

Universal H-IXOHOXI Magic Squares of Order Eight

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Abstract

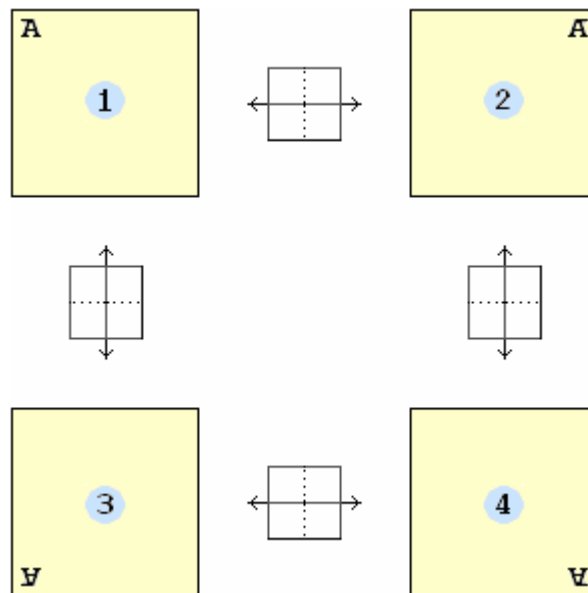
Universal H-IXOHOXI Magic Squares of order eight with numbers of six digits and using only the digits **0-1** , **1-8** or **2-5**, have been constructed. In this paper an example of *Universal H-IXOHOXI Magic Square* of the same order with numbers of four digits and using the digits **1, 2, 5** and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

1112	2225	2881	5552	1521	8258	8818	5185
2821	5558	1118	2285	8812	5125	1581	8252
8225	1512	5152	8881	2258	1121	5585	2818
5158	8821	8285	1518	5525	2812	2252	1181
2218	1185	5521	2858	8281	1552	5112	8825
5581	2852	2212	1125	5118	8885	8221	1558
1585	8218	8858	5121	1152	2281	2825	5512
8852	5181	1525	8212	2885	5518	1158	2221

2812	8188	8258	1521	5222	1885	2555	5111
5258	1821	2512	5188	2855	8111	8222	1585
8185	2822	1511	8255	1888	5212	5121	2558
1811	5255	5185	2522	8121	2858	1588	8212
2588	5112	5221	1858	8285	1522	2811	8155
8221	1558	2888	8112	2511	5155	5285	1822
5122	2585	1855	5211	1512	8288	8158	2821
1555	8211	8122	2885	5158	2521	1812	5288

8825	2181	1252	8515	5882	2218	1128	5551
1282	8518	8828	2151	1125	5581	5852	2215
2281	5825	5515	1152	2118	8882	8551	1228
5518	1182	2251	5828	8581	1225	2115	8852
2128	8851	8582	1218	2252	5815	5525	1181
8552	1215	2125	8881	5528	1151	2282	5818
5851	2228	1118	5582	8815	2152	1281	8525
1115	5552	5881	2225	1251	8528	8818	2182

1222	8511	8155	5882	2128	5251	1815	2588
2155	5282	1822	2511	1215	8588	8128	5851
8551	1228	5888	8115	5211	2122	2582	1855
5288	2115	2551	1828	8582	1255	5811	8122
1811	2522	2182	5255	8151	5828	1288	8515
8182	5855	1211	8522	1888	2515	2151	5228
2528	1851	5215	2188	5822	8111	8555	1282
5815	8188	8528	1251	2555	1882	5222	2111

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 :

$$\text{Sequence } S_1 \bullet 1 : 11 + 15 + 22 + 28 + 51 + 55 + 82 + 88 = 352$$

$$\text{Sequence } S_1 \bullet 2 : 11 + 21 + 55 + 85 + 12 + 22 + 58 + 88 = 352$$

$$\text{Sequence } S_1 \bullet 3 : 11 + 12 + 55 + 58 + 21 + 22 + 85 + 88 = 352$$

$$\text{Sequence } S_1 \bullet 4 : 11 + 51 + 22 + 82 + 15 + 55 + 28 + 88 = 352$$

$$\text{Sequence } S_2 \bullet 1 : 12 + 18 + 21 + 25 + 52 + 58 + 81 + 85 = 352$$

$$\text{Sequence } S_2 \bullet 2 : 51 + 81 + 15 + 25 + 52 + 82 + 18 + 28 = 352$$

$$\text{Sequence } S_2 \bullet 3 : 15 + 18 + 51 + 52 + 25 + 28 + 81 + 82 = 352$$

$$\text{Sequence } S_2 \bullet 4 : 21 + 81 + 12 + 52 + 25 + 85 + 18 + 58 = 352$$

- 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 S₁ and S₂;

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 :

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

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

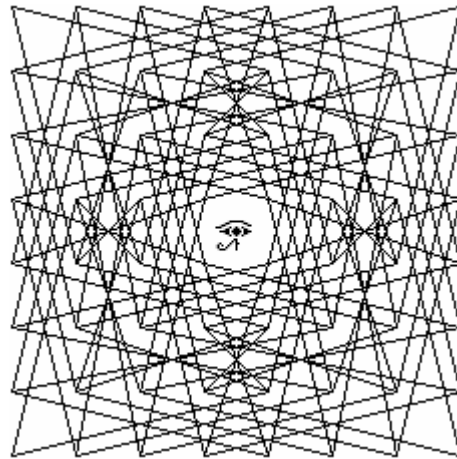
With the four sets of sixty-four numbers, the Universal H-IXOHOXI Bimagic Squares are impossible because the bimagic sums would be :

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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