

# Chapter 6: Fundamental Studies of High-Dimensional Extra-Cubic Magic Objects and their Decomposed Ones: Kanji Setsuda

## Section 3: Study of 6-Dimensional Extra-Cubic Magic Objects of Order 2 and their Decomposed Ones

**#1.** Now let's try to make a 6-dimensional magic object of order 2 in the  $2 \times 2 \times 2 \times 2 \times 2 \times 2$  array. Why do I want to do so? It is because I want to know of the highest symmetry of magic objects by increasing the dimensions up to 6, and because I want to find the inherent relations among some types of 2-dimensional magic squares of order 8, 3-dimensional magic cubes of order 4, and the only one original concept of the highest dimension 6.

**#2.** The structural data of the consecutive whole numbers from 1 to 64 are placed in the 6-dimensional array of  $2^6$ . No one can directly draw a single picture of that. But without using any kind of figures, it is too difficult for us to plan to build it.

I have tried to prepare as many figures as possible for those 'Decomposed Forms', so that we could feel and know the concept clearer.

\*\* Basic Diagrams #1 for our Objects \*\*

0/EC02<sup>6</sup> by 8x2<sup>3</sup>

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

1-----	2-----	3-----	4	SC4 <sup>3</sup> /SC8 <sup>2</sup>					
17		18	19	20	1	2	3	4	17 18 19 20
5	33	6	34	7	35	8	36		5 6 7 8 21 22 23 24
21	49	22	50	23	51	24	52		9 10 11 12 25 26 27 28
9	37	10	38	11	39	12	40		13 14 15 16 29 30 31 32
25	53	26	54	27	55	28	56		33 34 35 36 49 50 51 52
13	41	-	14	42	15	43	16	44	37 38 39 40 53 54 55 56
29	57	30	58	31	59	32	60		41 42 43 44 57 58 59 60
45		46	47	48		45	46	47	48 61 62 63 64
61	-----	62	-----	63	-----	64			

1-----	2-----	4-----	3	CC4 <sup>3</sup> /SC8 <sup>2</sup>					
17		18	20	19	1	2	4	3	29 30 32 31
5	49	6	50	8	52	7	51		5 6 8 7 25 26 28 27
21	33	22	34	24	36	23	35		13 14 16 15 17 18 20 19
13	53	14	54	16	56	15	55		9 10 12 11 21 22 24 23
29	37	30	38	32	40	31	39		36 35 33 34 64 63 61 62
9	61	-	10	62	12	64	11	63	40 39 37 38 60 59 57 58
25	45	26	46	28	48	27	47		48 47 45 46 52 51 49 50
57		58	60	59		44	43	41	42 56 55 53 54
41	-----	42	-----	44	-----	43			

The first decomposed form [8x2<sup>3</sup>] has 8 pieces of 3-dimensional cube of order 2. All of them stand for a single 6-dimensional extra-cubic object on the whole. It might seem very difficult for you to imagine it, but don't give it up, please.

The second Basic Form [SC4<sup>3</sup>] also contains a 3-dimensional cube of order 4, which each component of those little cubes 2<sup>3</sup> above is brought into.

The next form [SC8<sup>2</sup>] is made from the cube left. Four plates of the cube are picked up and placed flat in the 2-dimensional square, and the total figure looks like a 2-dimensional square of order 8 at a whole sight.

We suppose these figures as the Basic Forms to make everything with.

**#3.** How should we think of the complementary pairs of 2<sup>6</sup>+1? Where are those pairs such as (n1, n64), (n2, n63), (n3, n62), (n4, n61), (n5, n60), (n6, n59), . . . ., (n31, n34), (n32, n33) in the figures above.

All of them seem to be located reasonably and appropriately, even in every kind of decomposed forms. Therefore we can assume the 32 Complementary Pairs of 65 and their 'symmetrical' locations.

$$n1+n64=n2+n63=n3+n62=n4+n61=n5+n60=n6+n59= \dots =n31+n34=n32+n33=C(=65)$$

**#4.** Where are the six 'axes' and the six 'adjacent numbers next to the Origin'? Binary notation is always useful for you to find them.

**\*\* Basic Diagrams #2 for our Objects \*\***

Classical Notation/				/N2i			
1-----2	3-----4	5-----6	7-----8	000000	000001	000010	000011
17-----+18	19-----+20	21-----+22	23-----+24	010000	010001	010010	010011
33-----+34	35-----+36	37-----+38	39-----+40	100000	100001	100010	100011
49-----+50	51-----+52	53-----+54	55-----+56	110000	110001	110010	110011
5-- --- ---6	7-- --- ---8	9-- --- ---10	11-- --- ---12	000100	000101	000110	000111
21-- --- ---22	23-- --- ---24	25-- --- ---26	27-- --- ---28	010100	010101	010110	010111
37-- --- ---38	39-- --- ---40	41-- --- ---42	43-- --- ---44	100100	100101	100110	100111
53-----54	55-----56	57-----58	59-----60	110100	110101	110110	110111
9-----10	11-----12	13-----14	15-----16	001000	001001	001010	001011
25-----+26	27-----+28	29-----+30	31-----+32	011000	011001	011010	011011
41-----+42	43-----+44	45-----+46	47-----+48	101000	101001	101010	101011
57-----+58	59-----+60	61-----+62	63-----+64	111000	111001	111010	111011
13-- --- ---14	15-- --- ---16	17-- --- ---18	19-- --- ---20	001100	001101	001110	001111
29-- --- ---30	31-- --- ---32	33-- --- ---34	35-- --- ---36	011100	011101	011110	011111
45-- --- ---46	47-- --- ---48	49-- --- ---50	51-- --- ---52	101100	101101	101110	101111
61-----62	63-----64	65-----66	67-----68	111100	111101	111110	111111

In the 6-dimensional system, 6 axes must meet on the Origin n1: n(0,0,0,0,0,0). The Origin makes each axis with each next number adjacent to itself. There must be six next numbers adjacent to the Origin. What are they?

The first 3 of them are n2: n(0,0,0,0,0,1), n5: n(0,0,0,1,0,0) and n17: n(0,1,0,0,0,0) no doubt, when you see the figures above. What are the other three, then?

They must be n3: n(0,0,0,0,1,0), n9: n(0,0,1,0,0,0) and n33: n(1,0,0,0,0,0).

We must treat them as impartially as possible, because they have neither a rank nor a determined order by themselves.

**#5.** What conditions should we accept when we make the object?

We cannot accept n1+n2 = n1+n3 = n1+n5 = n1+n9 = n1+n17 = n1+n33 = C(= 65) to the objects of order 2. Instead of giving them up, we assume such equations as below, so that the sums of 4 entries should be equal to the magic constant Q.

For example,

n1 + n2 + n3 + n4 = Q	....(1)		n9 + n10 + n11 + n12 = Q	....(7)
n1 + n2 + n5 + n6 = Q	....(2)		n9 + n10 + n13 + n14 = Q	....(8)
n1 + n3 + n5 + n7 = Q	....(3)		n9 + n11 + n13 + n15 = Q	....(9)
n2 + n4 + n6 + n8 = Q	....(4)		n10 + n12 + n14 + n16 = Q	....(10)
n3 + n4 + n7 + n8 = Q	....(5)		n11 + n12 + n15 + n16 = Q	....(11)
n5 + n6 + n7 + n8 = Q	....(6)		n13 + n14 + n15 + n16 = Q	....(12)
n17 + n18 + n19 + n20 = Q	....(13)		n25 + n26 + n27 + n28 = Q	....(19)

$$\begin{array}{l}
n_{17} + n_{18} + n_{21} + n_{22} = Q \quad \dots(14) \quad | \quad n_{25} + n_{26} + n_{29} + n_{30} = Q \quad \dots(20) \\
n_{17} + n_{19} + n_{21} + n_{23} = Q \quad \dots(15) \quad | \quad n_{25} + n_{27} + n_{29} + n_{31} = Q \quad \dots(21) \\
n_{18} + n_{20} + n_{22} + n_{24} = Q \quad \dots(16) \quad | \quad n_{26} + n_{28} + n_{30} + n_{32} = Q \quad \dots(22) \\
n_{19} + n_{20} + n_{23} + n_{24} = Q \quad \dots(17) \quad | \quad n_{27} + n_{28} + n_{31} + n_{32} = Q \quad \dots(23) \\
n_{21} + n_{22} + n_{23} + n_{24} = Q \quad \dots(18) \quad | \quad n_{29} + n_{30} + n_{31} + n_{32} = Q \quad \dots(24)
\end{array}$$

$$\begin{array}{l}
n_1 + n_2 + n_9 + n_{10} = Q \quad \dots(25) \quad | \quad n_1 + n_5 + n_9 + n_{13} = Q \quad \dots(31) \\
n_1 + n_2 + n_{17} + n_{18} = Q \quad \dots(26) \quad | \quad n_1 + n_5 + n_{17} + n_{21} = Q \quad \dots(32) \\
n_1 + n_2 + n_{33} + n_{34} = Q \quad \dots(27) \quad | \quad n_1 + n_5 + n_{33} + n_{37} = Q \quad \dots(33) \\
n_1 + n_3 + n_9 + n_{11} = Q \quad \dots(28) \quad | \quad n_2 + n_4 + n_{10} + n_{12} = Q \quad \dots(34) \\
n_1 + n_3 + n_{17} + n_{19} = Q \quad \dots(29) \quad | \quad n_2 + n_4 + n_{18} + n_{20} = Q \quad \dots(35) \\
n_1 + n_3 + n_{33} + n_{35} = Q \quad \dots(30) \quad | \quad n_2 + n_4 + n_{34} + n_{36} = Q \quad \dots(36)
\end{array}$$

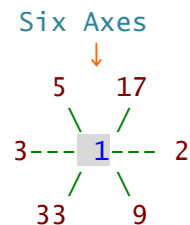
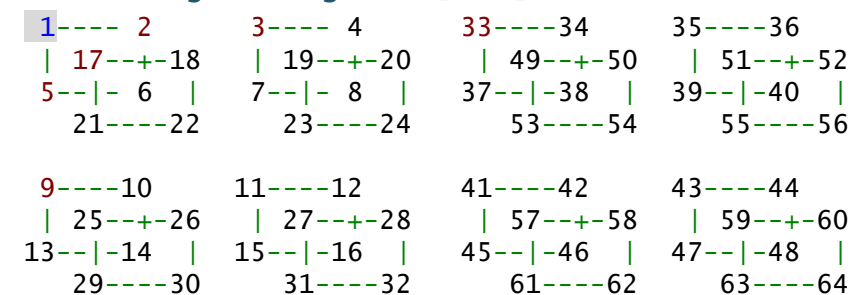
$$\begin{array}{l}
n_2 + n_6 + n_{10} + n_{14} = Q \quad \dots(37) \quad | \quad n_3 + n_7 + n_{11} + n_{15} = Q \quad \dots(43) \\
n_2 + n_6 + n_{18} + n_{22} = Q \quad \dots(38) \quad | \quad n_3 + n_7 + n_{19} + n_{23} = Q \quad \dots(44) \\
n_2 + n_6 + n_{34} + n_{38} = Q \quad \dots(39) \quad | \quad n_3 + n_7 + n_{35} + n_{39} = Q \quad \dots(45) \\
n_3 + n_4 + n_{11} + n_{12} = Q \quad \dots(40) \quad | \quad n_4 + n_8 + n_{12} + n_{16} = Q \quad \dots(46) \\
n_3 + n_4 + n_{19} + n_{20} = Q \quad \dots(41) \quad | \quad n_4 + n_8 + n_{20} + n_{24} = Q \quad \dots(47) \\
n_3 + n_4 + n_{35} + n_{36} = Q \quad \dots(42) \quad | \quad n_4 + n_8 + n_{36} + n_{40} = Q \quad \dots(48)
\end{array}$$

$$\begin{array}{l}
n_5 + n_6 + n_{13} + n_{14} = Q \quad \dots(49) \quad | \quad n_6 + n_8 + n_{38} + n_{40} = Q \quad \dots(54) \\
n_5 + n_6 + n_{21} + n_{22} = Q \quad \dots(50) \quad | \quad n_7 + n_8 + n_{15} + n_{16} = Q \quad \dots(55) \\
n_5 + n_6 + n_{37} + n_{38} = Q \quad \dots(51) \quad | \quad n_7 + n_8 + n_{23} + n_{24} = Q \quad \dots(56) \\
n_6 + n_8 + n_{14} + n_{16} = Q \quad \dots(52) \quad | \quad n_7 + n_8 + n_{39} + n_{40} = Q \quad \dots(57) \\
n_6 + n_8 + n_{22} + n_{24} = Q \quad \dots(53) \quad |
\end{array}$$

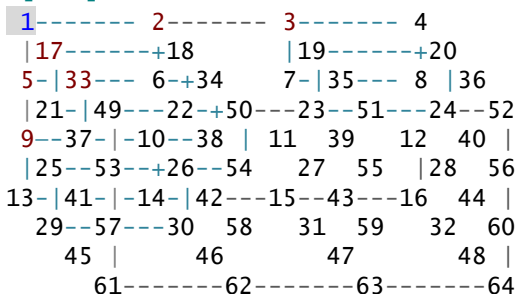
$$\begin{array}{l}
n_1 + n_{17} + n_{33} + n_{49} = Q \quad \dots(58) \quad | \quad n_5 + n_{21} + n_{37} + n_{53} = Q \quad \dots(62) \\
n_2 + n_{18} + n_{34} + n_{50} = Q \quad \dots(59) \quad | \quad n_6 + n_{22} + n_{38} + n_{54} = Q \quad \dots(63) \\
n_3 + n_{19} + n_{35} + n_{51} = Q \quad \dots(60) \quad | \quad n_7 + n_{23} + n_{39} + n_{55} = Q \quad \dots(64) \\
n_4 + n_{20} + n_{36} + n_{52} = Q \quad \dots(61) \quad | \quad n_8 + n_{24} + n_{40} + n_{56} = Q \quad \dots(65)
\end{array}$$

.... , etc. (Q = 130)

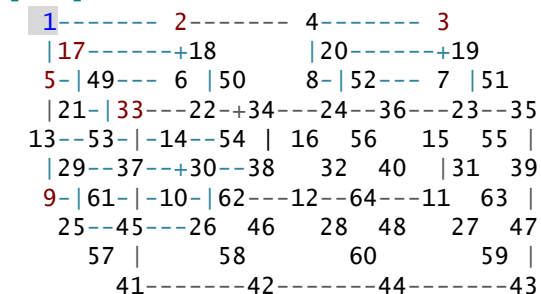
### Basic Diagrams Again [8x2³]



### [SC4³]



### [CC4³]



All 4 entries on each surface of 8 cubes above add up to the same sum 130.

You could thus put on many simultaneous equations to the rest. But you don't actually have to use them all, because half of variables are determined by those Complementary Pairs of the constant C(= 65).

For example,

$$n_{64}=C-n_1, n_{63}=C-n_2, n_{62}=C-n_3, n_{61}=C-n_4, n_{60}=C-n_5, n_{59}=C-n_6, n_{58}=C-n_7,$$

n57=C-n8, n56=C-n9, n55=C-n10, n54=C-n11, n53=C-n12, n52=C-n13,  
n51=C-n14, n50=C-n15, n49=C-n16, n48=C-n17, n47=C-n18, n46=C-n19,  
n45=C-n20, n44=C-n21, n43=C-n22, n42=C-n23, n41=C-n24, n25=C-n40,  
n26=C-n39, n27=C-n38, n28=C-n37, n29=C-n36, n30=C-n35, n31=C-n34,  
n32=C-n33 . . . . (C= 65)

**#6.** You must make the object under these strict conditions.

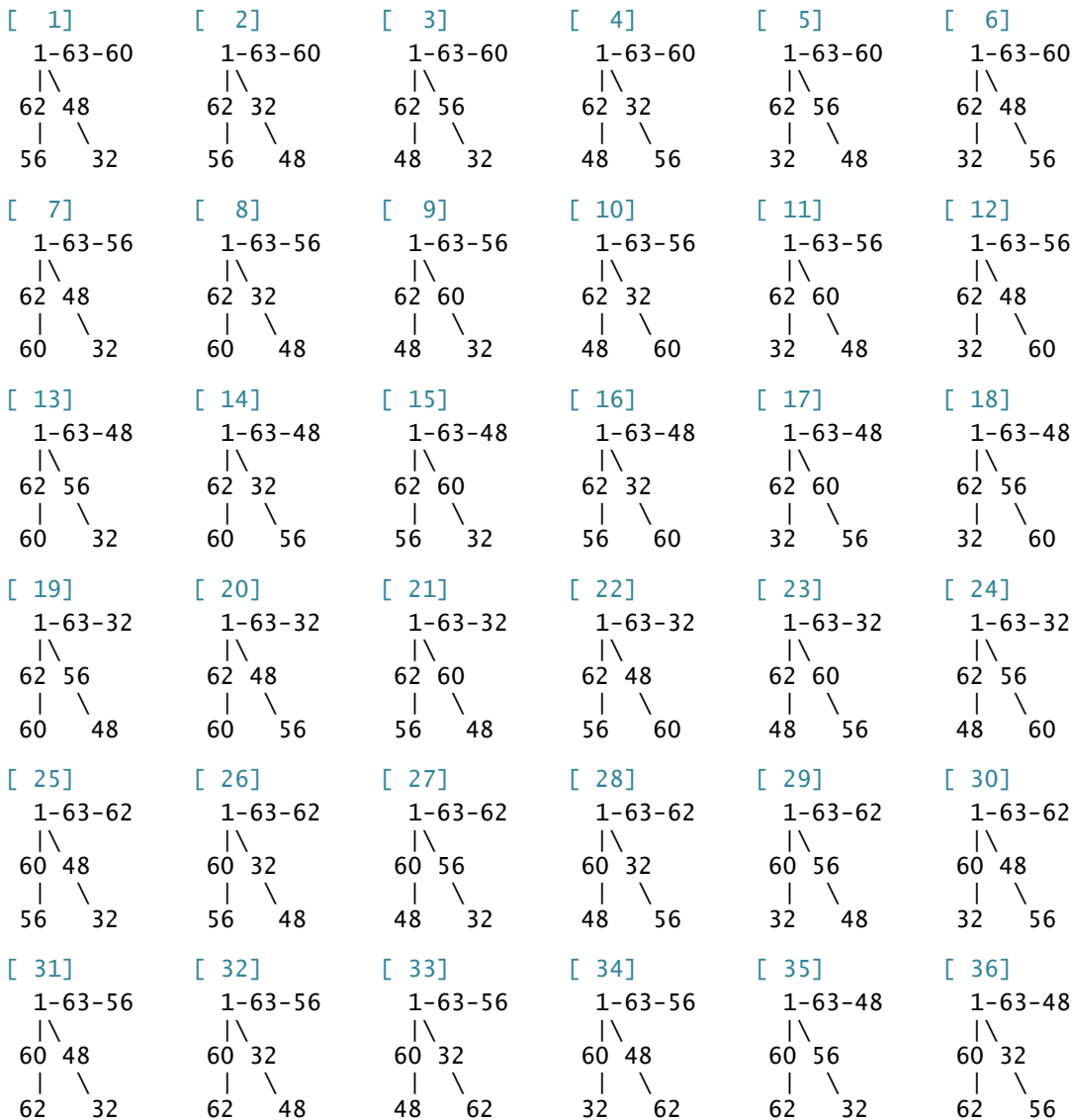
How many solutions can you make in all? Of course, you can use your computer to calculate and count them.

The count of solutions depends on the permutations of the '6 next numbers.'

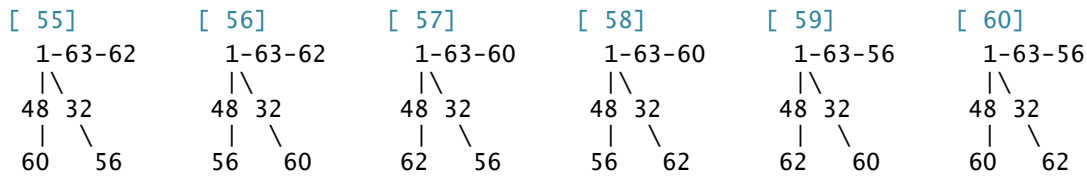
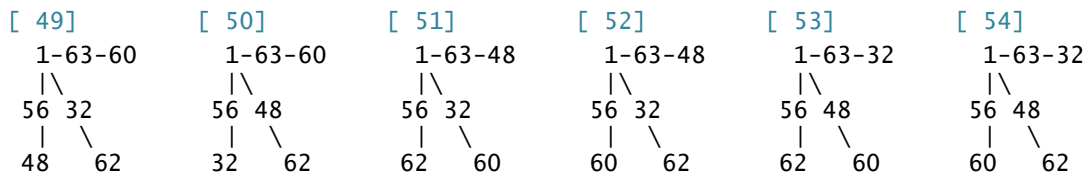
Add the conditions  $n1==1$  and  $n2>n3>n5>n9>n17>n33$  to those above, and you will get the only one solution. If you assume as  $n1==1$ ,  $n2>n5>n17$ ,  $n2>n3$ ,  $n5>n9$  and  $n17>n33$ , you will get 15 solutions in all. When you assume as  $n1==1$  and  $n2>n5>n17$ , you will get more solutions even up to 120

If you don't assume any strict inequality but only for  $n1==1$ , you will get the set of most solutions as counts:  $720 = 6 \times 5 \times 4 \times 3 \times 2 \times 1$ .

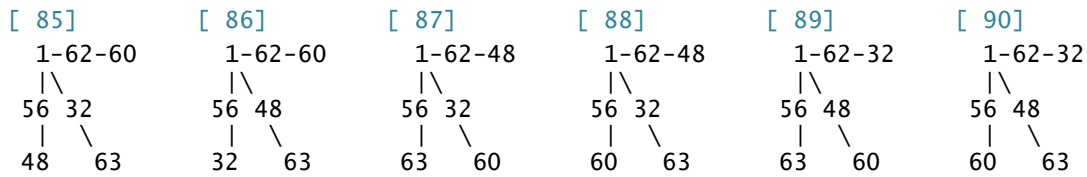
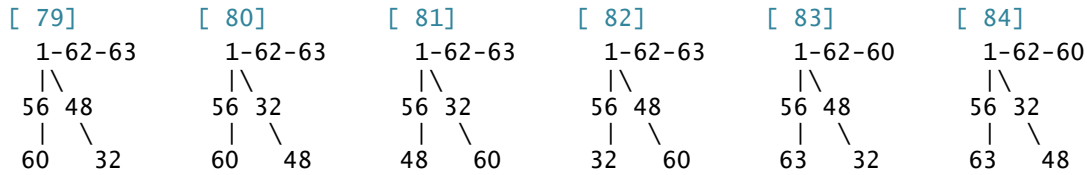
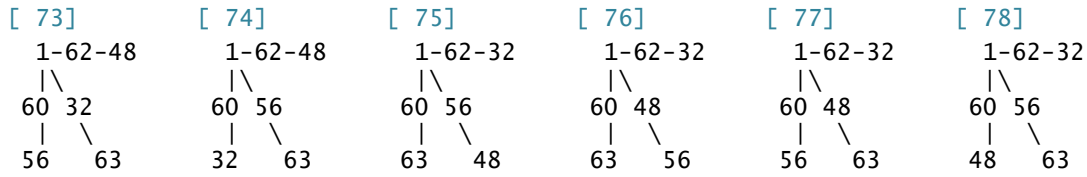
See some parts of the larger list of 120 solutions below. Watch and check where the six axes are. What are the next numbers adjacent to the Origin  $n1$ ?



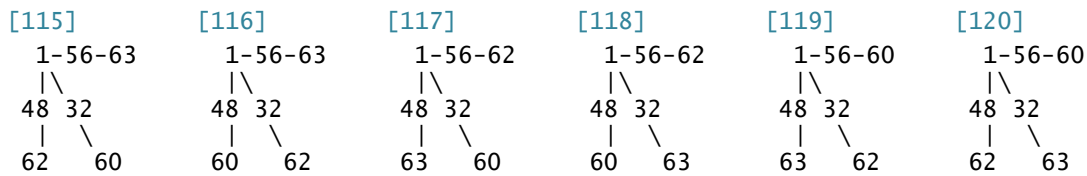
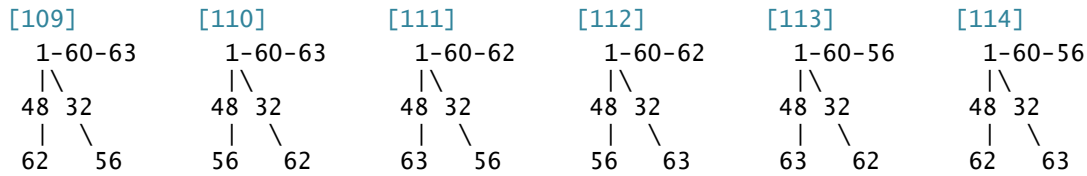
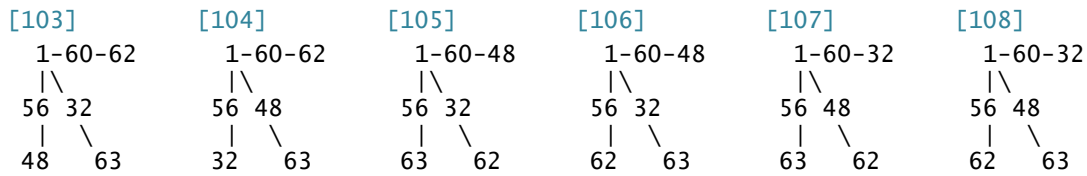
....(skip)....



....(skip)....



....(skip)....



[Count = 120] OK!

The 'next' numbers on the six proper axes are only 63, 62, 60, 56, 48 and 32. It is just the same property with one of the most important characteristics of 'Composite & Complete' Pan-magic Cubes of order 4.

Each number of those six is free to go anywhere on the axes. As a result some kind of rotation seems to occur. The number of permutations  ${}_6P_6$  is 720.

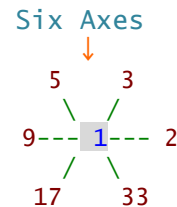
Everything seems to imply our success, doesn't it? Yes, we have succeeded in making the 6-dimensional object at last.

### #7. Now let's study about the 'dimension convertor.'

\*\* Basic Diagrams Again \*\*

0/ECO2<sup>6</sup>

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



[SC4<sup>3</sup>]

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

[CC4<sup>3</sup>]

1	2	4	3
17	18	20	19
5	49	6	50
8	52	7	51
21	33	22	34
24	36	23	35
13	53	14	54
16	56	15	55
29	37	30	38
32	40	31	39
9	61	10	62
12	64	11	63
25	45	26	46
28	48	27	47
57	60	58	59
41	62	42	63
44	64	43	65

Decomposed Forms [SC4<sup>3</sup>] and [CC4<sup>3</sup>] are derived from the Form [ECO2<sup>6</sup>]. That implies the possibility of 'Dimension Convertor.'

Yes. Form [SC4<sup>3</sup>] is already a Self-complementary Magic Cube of order 4.

Equations such as  $n_1+n_64=n_2+n_63=n_3+n_62=\dots=n_{31}+n_{34}=n_{32}+n_{33}=C=65$  are still active.

Therefore the 4 primary triangulars ( $n_1+n_{22}+n_{43}+n_{64}=Q$ ;  $n_4+n_{23}+n_{42}+n_{61}=Q$ ;

$N_{49}+n_{38}+n_{27}+n_{16}=Q$ ;  $n_{52}+n_{39}+n_{26}+n_{13}=Q$ ;) are consequently true.

And  $n_1+n_2+n_3+n_4=Q$ ;  $n_1+n_5+n_9+n_{13}=Q$ ;  $n_1+n_{17}+n_{33}+n_{49}=Q$ ; . . . .,

$n_2+n_6+n_{10}+n_{14}=Q$ ;  $n_2+n_{18}+n_{34}+n_{50}=Q(=130)$ ; . . . . etc. must be true.

It must be a Magic Cube.

Let's now transform the Form [SC4<sup>3</sup>] into the Form [CC4<sup>3</sup>] shown above.

First of all, divide it into 8 blocks of 2x2x2 little cubes as existed in the Form [ECO2<sup>6</sup>]. You must always keep the first block on the left rear unchanged as it is.

Don't change any positions of every other blocks on the whole, but change the surfaces of their inner contents. They always 'turn over' or 'turn around'.

Only exchange their inner positions in any 2x2x2 blocks just in the same ways as drawn in those figures above, and you could finally get a 'Composite and Complete' Pan-magic Cube of order 4. Here you are at the program codes below.

```
//
/** Transform it into 'C&C' MC444 *
void trnsfcc(){
    tnm[1]=nm[1];    tnm[2]=nm[2];    tnm[3]=nm[4];    tnm[4]=nm[3];
    tnm[5]=nm[5];    tnm[6]=nm[6];    tnm[7]=nm[8];    tnm[8]=nm[7];
    tnm[9]=nm[13];   tnm[10]=nm[14]; tnm[11]=nm[16]; tnm[12]=nm[15];
    tnm[13]=nm[9];   tnm[14]=nm[10]; tnm[15]=nm[12]; tnm[16]=nm[11];
    tnm[17]=nm[17];  tnm[18]=nm[18]; tnm[19]=nm[20]; tnm[20]=nm[19];
    tnm[21]=nm[21];  tnm[22]=nm[22]; tnm[23]=nm[24]; tnm[24]=nm[23];
    tnm[25]=nm[29];  tnm[26]=nm[30]; tnm[27]=nm[32]; tnm[28]=nm[31];
}
```

```

tnm[29]=nm[25]; tnm[30]=nm[26]; tnm[31]=nm[28]; tnm[32]=nm[27];
tnm[33]=nm[49]; tnm[34]=nm[50]; tnm[35]=nm[52]; tnm[36]=nm[51];
tnm[37]=nm[53]; tnm[38]=nm[54]; tnm[39]=nm[56]; tnm[40]=nm[55];
tnm[41]=nm[61]; tnm[42]=nm[62]; tnm[43]=nm[64]; tnm[44]=nm[63];
tnm[45]=nm[57]; tnm[46]=nm[58]; tnm[47]=nm[60]; tnm[48]=nm[59];
tnm[49]=nm[33]; tnm[50]=nm[34]; tnm[51]=nm[36]; tnm[52]=nm[35];
tnm[53]=nm[37]; tnm[54]=nm[38]; tnm[55]=nm[40]; tnm[56]=nm[39];
tnm[57]=nm[45]; tnm[58]=nm[46]; tnm[59]=nm[48]; tnm[60]=nm[47];
tnm[61]=nm[41]; tnm[62]=nm[42]; tnm[63]=nm[44]; tnm[64]=nm[43];
}
//

```

Yes. You can finally pick up the 'C&C' MC444 out of the original 6-d object.

Check all rows, columns and pillars if every 4 entries of them add up to the magic constant 130. Examine if 4 entries of any 2x2 little squares in all directions add up to 130. And watch carefully whether all Complementary Pairs of 65 do surely exist on all the pan-triagonals or not.

Where are now the six numbers next to the origin of 6-d object in our cubes? They are on the three axes of our cubes by 2 x 3.

Examine the 15 'C&C' Pan-magic Cubes in the next list below, and you can find that they are perfectly the same with the old 'fundamental' solutions we found and classified in the past.

How amazing it is!

```

** Build the High Dimensional Extra-Cubic Magic Objects, **
** Transform them into SC & CC Types of Cubes and **
** List out the Most Fundamental 15 Solutions **
(Under n1=1, n2>n5>n17, n2>n3, n5>n9, n17>n33)

```

1/EC02^6

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

1/SC

1/CC

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

2/EC02^6

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

2/SC

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

2/CC

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

3/EC02^6

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

3/SC

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

3/CC

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

4/EC02^6

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

4/SC

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

4/CC

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

5/EC02^6

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



5/SC

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

5/CC

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

6/EC02^6

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

6/SC

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

6/CC

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

7/EC02^6

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

7/SC

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

7/CC

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

8/EC02^6

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

## 8/SC

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

## 8/CC

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

## 9/EC02^6

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

## 9/SC

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

## 9/CC

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

## 10/EC02^6

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

## 10/SC

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

## 10/CC

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

## 11/EC02^6

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

11/SC

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

11/CC

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

12/EC02^6

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

12/SC

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

12/CC

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

13/EC02^6

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

13/SC

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

13/CC

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

14/EC02^6

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

14/SC

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

14/CC

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

15/EC02A6

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

15/SC

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

15/CC

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

[Count = 15] OK!

Basic Diagrams #1 Again

1	2	3	4	SC4^3/SC8^2	1	2	3	4	17	18	19	20				
17	18	19	20	5	6	7	8	21	22	23	24					
5	33	6	34	7	35	8	36	9	10	11	12	25	26	27	28	
21	49	22	50	23	51	24	52	13	14	15	16	29	30	31	32	
9	37	10	38	11	39	12	40		33	34	35	36	49	50	51	52
25	53	26	54	27	55	28	56	37	38	39	40	53	54	55	56	
13	41	14	42	15	43	16	44		41	42	43	44	57	58	59	60
29	57	30	58	31	59	32	60		45	46	47	48	61	62	63	64
45		46	47	48												
61	62	63	64													

1	2	4	3	CC4^3/CC8^2	1	2	4	3	29	30	32	31				
17	18	20	19	5	6	8	7	25	26	28	27					
5	49	6	50	8	52	7	51	13	14	16	15	17	18	20	19	
21	33	22	34	24	36	23	35	9	10	12	11	21	22	24	23	
13	53	14	54	16	56	15	55		36	35	33	34	64	63	61	62
29	37	30	38	32	40	31	39	40	39	37	38	60	59	57	58	
9	61	10	62	12	64	11	63		48	47	45	46	52	51	49	50
25	45	26	46	28	48	27	47		44	43	41	42	56	55	53	54
57		58	60	59												
41	42	44	43													

#8. You can also make the 2-dimensional 'Self-Complementary' or 'Composite & Complete' type of Magic Squares of order 8. Watch the diagrams above again and

know how to make the Forms  $SC8^2$  or  $CC8^2$  out of the Forms  $SC4^3$  or  $CC4^3$ . They are the grandchildren of 6-dimensional Magic Object in the heaven.

I skip explaining how I discovered those ways of making them, but I believe the two figures above for 'starts' and 'goals' might tell you about everything.

Let's come quickly to the Solution List No.2 below. Though it is the smallest list with only 10 solutions in all, it sounds to tell us most, I would say.

They prove to be the 'fundamental' solutions. Each of them corresponds one-to-one to each of "Ten **Principal Squares** (Drs. Ollerenshaw and Brae, English mathematicians, discovered) ".

```
** Build the Extra-Cubic Magic Objects of Order 2x2x2x2x2x2; **
** Transform them into 'SC' & 'CC' Types of Cubes & Squares; **
** and List out the Most Fundamental 10 Solutions of MS88; **
      (n1==1, n2>n5, n2>n3>n31, n5>n9>n44)
```

[1]

```
1-----63-----60----- 6          SC4^3/8^2
| 48          18          21          | 43          1 63 60 6 48 18 21 43
62  32      4   34      7   37      57   27      62  4  7 57 19 45 42 24
| 19      49----45----15----42----12---+24----54  56 10 13 51 25 39 36 30
56  35  | 10   29   13   26   51   40  | 11 53 50 16 38 28 31 33
| 25   14  39   52   36   55  | 30   9   32 34 37 27 49 15 12 54
11----41--|-53----23----50----20----16   46  | 35 29 26 40 14 52 55 9
      38   8   28   58   31   61   33   3   41 23 20 46 8 58 61 3
          22  |          44          47          17  | 22 44 47 17 59 5 2 64
          59----- 5----- 2-----64
```

```
1-----63----- 6-----60          CC4^3/8^2
| 48          18          43          | 21          1 63 6 60 38 28 33 31
62  49      4   15   57   54      7   12      62  4 57 7 25 39 30 36
| 19      32----45----34----24----27---+42----37  11 53 16 50 48 18 43 21
11  14  | 53   52   16   9   50   55  | 56 10 51 13 19 45 24 42
| 38   35  28   29   33   40  | 31   26  27 37 32 34 64 2 59 5
56----59--|-10---- 5----51----64----13     2  | 40 26 35 29 3 61 8 58
      25   22  39   44   30   17   36   47  17 47 22 44 54 12 49 15
          8  |          58          3          61  | 46 20 41 23 9 55 14 52
          41-----23-----46-----20
```

[2]

```
1-----63-----60----- 6          SC4^3/8^2
| 32          34          37          | 27          1 63 60 6 32 34 37 27
62  48      4   18      7   21      57   43      62  4  7 57 35 29 26 40
| 35      49----29----15----26----12---+40----54  56 10 13 51 41 23 20 46
56  19  | 10   45   13   42   51   24  | 11 53 50 16 22 44 47 17
| 41   14  23   52   20   55  | 46   9   48 18 21 43 49 15 12 54
11----25--|-53----39----50----36----16   30  | 19 45 42 24 14 52 55 9
      22   8   44   58   47   61   17   3   25 39 36 30 8 58 61 3
          38  |          28          31          33  | 38 28 31 33 59 5 2 64
          59----- 5----- 2-----64
```

```
1-----63----- 6-----60          CC4^3/8^2
| 32          34          27          | 37          1 63 6 60 22 44 17 47
62  49      4   15   57   54      7   12      62  4 57 7 41 23 46 20
| 35      48----29----18----40----43---+26----21  11 53 16 50 32 34 27 37
11  14  | 53   52   16   9   50   55  | 56 10 51 13 35 29 40 26
| 22   19  44   45   17   24  | 47   42  43 21 48 18 64 2 59 5
56----59--|-10---- 5----51----64----13     2  | 24 42 19 45 3 61 8 58
      41   38  23   28   46   33   20   31  33 31 38 28 54 12 49 15
          8  |          58          3          61  | 30 36 25 39 9 55 14 52
          25-----39-----30-----36
```

[3]

1-----63-----60-----6	SC4^3/8^2	
32            34            37              27		1 63 60 6 32 34 37 27
62    56        4        10        7        13        57        51		62 4 7 57 35 29 26 40
35    41-----29-----23-----26-----20---+40-----46		48 18 21 43 49 15 12 54
48    11   18        53        21        50        43        16		19 45 42 24 14 52 55 9
49    22    15    44        12    47   54        17		56 10 13 51 41 23 20 46
19-----25-- -45-----39-----42-----36-----24    30		11 53 50 16 22 44 47 17
14    8    52    58        55    61        9        3		25 39 36 30 8 58 61 3
38              28            31            33		38 28 31 33 59 5 2 64
59-----5-----2-----64		

1-----63-----6-----60	CC4^3/8^2	
32            34            27              37		1 63 6 60 14 52 9 55
62    41        4        23        57        46        7        20		62 4 57 7 49 15 54 12
35    56-----29-----10-----40-----51---+26-----13		19 45 24 42 32 34 27 37
19    22   45        44        24        17        42        47		48 18 43 21 35 29 40 26
14    11    52    53        9        16   55        50		51 13 56 10 64 2 59 5
48-----59-- -18-----5-----43-----64-----21    2		16 50 11 53 3 61 8 58
49    38    15    28        54    33        12    31		33 31 38 28 46 20 41 23
8              58            3            61		30 36 25 39 17 47 22 44
25-----39-----30-----36		

[4]

1-----63-----56-----10	SC4^3/8^2	
48            18            25              39		1 63 56 10 48 18 25 39
62    32        4        34        11        41        53        23		62 4 11 53 19 45 38 28
19    49-----45-----15-----38-----8---+28-----58		60 6 13 51 21 43 36 30
60    35   6        29        13        22        51        44		7 57 50 16 42 24 31 33
21    14    43    52        36    59   30        5		32 34 41 23 49 15 8 58
7-----37-- -57-----27-----50-----20-----16    46		35 29 22 44 14 52 59 5
42    12    24    54        31    61        33        3		37 27 20 46 12 54 61 3
26              40            47            17		26 40 47 17 55 9 2 64
55-----9-----2-----64		

1-----63-----10-----56	CC4^3/8^2	
48            18            39              25		1 63 10 56 42 24 33 31
62    49        4        15        53        58        11        8		62 4 53 11 21 43 30 36
19    32-----45-----34-----28-----23---+38-----41		7 57 16 50 48 18 39 25
7    14   57        52        16        5        50        59		60 6 51 13 19 45 28 38
42    35    24    29        33    44   31        22		23 41 32 34 64 2 55 9
60-----55-- -6-----9-----51-----64-----13    2		44 22 35 29 3 61 12 54
21    26    43    40        30    17        36        47		17 47 26 40 58 8 49 15
12              54            3            61		46 20 37 27 5 59 14 52
37-----27-----46-----20		

[5]

1-----63-----56-----10	SC4^3/8^2	
32            34            41              23		1 63 56 10 32 34 41 23
62    48        4        18        11        25        53        39		62 4 11 53 35 29 22 44
35    49-----29-----15-----22-----8---+44-----58		60 6 13 51 37 27 20 46
60    19   6        45        13        38        51        28		7 57 50 16 26 40 47 17
37    14    27    52        20    59   46        5		48 18 25 39 49 15 8 58
7-----21-- -57-----43-----50-----36-----16    30		19 45 38 28 14 52 59 5
26    12    40    54        47    61        17        3		21 43 36 30 12 54 61 3
42              24            31            33		42 24 31 33 55 9 2 64
55-----9-----2-----64		

1-----63-----10-----56	CC4^3/8^2	
32            34            23              41		1 63 10 56 26 40 17 47
62    49        4        15        53        58        11        8		62 4 53 11 37 27 46 20
35    48-----29-----18-----44-----39---+22-----25		7 57 16 50 32 34 23 41
7    14   57        52        16        5        50        59		60 6 51 13 35 29 44 22
26    19    40    45        17    28   47        38		39 25 48 18 64 2 55 9
60-----55-- -6-----9-----51-----64-----13    2		28 38 19 45 3 61 12 54
37    42    27    24        46    33        20        31		33 31 42 24 58 8 49 15
12              54            3            61		30 36 21 43 5 59 14 52
21-----43-----30-----36		

[6]

1-----63-----48-----18	SC4^3/8^2	
56           10           25             39		1 63 48 18 56 10 25 39
62 32       4       34       19       49         45       15		62 4 19 45 11 53 38 28
11       41-----53-----23-----38-----8---+---28-----58		60 6 21 43 13 51 36 30
60 35   6       29       21       14       43       52		7 57 42 24 50 16 31 33
13       22       51       44       36       59   30       5		32 34 49 15 41 23 8 58
7---37-- -57-----27-----42-----12-----24   54		35 29 14 52 22 44 59 5
50   20   16   46   31   61   33   3		37 27 12 54 20 46 61 3
26             40           55           9		26 40 55 9 47 17 2 64
47-----17-----2-----64		

1-----63-----18-----48	CC4^3/8^2	
56           10           39             25		1 63 18 48 50 16 33 31
62 41       4       23       45       58       19       8		62 4 45 19 13 51 30 36
11       32-----53-----34-----28-----15---+---38-----49		7 57 24 42 56 10 39 25
7 22   57       44       24       5       42       59		60 6 43 21 11 53 28 38
50       35       16       29       33       52   31       14		15 49 32 34 64 2 47 17
60---47-- -6-----17-----43-----64-----21   2		52 14 35 29 3 61 20 46
13   26   51   40   30   9   36   55		9 55 26 40 58 8 41 23
20             46           3           61		54 12 37 27 5 59 22 44
37-----27-----54-----12		

[7]

1-----63-----62-----4	SC4^3/8^2	
48           18           19             45		1 63 62 4 48 18 19 45
60 32       6       34       7       35       57       29		60 6 7 57 21 43 42 24
21       49-----43-----15-----42-----14---+---24-----52		56 10 11 53 25 39 38 28
56 37   10       27       11       26       53       40		13 51 50 16 36 30 31 33
25       12       39       54       38       55   28       9		32 34 35 29 49 15 14 52
13---41-- -51-----23-----50-----22-----16   44		37 27 26 40 12 54 55 9
36   8   30   58   31   59   33   5		41 23 22 44 8 58 59 5
20             46           47           17		20 46 47 17 61 3 2 64
61-----3-----2-----64		

1-----63-----4-----62	CC4^3/8^2	
48           18           45             19		1 63 4 62 36 30 33 31
60 49       6       15       57       52       7       14		60 6 57 7 25 39 28 38
21       32-----43-----34-----24-----29---+---42-----35		13 51 16 50 48 18 45 19
13 12   51       54       16       9       50       55		56 10 53 11 21 43 24 42
36       37       30       27       33       40   31       26		29 35 32 34 64 2 61 3
56---61-- -10-----3-----53-----64-----11   2		40 26 37 27 5 59 8 58
25   20   39   46   28   17   38   47		17 47 20 46 52 14 49 15
8             58           5           59		44 22 41 23 9 55 12 54
41-----23-----44-----22		

[8]

1-----63-----62-----4	SC4^3/8^2	
32           34           35             29		1 63 62 4 32 34 35 29
60 48       6       18       7       19       57       45		60 6 7 57 37 27 26 40
37       49-----27-----15-----26-----14---+---40-----52		56 10 11 53 41 23 22 44
56 21   10       43       11       42       53       24		13 51 50 16 20 46 47 17
41       12       23       54       22       55   44       9		48 18 19 45 49 15 14 52
13---25-- -51-----39-----50-----38-----16   28		21 43 42 24 12 54 55 9
20   8   46   58   47   59   17   5		25 39 38 28 8 58 59 5
36             30           31           33		36 30 31 33 61 3 2 64
61-----3-----2-----64		

1-----63-----4-----62	CC4^3/8^2	
32           34           29             35		1 63 4 62 20 46 17 47
60 49       6       15       57       52       7       14		60 6 57 7 41 23 44 22
37       48-----27-----18-----40-----45---+---26-----19		13 51 16 50 32 34 29 35
13 12   51       54       16       9       50       55		56 10 53 11 37 27 40 26
20       21       46       43       17       24   47       42		45 19 48 18 64 2 61 3
56---61-- -10-----3-----53-----64-----11   2		24 42 21 43 5 59 8 58
41   36   23   30   44   33   22   31		33 31 36 30 52 14 49 15
8             58           5           59		28 38 25 39 9 55 12 54
25-----39-----28-----38		

[9]

```

1-----63-----62----- 4          SC4^3/8^2
| 32          34          35          | 29          1 63 62 4 32 34 35 29
60 56      6 10      7 11      57 53      60 6 7 57 37 27 26 40
| 37 41-----27-----23-----26-----22-----40-----44      48 18 19 45 49 15 14 52
48 13 | 18 51 19 50 45 16 | 21 43 42 24 12 54 55 9
| 49 20 15 46 14 47 | 52 17 56 10 11 53 41 23 22 44
21-----25--|-43-----39-----42-----38-----24      28 | 13 51 50 16 20 46 47 17
12      8 54 58 55 59 9 5 25 39 38 28 8 58 59 5
36 | 30 31 33 | 36 30 31 33 61 3 2 64
61----- 3----- 2-----64

```

```

1-----63----- 4-----62          CC4^3/8^2
| 32          34          29          | 35          1 63 4 62 12 54 9 55
60 41      6 23      57 44      7 22      60 6 57 7 49 15 52 14
| 37 56-----27-----10-----40-----53-----26-----11      21 43 24 42 32 34 29 35
21 20 | 43 46 24 17 42 47 | 48 18 45 19 37 27 40 26
| 12 13 54 51 9 16 | 55 50 53 11 56 10 64 2 61 3
48-----61--|-18----- 3-----45-----64-----19      2 | 16 50 13 51 5 59 8 58
49 36 15 30 52 33 14 31 33 31 36 30 44 22 41 23
8 | 58 5 59 | 28 38 25 39 17 47 20 46
25-----39-----28-----38

```

[10]

```

1-----63-----62----- 4          SC4^3/8^2
| 32          34          35          | 29          1 63 62 4 32 34 35 29
56 60      10 6      11 7      53 57      56 10 11 53 41 23 22 44
| 41 37-----23-----27-----22-----26-----44-----40      48 18 19 45 49 15 14 52
48 13 | 18 51 19 50 45 16 | 25 39 38 28 8 58 59 5
| 49 20 15 46 14 47 | 52 17 60 6 7 57 37 27 26 40
25-----21--|-39-----43-----38-----42-----28      24 | 13 51 50 16 20 46 47 17
8 12 58 54 59 55 5 9 21 43 42 24 12 54 55 9
36 | 30 31 33 | 36 30 31 33 61 3 2 64
61----- 3----- 2-----64

```

```

1-----63----- 4-----62          CC4^3/8^2
| 32          34          29          | 35          1 63 4 62 8 58 5 59
56 37      10 27      53 40      11 26      56 10 53 11 49 15 52 14
| 41 60-----23----- 6-----44-----57-----22----- 7      25 39 28 38 32 34 29 35
25 20 | 39 46 28 17 38 47 | 48 18 45 19 41 23 44 22
| 8 13 58 51 5 16 | 59 50 57 7 60 6 64 2 61 3
48-----61--|-18----- 3-----45-----64-----19      2 | 16 50 13 51 9 55 12 54
49 36 15 30 52 33 14 31 33 31 36 30 40 26 37 27
12 | 54 9 55 | 24 42 21 43 17 47 20 46
21-----43-----24-----42

```

[Count = 10] OK!

\*\* Calculated and Listed by Kanji Setsuda on Sep.27, 2013 with MacOSX 10.8.5 & Xcode 5.0 \*\*

15 and 10: What do you think of the reason why the 'fundamental' solutions count 15 for 'C&C' Magic Cubes of order 4 and count 10 for 'C&C' Magic Squares of order 8?

I think the reason depends on the permutations of the six next numbers, originally adjacent to the n1 of 6-dimensional 'grandmother.'

How many ways do they appear in our objects?

The final conclusions I have found are:

In Magic Cubes of order 4: 2 by 3 axes:  ${}^6C_2 \times {}^4C_2 / {}^3P_3 = 15$

In Magic Squares of order 8: 3 by 2 axes:  ${}^6C_3 / {}^2P_2 = 10$



## \*\* Conversions and Transformations \*\*

The original 6-d Extra-C Magic Object of order 2 (Only one)	--> 3-d Self- complementary Magic Cube of order 4 (15 solutions)	--> 3-d 'C&C' Magic Cube of order 4 (15 solutions)	--> 2-d 'C&C' Magic Square of order 8 (10 solutions)
---	--	--	--

(Originally Written on June 27, 2001; Revised on May 7, 2005;  
The Newest Revision by Kanji Setsuda on Sep.27, 2013;  
Working with MacOSX 10.8.5 & Xcode 5.0)

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### 【Program List】

```
/** Make the Extra-Cubic Magic Objects of Order 2^6 and **
/** Transform them into SC & CC Magic Cubes & Squares **
/** and List out the Most Fundamental 10 Solutions **
/** File Name: 'EC026CCF10.c' Dictated by Kanji Setsuda **
/** on Mar.22, 2005; Jan.26, 2009 and Sep.27, 2013; **
/** with MacOSX 10.8.5 and Xcode 5.0 **
//
#include <stdio.h>
//
/** Variables *
short int cnt, tc[3];
short c2, c3;
short CC, LSM, SSM;
short nm[65], flg[65];
short tn[3][65];
//
/** Sub-Routines *
void stp01(void), stp02(void), stp03(void), stp04(void), stp05(void);
void stp06(void), stp07(void), stp08(void), stp09(void), stp10(void);
void stp11(void), stp12(void), stp13(void), stp14(void), stp15(void);
void stp16(void), stp17(void), stp18(void), stp19(void), stp20(void);
void stp21(void), stp22(void), stp23(void), stp24(void), stp25(void);
void stp26(void), stp27(void), stp28(void), stp29(void), stp30(void);
void stp31(void), stp32(void), stp33(void), stp34(void), stp35(void);
void stp36(void), stp37(void), stp38(void), stp39(void), stp40(void);
void ansprint(void), prpat1(void), prpat2(void), prpat3(void);
void ans26print(void), pr1pat26(void), pr2pat26(void), pr3pat26(void);
void ans8print(void), prpat8(short x), trnsfcc(void);
//
/** The Basic Diagrams for Extra-Cubic Object 2^6 **
//
// 1---- 2      3---- 4      33----34      35----36
// | 17---+18  | 19---+20  | 49---+50  | 51---+52
// 5--|- 6 | 7--|- 8 | 37--|-38 | 39--|-40 |
// 21----22      23----24      53----54      55----56
//
// 9----10      11----12      41----42      43----44
// | 25---+26  | 27---+28  | 57---+58  | 59---+60
// 13--|-14 | 15--|-16 | 45--|-46 | 47--|-48 |
// 29----30      31----32      61----62      63----64
//
//
```

```

// 1----- 2----- 3----- 4          SC4^3/8^2
// | 17          18          19          | 20          1 2 3 4 17 18 19 20
// | 5 33        6 34        7 35        8 36        5 6 7 8 21 22 23 24
// | 21 49-----22-----50-----23-----51-----24-----52 9 10 11 12 25 26 27 28
// | 9 37 | 10 38 | 11 39 | 12 40 | 13 14 15 16 29 30 31 32
// | 25 53 | 26 54 | 27 55 | 28 56 | 33 34 35 36 49 50 51 52
// | 13-----41--|14-----42-----15-----43-----16 44 | 37 38 39 40 53 54 55 56
// | 29 57 | 30 58 | 31 59 | 32 60 | 41 42 43 44 57 58 59 60
// | 45 | 46 | 47 | 48 | 45 46 47 48 61 62 63 64
// | 61-----62-----63-----64
//
// 1----- 2----- 4----- 3          CC4^3/8^2
// | 17          18          20          | 19          1 2 4 3 29 30 32 31
// | 5 49        6 50        8 52        7 51        5 6 8 7 25 26 28 27
// | 13 21 33-----22-----34-----24-----36-----23-----35 13 14 16 15 17 18 20 19
// | 29 53 | 14 54 | 16 56 | 15 55 | 9 10 12 11 21 22 24 23
// | 9 37 | 30 38 | 32 40 | 31 39 | 36 35 33 34 64 63 61 62
// | 25 45 | 26 46 | 28 48 | 27 47 | 40 39 37 38 60 59 57 58
// | 57 | 58 | 60 | 59 | 44 43 41 42 56 55 53 54
// | 41-----42-----44-----43
//
/* Main Program *
int main(){
short n;
printf("\n");
printf("*** Build the Extra-Cubic Magic Objects of Order 2x2x2x2x2; **\n");
printf("*** Transform them into 'SC' & 'CC' Types of Cubes & Squares; **\n");
printf("*** and List out the Most Fundamental 10 Solutions of MS88; **\n");
printf("      (n1==1, n2>n5, n2>n3>n31, n5>n9>n44)\n");
for(n=0;n<65;n++){nm[n]=0; flg[n]=0;}
CC=65; SSM=130; cnt=0; c3=0;
stp01(); /* Begin the Calculations *
//if(c3>0){prpat8(c3);}
printf("\n");
printf(" [Count = %d] OK!\n",cnt);
printf("\n");
printf("*** Calculated and Listed by Kanji Setsuda on\n");
printf("      Sep.27, 2013 with MacOSX 10.8.5 & Xcode 5.0 **\n");
printf("\n");
return 0;
}
//
/* Begin the Calculations *
/* Set n1=1 & n64=64 *
void stp01(){
short a,b;
for(a=1;a<2;a++){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[1]=a; nm[64]=b;
flg[a]=1; flg[b]=1;
stp02();
flg[b]=0; flg[a]=0;}
}
}
/* Set n2 & n63 *
void stp02(){
short a,b;
for(a=63;a>1;a--){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[2]=a; nm[63]=b;
flg[a]=1; flg[b]=1;
stp03();
flg[b]=0; flg[a]=0;}
}
}
}

```

```

/** Set n5 & n60 & n5<n2 *
void stp03(){
  short a,b;
  for(a=nm[2]-1;a>1;a--){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[5]=a; nm[60]=b;
      flg[a]=1; flg[b]=1;
      stp04();
      flg[b]=0; flg[a]=0;}
  }
}
/** Set n6=SSM-n1-n2-n5 & n59 *
void stp04(){
  short a,b;
  a=SSM-nm[1]-nm[2]-nm[5];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[6]=a; nm[59]=b;
      flg[a]=1; flg[b]=1;
      stp05();
      flg[b]=0; flg[a]=0;}}
}
/** Set n3 & n62 & n2>n3 *
void stp05(){
  short a,b;
  for(a=nm[2]-1;a>1;a--){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[3]=a; nm[62]=b;
      flg[a]=1; flg[b]=1;
      stp06();
      flg[b]=0; flg[a]=0;}
  }
}
/** Set n4=SSM-n1-n2-n3 & n61 *
void stp06(){
  short a,b;
  a=SSM-nm[1]-nm[2]-nm[3];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[4]=a; nm[61]=b;
      flg[a]=1; flg[b]=1;
      stp07();
      flg[b]=0; flg[a]=0;}}
}
/** Set n7=SSM-n1-n3-n5 & n58 *
void stp07(){
  short a,b;
  a=SSM-nm[1]-nm[3]-nm[5];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[7]=a; nm[58]=b;
      flg[a]=1; flg[b]=1;
      stp08();
      flg[b]=0; flg[a]=0;}}
}
/** Set n8=SSM-n2-n4-n6 & n57 *
void stp08(){
  short a,b;
  a=SSM-nm[2]-nm[4]-nm[6];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[8]=a; nm[57]=b;
      flg[a]=1; flg[b]=1;
      stp09();
      flg[b]=0; flg[a]=0;}}
}

```

```

/** Level: 2 *
/** Set n9 & n56 & n5>n9 *
void stp09(){
  short a,b;
  for(a=nm[5]-1;a>1;a--){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[9]=a; nm[56]=b;
      flg[a]=1; flg[b]=1;
      stp10();
      flg[b]=0; flg[a]=0;}
  }
}
/** Set n10=SSM-n1-n2-n9 & n55 *
void stp10(){
  short a,b;
  a=SSM-nm[1]-nm[2]-nm[9];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[10]=a; nm[55]=b;
      flg[a]=1; flg[b]=1;
      stp11();
      flg[b]=0; flg[a]=0;}}
}
/** Set n11=SSM-n1-n3-n9 & n54 *
void stp11(){
  short a,b;
  a=SSM-nm[1]-nm[3]-nm[9];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[11]=a; nm[54]=b;
      flg[a]=1; flg[b]=1;
      stp12();
      flg[b]=0; flg[a]=0;}}
}
/** Set n12=SSM-n2-n4-n10 & n53 *
void stp12(){
  short a,b;
  a=SSM-nm[2]-nm[4]-nm[10];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[12]=a; nm[53]=b;
      flg[a]=1; flg[b]=1;
      stp13();
      flg[b]=0; flg[a]=0;}}
}
/** Set n13=SSM-n1-n5-n9 & n52 *
void stp13(){
  short a,b;
  a=SSM-nm[1]-nm[5]-nm[9];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[13]=a; nm[52]=b;
      flg[a]=1; flg[b]=1;
      stp14();
      flg[b]=0; flg[a]=0;}}
}
/** Set n14=SSM-n2-n6-n10 & n51 *
void stp14(){
  short a,b;
  a=SSM-nm[2]-nm[6]-nm[10];
  if((1<a)&&(a<64)){b=CC-a;
    if((flg[a]==0)&&(flg[b]==0)){
      nm[14]=a; nm[51]=b;
      flg[a]=1; flg[b]=1;
      stp15();
      flg[b]=0; flg[a]=0;}}
}

```

```

}
/** Set n15=SSM-n3-n7-n11 & n50 *
void stp15(){
short a,b;
a=SSM-nm[3]-nm[7]-nm[11];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[15]=a; nm[50]=b;
flg[a]=1; flg[b]=1;
stp16();
flg[b]=0; flg[a]=0;}}
}
/** Set n16=SSM-n4-n8-n12 & n49 *
void stp16(){
short a,b;
a=SSM-nm[4]-nm[8]-nm[12];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[16]=a; nm[49]=b;
flg[a]=1; flg[b]=1;
stp17();
flg[b]=0; flg[a]=0;}}
}
/** Level: 3 *
/** Set n17 & n48 *
void stp17(){
short a,b;
for(a=63;a>1;a--){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){c2=0;
nm[17]=a; nm[48]=b;
flg[a]=1; flg[b]=1;
stp18();
flg[b]=0; flg[a]=0;}
}
}
/** Set n18=SSM-n1-n2-n17 & n47 *
void stp18(){
short a,b;
a=SSM-nm[1]-nm[2]-nm[17];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[18]=a; nm[47]=b;
flg[a]=1; flg[b]=1;
stp19();
flg[b]=0; flg[a]=0;}}
}
/** Set n19=SSM-n1-n3-n17 & n46 *
void stp19(){
short a,b;
a=SSM-nm[1]-nm[3]-nm[17];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[19]=a; nm[46]=b;
flg[a]=1; flg[b]=1;
stp20();
flg[b]=0; flg[a]=0;}}
}
/** Set n20=SSM-n2-n4-n18 & n45 *
void stp20(){
short a,b;
a=SSM-nm[2]-nm[4]-nm[18];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[20]=a; nm[45]=b;
flg[a]=1; flg[b]=1;
stp21();

```

```

        flg[b]=0; flg[a]=0;}}
}
/* Set n21=SSM-n1-n5-n17 & n44(<n9) *
void stp21(){
    short a,b;
    a=SSM-nm[1]-nm[5]-nm[17];
    if((1<a)&&(a<64)){b=CC-a;
        if((b<nm[9])&&(flg[a]==0)&&(flg[b]==0)){
            nm[21]=a; nm[44]=b;
            flg[a]=1; flg[b]=1;
            stp22();
            flg[b]=0; flg[a]=0;}}
}
/* Set n22=SSM-n2-n6-n18 & n43 *
void stp22(){
    short a,b;
    a=SSM-nm[2]-nm[6]-nm[18];
    if((1<a)&&(a<64)){b=CC-a;
        if((flg[a]==0)&&(flg[b]==0)){
            nm[22]=a; nm[43]=b;
            flg[a]=1; flg[b]=1;
            stp23();
            flg[b]=0; flg[a]=0;}}
}
/* Set n23=SSM-n3-n7-n19 & n42 *
void stp23(){
    short a,b;
    a=SSM-nm[3]-nm[7]-nm[19];
    if((1<a)&&(a<64)){b=CC-a;
        if((flg[a]==0)&&(flg[b]==0)){
            nm[23]=a; nm[42]=b;
            flg[a]=1; flg[b]=1;
            stp24();
            flg[b]=0; flg[a]=0;}}
}
/* Set n24=SSM-n4-n8-n20 & n41 *
void stp24(){
    short a,b;
    a=SSM-nm[4]-nm[8]-nm[20];
    if((1<a)&&(a<64)){b=CC-a;
        if((flg[a]==0)&&(flg[b]==0)){
            nm[24]=a; nm[41]=b;
            flg[a]=1; flg[b]=1;
            stp25();
            flg[b]=0; flg[a]=0;}}
}
/* Level: 4 *
/* Set n25=SSM-n1-n9-n17 & n40 *
void stp25(){
    short a,b;
    a=SSM-nm[1]-nm[9]-nm[17];
    if((1<a)&&(a<64)){b=CC-a;
        if((flg[a]==0)&&(flg[b]==0)){
            nm[25]=a; nm[40]=b;
            flg[a]=1; flg[b]=1;
            stp26();
            flg[b]=0; flg[a]=0;}}
}
/* Set n26=SSM-n2-n10-n18 & n39 *
void stp26(){
    short a,b;
    a=SSM-nm[2]-nm[10]-nm[18];
    if((1<a)&&(a<64)){b=CC-a;
        if((flg[a]==0)&&(flg[b]==0)){
            nm[26]=a; nm[39]=b;
            flg[a]=1; flg[b]=1;

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        stp27();
        flg[b]=0; flg[a]=0;}}
}
/** Set n27=SSM-n3-n11-n19 & n38 *
void stp27(){
short a,b;
a=SSM-nm[3]-nm[11]-nm[19];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[27]=a; nm[38]=b;
flg[a]=1; flg[b]=1;
stp28();
flg[b]=0; flg[a]=0;}}
}
/** Set n28=SSM-n4-n12-n20 & n37 *
void stp28(){
short a,b;
a=SSM-nm[4]-nm[12]-nm[20];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[28]=a; nm[37]=b;
flg[a]=1; flg[b]=1;
stp29();
flg[b]=0; flg[a]=0;}}
}
/** Set n29=SSM-n5-n13-n21 & n36 *
void stp29(){
short a,b;
a=SSM-nm[5]-nm[13]-nm[21];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[29]=a; nm[36]=b;
flg[a]=1; flg[b]=1;
stp30();
flg[b]=0; flg[a]=0;}}
}
/** Set n30=SSM-n6-n14-n22 & n35 *
void stp30(){
short a,b;
a=SSM-nm[6]-nm[14]-nm[22];
if((1<a)&&(a<64)){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[30]=a; nm[35]=b;
flg[a]=1; flg[b]=1;
stp31();
flg[b]=0; flg[a]=0;}}
}
/** Set n31=SSM-n7-n15-n23 & n34 & n31<n3 *
void stp31(){
short a,b;
a=SSM-nm[7]-nm[15]-nm[23];
if((1<a)&&(a<nm[3])){b=CC-a;
if((flg[a]==0)&&(flg[b]==0)){
nm[31]=a; nm[34]=b;
flg[a]=1; flg[b]=1;
stp32();
flg[b]=0; flg[a]=0;}}
}
/** Set n32=SSM-n8-n16-n24 & n33 *
void stp32(){
short a,b;
a=SSM-nm[8]-nm[16]-nm[24];
b=SSM-nm[1]-nm[2]-nm[34];
if((1<a)&&(a<64)&&(a+b==CC)){
if((flg[a]==0)&&(flg[b]==0)){
nm[32]=a; nm[33]=b;

```

```

        flg[a]=1; flg[b]=1;
        stp33();
        flg[b]=0; flg[a]=0;}}
}
/* Check some Composite Sums *
void stp33(){
    short sm1,sm2,sm3;
    sm1=nm[1]+nm[3]+nm[33]+nm[35];
    sm2=nm[1]+nm[5]+nm[33]+nm[37];
    sm3=nm[1]+nm[9]+nm[33]+nm[41];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp34();}
}
/* Check some Composite Sums *
void stp34(){
    short sm1,sm2,sm3;
    sm1=nm[1]+nm[17]+nm[33]+nm[49];
    sm2=nm[2]+nm[4]+nm[34]+nm[36];
    sm3=nm[2]+nm[6]+nm[34]+nm[38];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp35();}
}
/* Check some Composite Sums *
void stp35(){
    short sm1,sm2,sm3;
    sm1=nm[2]+nm[10]+nm[34]+nm[42];
    sm2=nm[2]+nm[18]+nm[34]+nm[50];
    sm3=nm[3]+nm[7]+nm[35]+nm[39];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp36();}
}
/* Check some Composite Sums */
void stp36(){
    short sm1,sm2,sm3;
    sm1=nm[3]+nm[11]+nm[35]+nm[43];
    sm2=nm[3]+nm[19]+nm[35]+nm[51];
    sm3=nm[4]+nm[8]+nm[36]+nm[40];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp37();}
}
/* Check some Composite Sums */
void stp37(){
    short sm1,sm2,sm3;
    sm1=nm[4]+nm[12]+nm[36]+nm[44];
    sm2=nm[4]+nm[20]+nm[36]+nm[52];
    sm3=nm[5]+nm[13]+nm[37]+nm[45];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp38();}
}
//
/* Check some Composite Sums *
void stp38(){
    short sm1,sm2,sm3;
    sm1=nm[5]+nm[21]+nm[37]+nm[53];
    sm2=nm[6]+nm[14]+nm[38]+nm[46];
    sm3=nm[6]+nm[22]+nm[38]+nm[54];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp39();}
}
/* Check some Composite Sums *
void stp39(){
    short sm1,sm2,sm3;
    sm1=nm[7]+nm[15]+nm[39]+nm[47];
    sm2=nm[7]+nm[23]+nm[39]+nm[55];
    sm3=nm[8]+nm[16]+nm[40]+nm[48];
    if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){stp40();}
}
/* Last Check of Composite Sums *
void stp40(){
    short sm1,sm2,sm3;
    sm1=nm[8]+nm[24]+nm[40]+nm[56];
    sm2=nm[17]+nm[18]+nm[49]+nm[50];

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sm3=nm[31]+nm[32]+nm[63]+nm[64];
if((sm1==SSM)&&(sm2==SSM)&&(sm3==SSM)){
    ans26print();}
//ans8print();}
}
//
/* Print Procedure for Listing the Answers *
void ans26print(){
    cnt++; c2++;
    if(c2==1){
        printf("\n");
        printf(" %2d/2^6\n",cnt);
        pr1pat26();
        pr2pat26();
        pr3pat26();
    }
}
/* Print the Pattern-1 *
void pr1pat26(){
    printf("%4d---%2d%7d---%2d",nm[1],nm[2],nm[3],nm[4]);
    printf("%8d---%2d%7d---%2d\n",nm[33],nm[34],nm[35],nm[36]);
    printf("  |%3d---%2d  |%3d---%2d",nm[17],nm[18],nm[19],nm[20]);
    printf("    |%3d---%2d    |%3d---%2d\n",nm[49],nm[50],nm[51],nm[52]);
    printf("%4d--l-%2d  |%4d--l-%2d  |",nm[5],nm[6],nm[7],nm[8]);
    printf("%5d--l-%2d  |%4d--l-%2d  | \n",nm[37],nm[38],nm[39],nm[40]);
    printf("%7d---%2d%7d---%2d",nm[21],nm[22],nm[23],nm[24]);
    printf("%8d---%2d%7d---%2d\n",nm[53],nm[54],nm[55],nm[56]);
    printf("\n");
    //
    printf("%4d---%2d%7d---%2d",nm[9],nm[10],nm[11],nm[12]);
    printf("%8d---%2d%7d---%2d\n",nm[41],nm[42],nm[43],nm[44]);
    printf("  |%3d---%2d  |%3d---%2d",nm[25],nm[26],nm[27],nm[28]);
    printf("    |%3d---%2d    |%3d---%2d\n",nm[57],nm[58],nm[59],nm[60]);
    printf("%4d--l-%2d  |%4d--l-%2d  |",nm[13],nm[14],nm[15],nm[16]);
    printf("%5d--l-%2d  |%4d--l-%2d  | \n",nm[45],nm[46],nm[47],nm[48]);
    printf("%7d---%2d%7d---%2d",nm[29],nm[30],nm[31],nm[32]);
    printf("%8d---%2d%7d---%2d\n",nm[61],nm[62],nm[63],nm[64]);
}
/* Print the Pattern-2 *
void pr2pat26(){
    printf("\n");
    printf("%3d-----%2d-----%2d-----%2d          SC4^3/8^2\n",
        nm[1],nm[2],nm[3],nm[4]);
    printf(" | %2d%12d%12d          | %2d",nm[17],nm[18],nm[19],nm[20]);
    printf("%11d%3d%3d%3d",nm[1],nm[2],nm[3],nm[4]);
    printf("%3d%3d%3d%3d\n",nm[17],nm[18],nm[19],nm[20]);
    printf("%3d%6d%6d%6d",nm[5],nm[33],nm[6],nm[34]);
    printf("%6d%6d%6d%6d",nm[7],nm[35],nm[8],nm[36]);
    printf("%8d%3d%3d%3d",nm[5],nm[6],nm[7],nm[8]);
    printf("%3d%3d%3d%3d\n",nm[21],nm[22],nm[23],nm[24]);
    printf(" | %2d%6d---%2d---%2d",nm[21],nm[49],nm[22],nm[50]);
    printf("----%2d---%2d---%2d---%2d",nm[23],nm[51],nm[24],nm[52]);
    printf("%5d%3d%3d%3d",nm[9],nm[10],nm[11],nm[12]);
    printf("%3d%3d%3d%3d\n",nm[25],nm[26],nm[27],nm[28]);
    printf("%3d%6d  | %2d%6d",nm[9],nm[37],nm[10],nm[38]);
    printf("%6d%6d%6d%6d  |",nm[11],nm[39],nm[12],nm[40]);
    printf("%5d%3d%3d%3d",nm[13],nm[14],nm[15],nm[16]);
    printf("%3d%3d%3d%3d\n",nm[29],nm[30],nm[31],nm[32]);
    printf(" | %2d%6d%6d%6d",nm[25],nm[53],nm[26],nm[54]);
    printf("%6d%6d  | %2d%6d",nm[27],nm[55],nm[28],nm[56]);
    printf("%5d%3d%3d%3d",nm[33],nm[34],nm[35],nm[36]);
    printf("%3d%3d%3d%3d\n",nm[49],nm[50],nm[51],nm[52]);
    printf("%3d---%2d---l-%2d---%2d",nm[13],nm[41],nm[14],nm[42]);
    printf("----%2d---%2d---%2d%6d  |",nm[15],nm[43],nm[16],nm[44]);
    printf("%5d%3d%3d%3d",nm[37],nm[38],nm[39],nm[40]);
    printf("%3d%3d%3d%3d\n",nm[53],nm[54],nm[55],nm[56]);
}

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```

printf("%6d%6d%6d%6d", nm[29], nm[57], nm[30], nm[58]);
printf("%6d%6d%6d%6d", nm[31], nm[59], nm[32], nm[60]);
printf("%5d%3d%3d%3d", nm[41], nm[42], nm[43], nm[44]);
printf("%3d%3d%3d%3d\n", nm[57], nm[58], nm[59], nm[60]);
printf("%9d l%9d%12d%12d l", nm[45], nm[46], nm[47], nm[48]);
printf("%5d%3d%3d%3d", nm[45], nm[46], nm[47], nm[48]);
printf("%3d%3d%3d%3d\n", nm[61], nm[62], nm[63], nm[64]);
printf("%12d-----%2d-----%2d-----%2d\n",
        nm[61], nm[62], nm[63], nm[64]);
}
/* Print the Pattern-3 *
void pr3pat26(){
printf("\n");
printf("%3d-----%2d-----%2d-----%2d          CC4^3/8^2\n",
        nm[1], nm[2], nm[4], nm[3]);
printf(" l %2d%12d%12d l %2d", nm[17], nm[18], nm[20], nm[19]);
printf("%11d%3d%3d%3d", nm[1], nm[2], nm[4], nm[3]);
printf("%3d%3d%3d%3d\n", nm[29], nm[30], nm[32], nm[31]);
printf("%3d%6d%6d%6d", nm[5], nm[49], nm[6], nm[50]);
printf("%6d%6d%6d%6d", nm[8], nm[52], nm[7], nm[51]);
printf("%8d%3d%3d%3d", nm[5], nm[6], nm[8], nm[7]);
printf("%3d%3d%3d%3d\n", nm[25], nm[26], nm[28], nm[27]);
printf(" l %2d%6d---%2d---%2d", nm[21], nm[33], nm[22], nm[34]);
printf("----%2d---%2d---%2d---%2d", nm[24], nm[36], nm[23], nm[35]);
printf("%5d%3d%3d%3d", nm[13], nm[14], nm[16], nm[15]);
printf("%3d%3d%3d%3d\n", nm[17], nm[18], nm[20], nm[19]);
printf("%3d%6d l %2d%6d", nm[13], nm[53], nm[14], nm[54]);
printf("%6d%6d%6d%6d l", nm[16], nm[56], nm[15], nm[55]);
printf("%5d%3d%3d%3d", nm[9], nm[10], nm[12], nm[11]);
printf("%3d%3d%3d%3d\n", nm[21], nm[22], nm[24], nm[23]);
printf(" l %2d%6d%6d%6d", nm[29], nm[37], nm[30], nm[38]);
printf("%6d%6d l %2d%6d", nm[32], nm[40], nm[31], nm[39]);
printf("%5d%3d%3d%3d", nm[36], nm[35], nm[33], nm[34]);
printf("%3d%3d%3d%3d\n", nm[64], nm[63], nm[61], nm[62]);
printf("%3d---%2d--l-%2d---%2d", nm[9], nm[61], nm[10], nm[62]);
printf("----%2d---%2d---%2d%6d l", nm[12], nm[64], nm[11], nm[63]);
printf("%5d%3d%3d%3d", nm[40], nm[39], nm[37], nm[38]);
printf("%3d%3d%3d%3d\n", nm[60], nm[59], nm[57], nm[58]);
printf("%6d%6d%6d%6d", nm[25], nm[45], nm[26], nm[46]);
printf("%6d%6d%6d%6d", nm[28], nm[48], nm[27], nm[47]);
printf("%5d%3d%3d%3d", nm[48], nm[47], nm[45], nm[46]);
printf("%3d%3d%3d%3d\n", nm[52], nm[51], nm[49], nm[50]);
printf("%9d l%9d%12d%12d l", nm[57], nm[58], nm[60], nm[59]);
printf("%5d%3d%3d%3d", nm[44], nm[43], nm[41], nm[42]);
printf("%3d%3d%3d%3d\n", nm[56], nm[55], nm[53], nm[54]);
printf("%12d-----%2d-----%2d-----%2d\n",
        nm[41], nm[42], nm[44], nm[43]);
}
//
/* Another Print Procedure *
void ans8print(){
cnt++; c2++;
if(c2==1){
tc[c3]=cnt;
trnsfcc();
c3++;
if(c3==3){prpat8(3); c3=0;}
}
}
//
/* Transform it into 'C&C' MS88 *
void trnsfcc(){
tn[c3][1]=nm[1];   tn[c3][2]=nm[2];   tn[c3][3]=nm[4];   tn[c3][4]=nm[3];
tn[c3][5]=nm[29]; tn[c3][6]=nm[30];  tn[c3][7]=nm[32];  tn[c3][8]=nm[31];
tn[c3][9]=nm[5];  tn[c3][10]=nm[6];   tn[c3][11]=nm[8];  tn[c3][12]=nm[7];
tn[c3][13]=nm[25]; tn[c3][14]=nm[26]; tn[c3][15]=nm[28]; tn[c3][16]=nm[27];

```

```

tn[c3][17]=nm[13]; tn[c3][18]=nm[14]; tn[c3][19]=nm[16]; tn[c3][20]=nm[15];
tn[c3][21]=nm[17]; tn[c3][22]=nm[18]; tn[c3][23]=nm[20]; tn[c3][24]=nm[19];
tn[c3][25]=nm[9]; tn[c3][26]=nm[10]; tn[c3][27]=nm[12]; tn[c3][28]=nm[11];
tn[c3][29]=nm[21]; tn[c3][30]=nm[22]; tn[c3][31]=nm[24]; tn[c3][32]=nm[23];
tn[c3][33]=nm[36]; tn[c3][34]=nm[35]; tn[c3][35]=nm[33]; tn[c3][36]=nm[34];
tn[c3][37]=nm[64]; tn[c3][38]=nm[63]; tn[c3][39]=nm[61]; tn[c3][40]=nm[62];
tn[c3][41]=nm[40]; tn[c3][42]=nm[39]; tn[c3][43]=nm[37]; tn[c3][44]=nm[38];
tn[c3][45]=nm[60]; tn[c3][46]=nm[59]; tn[c3][47]=nm[57]; tn[c3][48]=nm[58];
tn[c3][49]=nm[48]; tn[c3][50]=nm[47]; tn[c3][51]=nm[45]; tn[c3][52]=nm[46];
tn[c3][53]=nm[52]; tn[c3][54]=nm[51]; tn[c3][55]=nm[49]; tn[c3][56]=nm[50];
tn[c3][57]=nm[44]; tn[c3][58]=nm[43]; tn[c3][59]=nm[41]; tn[c3][60]=nm[42];
tn[c3][61]=nm[56]; tn[c3][62]=nm[55]; tn[c3][63]=nm[53]; tn[c3][64]=nm[54];
}
//
/** Print 3 Pieces of 'C&C' MS88 *
void prpat8(short x){
short l,m,m8,n;
for(n=0;n<x;n++){printf("%25d/",tc[n]);}
printf("\n");
for(m=0;m<8;m++){m8=m*8;
for(l=0;l<x;l++){
printf(" ");
for(n=1;n<9;n++){printf("%3d",tn[l][m8+n]);}
}
printf("\n");
}
}
//
//
/** Build the Extra-Cubic Magic Objects of Order 2x2x2x2x2x2; **
/** Transform them into 'SC' & 'CC' Types of Cubes & Squares; **
/** and List out the Most Fundamental 10 Solutions of MS88; **
// (n1==1, n2>n5, n2>n3>n31, n5>n9>n44)
// 1/
// 2/
// 3/
// 1 63 6 60 38 28 33 31 1 63 6 60 22 44 17 47 1 63 6 60 14 52 9 55
// 62 4 57 7 25 39 30 36 62 4 57 7 41 23 46 20 62 4 57 7 49 15 54 12
// 11 53 16 50 48 18 43 21 11 53 16 50 32 34 27 37 19 45 24 42 32 34 27 37
// 56 10 51 13 19 45 24 42 56 10 51 13 35 29 40 26 48 18 43 21 35 29 40 26
// 27 37 32 34 64 2 59 5 43 21 48 18 64 2 59 5 51 13 56 10 64 2 59 5
// 40 26 35 29 3 61 8 58 24 42 19 45 3 61 8 58 16 50 11 53 3 61 8 58
// 17 47 22 44 54 12 49 15 33 31 38 28 54 12 49 15 33 31 38 28 46 20 41 23
// 46 20 41 23 9 55 14 52 30 36 25 39 9 55 14 52 30 36 25 39 17 47 22 44
// 4/
// 5/
// 6/
// 1 63 10 56 42 24 33 31 1 63 10 56 26 40 17 47 1 63 18 48 50 16 33 31
// 62 4 53 11 21 43 30 36 62 4 53 11 37 27 46 20 62 4 45 19 13 51 30 36
// 7 57 16 50 48 18 39 25 7 57 16 50 32 34 23 41 7 57 24 42 56 10 39 25
// 60 6 51 13 19 45 28 38 60 6 51 13 35 29 44 22 60 6 43 21 11 53 28 38
// 23 41 32 34 64 2 55 9 39 25 48 18 64 2 55 9 15 49 32 34 64 2 47 17
// 44 22 35 29 3 61 12 54 28 38 19 45 3 61 12 54 52 14 35 29 3 61 20 46
// 17 47 26 40 58 8 49 15 33 31 42 24 58 8 49 15 9 55 26 40 58 8 41 23
// 46 20 37 27 5 59 14 52 30 36 21 43 5 59 14 52 54 12 37 27 5 59 22 44
// 7/
// 8/
// 9/
// 1 63 4 62 36 30 33 31 1 63 4 62 20 46 17 47 1 63 4 62 12 54 9 55
// 60 6 57 7 25 39 28 38 60 6 57 7 41 23 44 22 60 6 57 7 49 15 52 14
// 13 51 16 50 48 18 45 19 13 51 16 50 32 34 29 35 21 43 24 42 32 34 29 35
// 56 10 53 11 21 43 24 42 56 10 53 11 37 27 40 26 48 18 45 19 37 27 40 26
// 29 35 32 34 64 2 61 3 45 19 48 18 64 2 61 3 53 11 56 10 64 2 61 3
// 40 26 37 27 5 59 8 58 24 42 21 43 5 59 8 58 16 50 13 51 5 59 8 58
// 17 47 20 46 52 14 49 15 33 31 36 30 52 14 49 15 33 31 36 30 44 22 41 23
// 44 22 41 23 9 55 12 54 28 38 25 39 9 55 12 54 28 38 25 39 17 47 20 46
// 10/
// 1 63 4 62 8 58 5 59
// 56 10 53 11 49 15 52 14
// 25 39 28 38 32 34 29 35
// 48 18 45 19 41 23 44 22
// 57 7 60 6 64 2 61 3

```

```
// 16 50 13 51 9 55 12 54
// 33 31 36 30 40 26 37 27
// 24 42 21 43 17 47 20 46
//
// [Count = 10] OK!
//
//** Calculated and Listed by Kanji Setsuda on
//   Sep.27, 2013 with MacOSX 10.8.5 & Xcode 5.0 **
//
```