VG101 — Intoduction to Computer and Programming

Lab 1 — Chiaki's Magic Square

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Goals of the Lab

- Basic Scripting in MATLAB
- Control and Loop Statements
- Documentation Look Up
- File I/O Operations

Introduction

One day, Kana[1] went to Chiaki[1] for playing. However, Chiaki was busy with her math homework from school: to generate magic squares.

According to Haruka[1], a magic square is a $n \times n$ square grid (where n is the number of cells on each side) filled with distinct positive integers in the range $1, 2, ..., n^2$ such that each cell contains a different integer and the sum of the integers in each row, column and diagonal is equal. The sum is called the magic constant or magic sum of the magic square. A square grid with n cells on each side is said to have order n[2].

4	9	2
3	5	7
8	1	6

2	16	13	3
11	5	8	10
7	9	12	6
14	4	1	15

1	23	16	4	21
15	14	7	18	11
24	17	13	9	2
20	8	19	12	6
5	3	10	22	25

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

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

Figure 1: Magic Squares of Orders 3, 4, 5, 6, and 9

Now, Kana turns to you for a MALAB script which can get an input value n from a file "**lab1.in**" and print a magic square of order n to another file "**lab1.out**".

Construction of Magic Square[2]

The teaching assistants also prepared some information for you, mainly about how to aconstruct magic squares.

There are many ways to construct magic squares, but the standard (and most simple) way is to follow certain configurations/formulas which generate regular patterns. Magic squares exist for all values of n, with only one exception: it is impossible to construct a magic square of order 2. Magic squares can be classified into three types: odd, singly even (n is even, but not divisible

by four), and doubly even (n is divisible by four).

Magic Square of Odd Order

For magic square of odd order, we may start in the central column of the first row with the number 1. After that, 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 continues as before. When an "up and to the right" move would leave the square, it is wrapped around to the last row or first column, respectively.

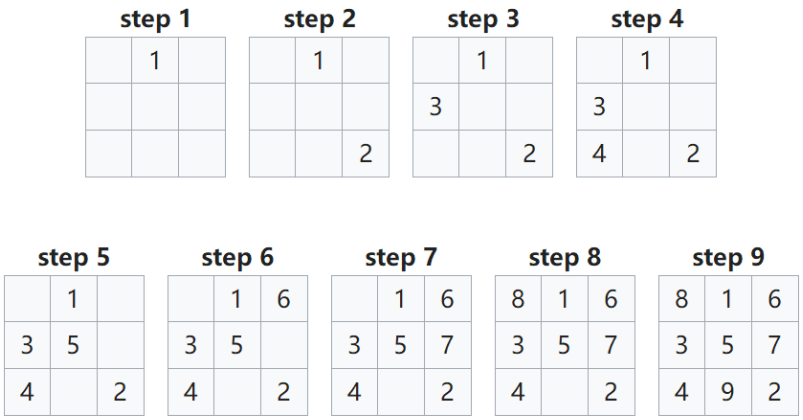

Figure 2: Construction of Magic Square of Odd Order.

Magic Square of Other Orders

When the teaching assistant start to show off the method of constructing magic squares of other orders[2]. You, unfortunately, fall asleep... However, in the dream you somehow remember that you have seen how to generate a magic square with a simple lovely code in MATLAB. But what is it? With the feeling of uncertain, you tried to type "magic square" in the search engine of MATLAB documentation...

File Input/Output

Now you have figured out how to generate a matrix, but what is file input/ouptut then? You tried to use the same trick and search "file", but ...

So you turn to the teaching assistants. Knowing that you had fallen asleep in the lab, the teaching assistants is very impatient and just let you search how to read and write text files on your own... But wait a minute, "**text file**"?

Ending

Somehow, you complete your work in the end and the teaching assistants are very pleased with it. So they decide to give you a second chance, you may refer to the previous lab manuel and see how to construct magic squares of other orders.

References

[1] Sakuraba, Koharu. *Minami-ke*. vol.1, Kodansha, 5 Nov. 2004, pp. 6.

[2] Liu, Yihao. “Lab 1”. *umjicanvas.com*, 29 May. 2018, umjicanvas.com/courses/848/files/118804/download?wrap=1. Accedded 29 May. 2018.