24 |  39 |  41 |  56 |  71 |  86 | 101 | 116 | 118 | 133 | 148 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |   8 |  23 |  38 |  40 |  55 |  70 |  85 | 100 | 115 | 130 | 132 | 147 | 162 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  22 |  37 |  52 |  54 |  69 |  84 |  99 | 114 | 129 | 131 | 146 | 161 |   7 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  36 |  51 |  53 |  68 |  83 |  98 | 113 | 128 | 143 | 145 | 160 |   6 |  21 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  50 |  65 |  67 |  82 |  97 | 112 | 127 | 142 | 144 | 159 |   5 |  20 |  35 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  64 |  66 |  81 |  96 | 111 | 126 | 141 | 156 | 158 |   4 |  19 |  34 |  49 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  78 |  80 |  95 | 110 | 125 | 140 | 155 | 157 |   3 |  18 |  33 |  48 |  63 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
    |     |     |     |     |     |     |     |     |     |     |     |     |     |
    |  79 |  94 | 109 | 124 | 139 | 154 | 169 |   2 |  17 |  32 |  47 |  62 |  77 |
    |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|

 Valid Magic Square.
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CS 202 - Magic Squares
  Title: Test, Order 14
  Magic Square, order: 14
  Magic Number: 1379

    ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ ______
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  177 |  186 |  195 |    1 |   10 |   19 |   28 |  128 |  137 |  146 |   99 |  108 |   68 |   77 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  185 |  194 |  154 |    9 |   18 |   27 |   29 |  136 |  145 |  105 |  107 |  116 |   76 |   78 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  193 |  153 |  155 |   17 |   26 |   35 |   37 |  144 |  104 |  106 |  115 |  124 |   84 |   86 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |    5 |  161 |  163 |  172 |   34 |   36 |   45 |  103 |  112 |  114 |  123 |  132 |   85 |   94 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  160 |  162 |  171 |   33 |   42 |   44 |    4 |  111 |  113 |  122 |  131 |  140 |   93 |   53 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  168 |  170 |  179 |   41 |   43 |    3 |   12 |  119 |  121 |  130 |  139 |  141 |   52 |   61 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  169 |  178 |  187 |   49 |    2 |   11 |   20 |  120 |  129 |  138 |  147 |  100 |   60 |   69 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   30 |   39 |   48 |  148 |  157 |  166 |  175 |   79 |   88 |   97 |   50 |   59 |  117 |  126 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   38 |   47 |    7 |  156 |  165 |  174 |  176 |   87 |   96 |   56 |   58 |   67 |  125 |  127 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   46 |    6 |    8 |  164 |  173 |  182 |  184 |   95 |   55 |   57 |   66 |   75 |  133 |  135 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |  152 |   14 |   16 |   25 |  181 |  183 |  192 |   54 |   63 |   65 |   74 |   83 |  134 |  143 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   13 |   15 |   24 |  180 |  189 |  191 |  151 |   62 |   64 |   73 |   82 |   91 |  142 |  102 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   21 |   23 |   32 |  188 |  190 |  150 |  159 |   70 |   72 |   81 |   90 |   92 |  101 |  110 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
   |   22 |   31 |   40 |  196 |  149 |  158 |  167 |   71 |   80 |   89 |   98 |   51 |  109 |  118 |
   |______|______|______|______|______|______|______|______|______|______|______|______|______|______|

Valid Magic Square.

************************************************************
Read Testing, 3x3...

Enter 3x3 Magic Square.

Enter Title: Test - Good

Enter Magic Square Values (3x3)
2 7 6
9 5 1
4 3 8

************************************************************

CS 202 - Magic Squares
  Title: Test - Good
  Magic Square, order: 3
  Magic Number: 15

    ______ ______ ______
   |      |      |      |
   |    2 |    7 |    6 |
   |______|______|______|
   |      |      |      |
   |    9 |    5 |    1 |
   |_____|_____|_____|
   |     |     |     |
   |   4 |   3 |   8 |
   |_____|_____|_____|


Valid Magic Square.


************************************************************
Enter 3x3 Magic Square.

Enter Title: Enter Title: Test - Bad

Enter Magic Square Values (3x3)
7 7 1
7 7 1
1 1 1

************************************************************

CS 202 - Magic Squares
  Title: Test - Bad
  Magic Square, order: 3
  Magic Number: 15
    _____ _____ _____
   |     |     |     |
   |   7 |   7 |   1 |
   |_____|_____|_____|
   |     |     |     |
   |   7 |   7 |   1 |
   |_____|_____|_____|
   |     |     |     |
   |   1 |   1 |   1 |
   |_____|_____|_____|


Not a Magic Square Solution.



************************************************************
Read Testing, 11x11...

Enter 11x11 Magic Square.

Enter Title: Enter Title: Test - 11x11

Enter Magic Square Values (11x11)
68  81  94 107 120   1  14  27  40  53  66
 80  93 106 119  11  13  26  39  52  65  67
 92 105 118  10  12  25  38  51  64  77  79
104 117   9  22  24  37  50  63  76  78  91
116   8  21  23  36  49  62  75  88  90 103
  7  20  33  35  48  61  74  87  89 102 115
 19  32  34  47  60  73  86  99 101 114   6
 31  44  46  59  72  85  98 100 113   5  18
 43  45  58  71  84  97 110 112   4  17  30
 55  57  70  83  96 109 111   3  16  29  42
 56  69  82  95 108 121   2  15  28  41  54

************************************************************

CS 202 - Magic Squares
  Title: Test - 11x11
  Magic Square, order: 11
  Magic Number: 671
    _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |     |     |     |     |     |
   |  68 |  81 |  94 | 107 | 120 |   1 |  14 |  27 |  40 |  53 |  66 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  80 |  93 | 106 | 119 |  11 |  13 |  26 |  39 |  52 |  65 |  67 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |     |     |     |
   |  92 | 105 | 118 |  10 |  12 |  25 |  38 |  51 |  64 |  77 |  79 |
   |_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|_____|
   |      |      |      |      |      |      |      |      |      |      |      |
   |  104 |  117 |    9 |   22 |   24 |   37 |   50 |   63 |   76 |   78 |   91 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |  116 |    8 |   21 |   23 |   36 |   49 |   62 |   75 |   88 |   90 |  103 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |    7 |   20 |   33 |   35 |   48 |   61 |   74 |   87 |   89 |  102 |  115 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   19 |   32 |   34 |   47 |   60 |   73 |   86 |   99 |  101 |  114 |    6 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   31 |   44 |   46 |   59 |   72 |   85 |   98 |  100 |  113 |    5 |   18 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   43 |   45 |   58 |   71 |   84 |   97 |  110 |  112 |    4 |   17 |   30 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   55 |   57 |   70 |   83 |   96 |  109 |  111 |    3 |   16 |   29 |   42 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   56 |   69 |   82 |   95 |  108 |  121 |    2 |   15 |   28 |   41 |   54 |
   |______|______|______|______|______|______|______|______|______|______|______|
```

Valid Magic Square.

```
************************************************************
Enter 11x11 Magic Square.

Enter Title: Enter Title: Test - 11x11 bad

Enter Magic Square Values (11x11)
6       117     46      107     36      97      26      87      16      77      6
7       57      118     47      108     37      98      27      88      17      67
68      8       58      119     48      109     38      99      28      78      18
19      69      9       59      120     49      110     39      89      29      79
80      20      70      10      60      121     50      100     40      90      30
31      81      21      71      11      61      111     51      101     41      91
92      32      82      22      72      1       62      112     52      102     42
43      93      33      83      12      73      2       63      113     53      103
104     44      94      23      84      13      74      3       64      114     54
55      105     34      95      24      85      14      75      4       65      115
116     45      106     35      96      25      86      15      76      5       66

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CS 202 - Magic Squares
Title: Test - 11x11 bad
Magic Square, order: 11
Magic Number: 671

```
    ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ ______
   |      |      |      |      |      |      |      |      |      |      |      |
   |    6 |  117 |   46 |  107 |   36 |   97 |   26 |   87 |   16 |   77 |    6 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |    7 |   57 |  118 |   47 |  108 |   37 |   98 |   27 |   88 |   17 |   67 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   68 |    8 |   58 |  119 |   48 |  109 |   38 |   99 |   28 |   78 |   18 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   19 |   69 |    9 |   59 |  120 |   49 |  110 |   39 |   89 |   29 |   79 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   80 |   20 |   70 |   10 |   60 |  121 |   50 |  100 |   40 |   90 |   30 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   31 |   81 |   21 |   71 |   11 |   61 |  111 |   51 |  101 |   41 |   91 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   92 |   32 |   82 |   22 |   72 |    1 |   62 |  112 |   52 |  102 |   42 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |   43 |   93 |   33 |   83 |   12 |   73 |    2 |   63 |  113 |   53 |  103 |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   | 104  |  44  |  94  |  23  |  84  |  13  |  74  |   3  |  64  | 114  |  54  |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   |  55  | 105  |  34  |  95  |  24  |  85  |  14  |  75  |   4  |  65  | 115  |
   |______|______|______|______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |      |      |      |
   | 116  |  45  | 106  |  35  |  96  |  25  |  86  |  15  |  76  |   5  |  66  |
   |______|______|______|______|______|______|______|______|______|______|______|
```

Not a Magic Square Solution.

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************************************************************
Read Testing, 6x6...

Enter 6x6 Magic Square.

Enter Title: Enter Title: Test 6x6 - good

Enter Magic Square Values (6x6)
6 32 3 34 35 1
7 11 27 28 8 30
19 14 16 15 23 24
18 20 22 21 17 13
25 29 10 9 26 12
36 5 33 4 2 31

************************************************************
```

CS 202 - Magic Squares
Title: Test 6x6 - good
Magic Square, order: 6
Magic Number: 111

```
    ______ ______ ______ ______ ______ ______
   |      |      |      |      |      |      |
   |   6  |  32  |   3  |  34  |  35  |   1  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |   7  |  11  |  27  |  28  |   8  |  30  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |  19  |  14  |  16  |  15  |  23  |  24  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |  18  |  20  |  22  |  21  |  17  |  13  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |  25  |  29  |  10  |   9  |  26  |  12  |
   |______|______|______|______|______|______|
   |      |      |      |      |      |      |
   |  36  |   5  |  33  |   4  |   2  |  31  |
   |______|______|______|______|______|______|
```

Valid Magic Square.

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************************************************************
Read Testing, 8x8...

Enter 8x8 Magic Square.

Enter Title: Enter Title: Test 8x8 - good

Enter Magic Square Values (8x8)
8 58 59 5 4 62 63 1
49 15 14 52 53 11 10 56
41 23 22 44 45 19 18 48
32 34 35 29 28 38 39 25
40 26 27 37 36 30 31 33
17 47 46 20 21 43 42 24
9 55 54 12 13 51 50 16
64 2 3 61 60 6 7 57
```

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************************************************************

CS 202 - Magic Squares
  Title: Test 8x8 - good
  Magic Square, order: 8
  Magic Number: 260
    _____ _____ _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |     |     |
   |   8 |  58 |  59 |   5 |   4 |  62 |  63 |   1 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  49 |  15 |  14 |  52 |  53 |  11 |  10 |  56 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  41 |  23 |  22 |  44 |  45 |  19 |  18 |  48 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  32 |  34 |  35 |  29 |  28 |  38 |  39 |  25 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  40 |  26 |  27 |  37 |  36 |  30 |  31 |  33 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  17 |  47 |  46 |  20 |  21 |  43 |  42 |  24 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |   9 |  55 |  54 |  12 |  13 |  51 |  50 |  16 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  64 |   2 |   3 |  61 |  60 |   6 |   7 |  57 |
   |_____|_____|_____|_____|_____|_____|_____|_____|


Valid Magic Square.


************************************************************
Enter 8x8 Magic Square.

Enter Title: Enter Title: Test 8x8 - bad

Enter Magic Square Values (8x8)
7 58 59 5 4 62 63 1
49 15 14 52 53 11 10 56
41 23 22 44 45 19 18 48
32 34 35 29 28 38 39 25
40 26 27 37 36 30 31 33
17 47 46 20 21 43 42 24
9 55 54 12 13 51 50 16
64 2 3 61 60 6 8 57

************************************************************

CS 202 - Magic Squares
  Title: Test 8x8 - bad
  Magic Square, order: 8
  Magic Number: 260
    _____ _____ _____ _____ _____ _____ _____ _____
   |     |     |     |     |     |     |     |     |
   |   7 |  58 |  59 |   5 |   4 |  62 |  63 |   1 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  49 |  15 |  14 |  52 |  53 |  11 |  10 |  56 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  41 |  23 |  22 |  44 |  45 |  19 |  18 |  48 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  32 |  34 |  35 |  29 |  28 |  38 |  39 |  25 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  40 |  26 |  27 |  37 |  36 |  30 |  31 |  33 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |     |     |     |     |     |     |     |     |
   |  17 |  47 |  46 |  20 |  21 |  43 |  42 |  24 |
   |_____|_____|_____|_____|_____|_____|_____|_____|
   |      |      |      |      |      |      |      |      |
   |   9  |  55  |  54  |  12  |  13  |  51  |  50  |  16  |
   |______|______|______|______|______|______|______|______|
   |      |      |      |      |      |      |      |      |
   |  64  |   2  |   3  |  61  |  60  |   6  |   8  |  57  |
   |______|______|______|______|______|______|______|______|

Not a Magic Square Solution.

ed-vm%
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