

## Magic square

Rifat Zadan Khalef\*

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### Abstract:

In this paper we introduce two Algorithms, the first Algorithms when it is odd order and how we calculate magic square and rotation for it. The second Algorithms when it be even order and how to find magic square and rotation for it.

**Key words:** matrix, magic square, number theory.

### Introduction:

If the number of dots are counted and arrays is obtained magic square. A magic square is a square array of number with property that the sum along each row, column and diagonal is the same, this common value is called magic sum.

### Magic square formula:

A magic square of order  $n$  has entries  $1, 2, 3, \dots, n^2$  then the sum of all entries in the square is  $n^2(n^2+1)/2$ , since there are  $n$  rows (column) the magic sum of square may be dividing the above expression by  $n$ . this result in the following rule for finding the magic sum.

### Odd order

There is method of constructing an odd order magic square which is attributed to an early envoy, that some times refried to as the "stair -case method ".the method is described below for an order 5 square with entries  $1, 2, 3, \dots, 25$  begin by sketching square divided in to 25 cell.

In to which the numbers 1-25 are to be entered proceed as described below referring to Fig -1-

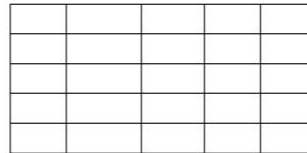
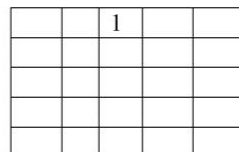


Fig-1-

### Algorithm of odd order:

The Algorithm of odd order as follows:

1- Write 1 in the Middle cell of the top row



2 -Always try to enter numbers in the cell s by moving diagonally from lower left to upper night, there are two exceptions to this.

a- If you go outside of the magic square move all the way across the row or column to enter the number there proceed to move diagonal .

b-If you run in to a cell which is already occupied "that is you are blocked" drop down one cell from the last entry written and enter the next number .then proceed to move diagonally.

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

Fig-2-

3- your last entry 25 will be in the middle cell of the bottom row .Fig-2- shows the completed magic square it is magic sum 65 , and the sum of all values in magic square is  $n^2(n^2+1)/2=5^2(5^2+1)/2=325$

**Example:**

Find the magic sum and the sum of all values in magic square of order 7

**Solution:**

30	39	49	1	10	19	28
38	47	7	9	18	27	29
46	6	8	17	26	35	37
5	14	16	25	34	36	45
13	15	24	33	42	44	4
21	23	32	41	43	3	12
22	31	40	49	2	11	20

$Ms=7(49+1)/2=175$

The sum of all values magic square  $n^2(n^2+1)/2$

$49(49+1)/2=1225$

**Relation of magic square :**

Given magic square ,other magic square may be obtained by rotating the given one

**Example:** Given magic square of order 5 in Fig -2- then find

1-90° in clockwise direction

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

2-180°in clockwise direction

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

3- 270 ° in clockwise direction

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

**Even order:**

The algorithm to compute magic square of order even may be constructed as follows:

Beginning at the upper left , move across each row from left to right counting the cell as you go along , if the cell is on diagonal count it but do not enter it 's number if it is not an diagonal enter it's number ,when this is completed ,Reverse the procedure ,beginning at the bottom right and move across from right to left ,,As you .counting the cell .enter the number if the cell is not enter it's number you should obtain a magic square similar to the one given

Example:- let a magic square of order 4(see Fig(3))

X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>
X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>
X <sub>9</sub>	X <sub>10</sub>	X <sub>11</sub>	X <sub>12</sub>
X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>	X <sub>16</sub>

Fig -3-(a)

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

Fig -3-(b)

**1-left to right**

X<sub>1</sub> is the maximum value =16

X<sub>1</sub> move to X<sub>14</sub>=15

X<sub>2</sub> move to X<sub>15</sub> =14

X<sub>3</sub> move to X<sub>4</sub>=13

X<sub>5</sub> move to X<sub>12</sub> =12

X<sub>6</sub> move to X<sub>6</sub> =11

X<sub>7</sub> move to X<sub>7</sub> =10

X<sub>8</sub> move to X<sub>9</sub> =9

X<sub>9</sub> move to X<sub>8</sub> =8

X<sub>10</sub> move to X<sub>10</sub> =7

X<sub>11</sub> move to X<sub>11</sub> =6

**2 - right the left**

$X_{16}$  is the maximum value =1

$X_{16}$  move to  $X_3=2$

$X_3$  move to  $X_2=3$

$X_2$  move to  $X_{13}=4$

**Example:** find magic square of order 8

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

**Relation of magic square (even order)**

Given magic square of order  $n$  , other magic square may be obtain the given one

**Example:**

Given magic square of order 4 in Fig - 3- then find

1-90° in clockwise direction

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

2-180° in clockwise direction

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

3- 270° in clockwise direction

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

**Reference:**

- 1-Anderon, J.A,Bell,J.M,1997 ,number theory with Applctons,1<sup>st</sup> edition, 280, London, England, Prentice Hall.
- 2-Apistol,T.M.1998,introduction to analytic number theory , 5<sup>th</sup> edition, 350, Berlin, Germany,springer-Verlag.
- 3-Backer, A, 1994, Aconcise introduction to the theory of number , frist edition, 240, Cambridge, England, Cambridge University press.
- 4-Miler, Heeren, Horrspy, 2000, Mathematical Ideas, Expanded 10<sup>th</sup> edition ,370,new York ,USA, Addison-Wesley.
- 5-Silverman , J.H,2006,A Friendly introduction to number theory ,1<sup>st</sup> edition, 340, London, England ,Prentice Hall.

**المربع السحري**

رفعت زيدان خلف\*

\*جامعة ديالى – كلية العلوم قسم الرياضيات

**الخلاصة :-**

قدمنا في هذا البحث خوارزميتين الخوارزمية الاولى عندما يكون ( odd order ) وكيف يتم حساب Magic square لها وحساب التدويرات الخاصة بها . الخوارزمية الثانية عندما يكون ( even order ) وكيف يتم حساب Magic square وحساب التدويرات الخاصة بها .