Universal H-IXOHOXI Magic Squares of Order Eight

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Abstract

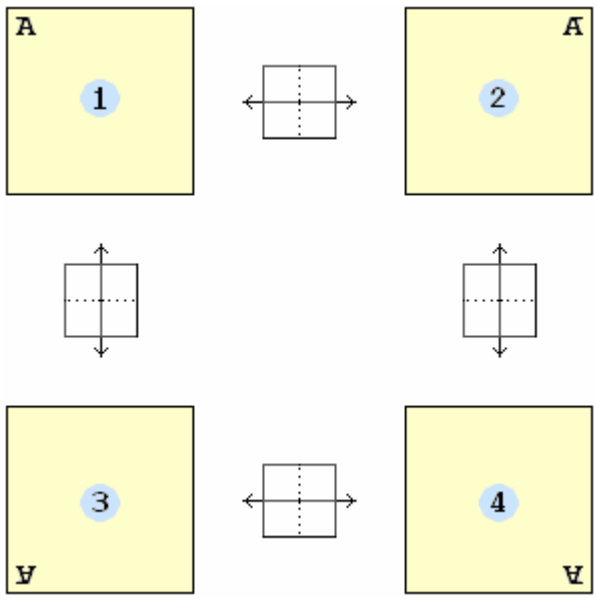
Universal H-IXOHOXI *Magic Squares* of order eight with numbers of six digits and using only the digits **0-1** , **1-8** or **2-5**, have been constructed. In this paper an example of *Universal* H-IXOHOXI *Magic Square* of the same order with numbers of four digits and using the digits **1**, **2**, **5** and **8**; is given**.** The method of construction is shown.-

Digits

When the digits 0 , 1 and 8 are rotated 180 degrees (horizontal or vertical), they remain the same digit. On the other hand, when the digit 2 is rotated 180 degrees (horizontal or vertical) is transformed to the digit 5 and vice versa.-

Universal IXOHOXI Magic Square

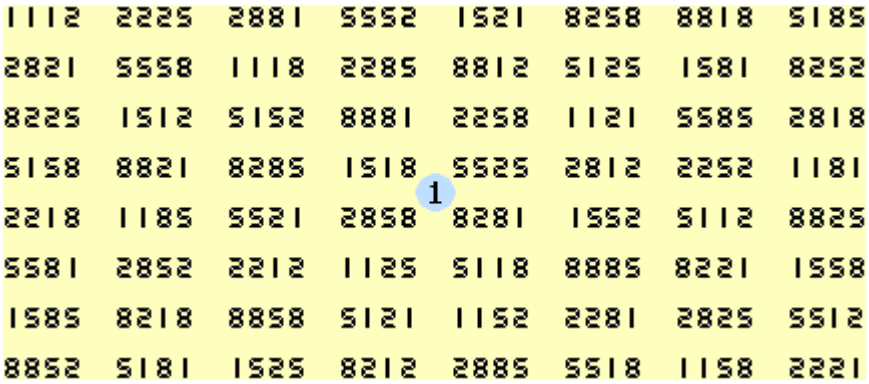
Using numbers with the above type of digits, a Magic Square is called *Universal* IXOHOXI if their rotations are *Magic***:**



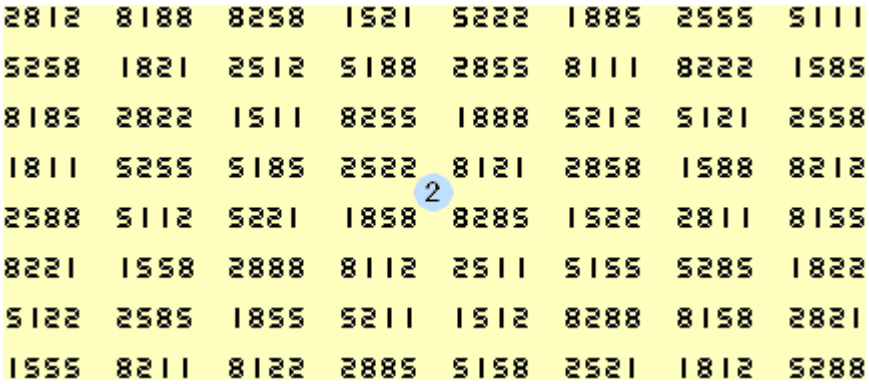
Types of Universal IXOHOXI Magic Squares

- H-IXOHOXI **:** the four squares have the same *Magic Sum*.-
- S-IXOHOXI **:** *Magic Sum* **1** = *Magic Sum* **4** ≠ *Magic Sum* **2** = *Magic Sum* **3**.-
- L-IXOHOXI **:** the four squares have distinct *Magic Sum*.-

The Example



1



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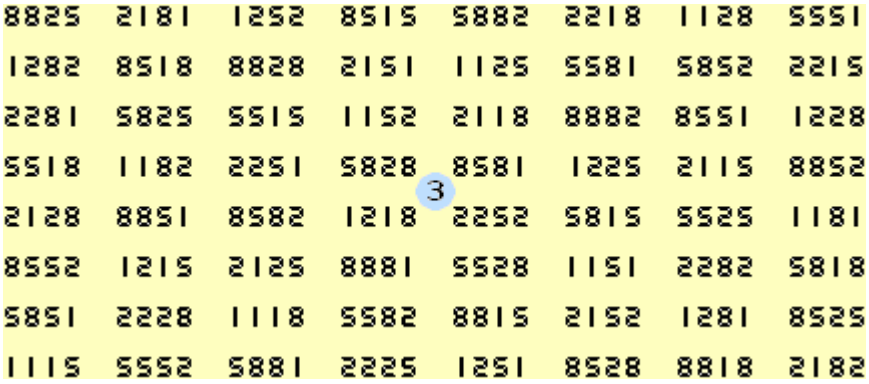

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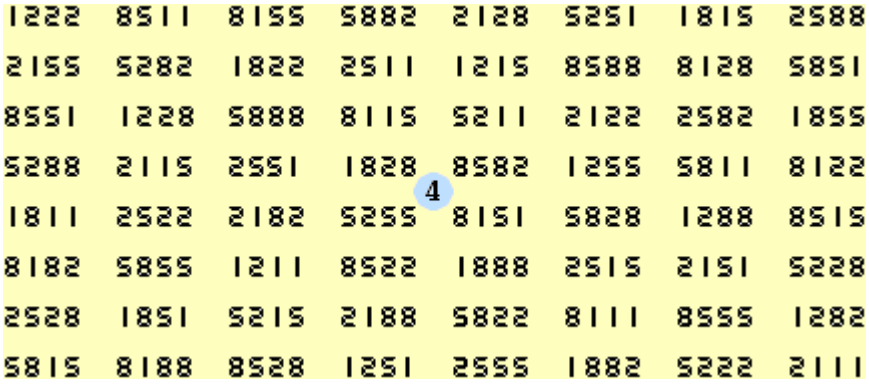


4

Magic Sum = 35552

Method of Construction

a) Using the digits **1**, **2**, **5, 8** and with the **16** possible numbers of two digits, the computer program showed that **45** pairs of H-IXOHOXI sequences of eight distinct entries (within and between them) adding **352** are possible. For example **:**

Sequence S_1 • **1 : 11** + **15** + **22** + **28** + **51** + **55** + **82** + **88** = **352**
Sequence S_1 • **2 :** 11 + 21 + 55 + 85 + 12 + 22 + 58 + 88 = 352
Sequence S_1 • **3 :** 11 + 12 + 55 + 58 + 21 + 22 + 85 + 88 = 352
Sequence S_1 • **4 :** 11 + 51 + 22 + 82 + 15 + 55 + 28 + 88 = 352

Sequence S_2 • **1 : 12** + **18** + **21** + **25** + **52** + **58** + **81** + **85** = **352**
Sequence S_2 • **2 :** 51 + 81 + 15 + 25 + 52 + 82 + 18 + 28 = 352
Sequence S_2 • **3 :** 15 + 18 + 51 + 52 + 25 + 28 + 81 + 82 = 352
Sequence S_2 • **4 :** 21 + 81 + 12 + 52 + 25 + 85 + 18 + 58 = 352

b) One arbitrary *Doubly Self-Orthogonal Diagonal Latin Square* (orthogonal to its transpose and its antitranspose) of order eight was constructed **:**

1 3 4 6 2 7 8 5	1 4 7 5 3 6 2 8	3 6 2 8 1 4 7 5
4 6 1 3 8 5 2 7	3 6 2 8 1 4 7 5	1 4 7 5 3 6 2 8
7 2 5 8 3 1 6 4	4 1 5 7 6 3 8 2	6 3 8 2 4 1 5 7
5 8 7 2 6 4 3 1	6 3 8 2 4 1 5 7	4 1 5 7 6 3 8 2
3 1 6 4 7 2 5 8	2 8 3 6 7 5 1 4	7 5 1 4 2 8 3 6
6 4 3 1 5 8 7 2	7 5 1 4 2 8 3 6	2 8 3 6 7 5 1 4
2 7 8 5 1 3 4 6	8 2 6 3 5 7 4 1	5 7 4 1 8 2 6 3
8 5 2 7 4 6 1 3	5 7 4 1 8 2 6 3	8 2 6 3 5 7 4 1
DLS_1	$DLS_1^{\,t}$	$DLS_1^{\,at}$

c) Replacing each digit of one pair orthogonal by one entry of two digits of the sequences S_1 and S_2 ;

For the example **:**

	1	2	3	4	5	6	7	8
DLS_1	**11**	**15**	**22**	**28**	**51**	**55**	**82**	**88**
$DLS_1^{\,t}$	**12**	**18**	**21**	**25**	**52**	**58**	**81**	**85**

the order of the eight entries in each sequence can be any;

then **:**

$$UIMS = 100\ DLS_{\mathbf{1}(i,j)} + DLS_{\mathbf{1}(i,j)}^{\,t} \quad \text{or} \quad UIMS = 100\ DLS_{\mathbf{1}(i,j)}^{\,t} + DLS_{\mathbf{1}(i,j)}$$

Observe

- Each sequence has not *complementary pairs*, therefore the set of sixty-four numbers has not complementary pairs.-
- The four sets of sixty-four numbers are distinct.-

Impossible Bimagic

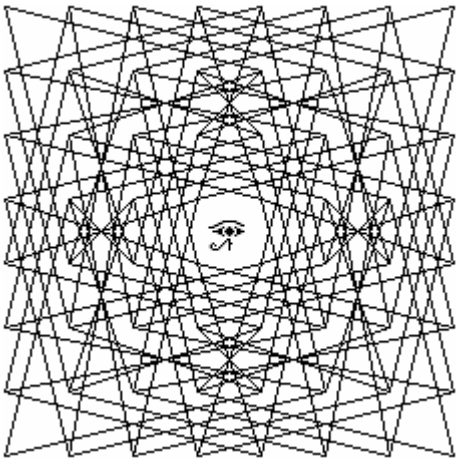
With the four sets of sixty-four numbers, the Universal H-IXOHOXI Bimagic Squares are impossible because the bimagic sums would be **:**

Square **1** = 220,198,988
Square **2** = 208,600,148
Square **3** = 228,598,148
Square **4** = 216,999,308

¿ For the same *magic sum* distinct *bimagic sums ? Yes*, because not all sixty-four numbers of the four squares are equal *!!!*

Open question

¿ The Universal (`H-IXOHOXI` Magic • `L-IXOHOXI` Bimagic) Squares are possible *?*



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