

**Part 4 : “New Advanced Study of Magic Squares and Cubes”**  
**Chapter 4 : Commentary Articles No.2 by Kanji Setsuda:**  
 “Various Arts and Tools for Studying Magic Squares”

**Section 14: Make ‘Complete Euler Squares’ of Order 13 for the Simultaneous Type: Self-complementary and Pan-diagonal**

**0. Our Purpose in this Section**

I would like to challenge next to build the Simultaneous Type of Magic Squares of Order 13: Both Self-complementary and Pan-diagonal.

It would be too hard for us to make any ordinary type of this object. I would like to build the ‘Complete Euler Type’ instead. It should be easier to make all ‘C.E.S.’ under the Positional Number System of Base 13 and count them up to the last, I expect.

In the case of Order 5 this type of object counts only 16 standard solutions in all, while Complete Euler Squares of Order 7 counts as many as 3456.

In the previous section we have come to know that the C.E.S. of Order 11 counts 4128768 when  $n1=1$  and 103219200 for all the standard solutions.

How many standard solutions of C.E.S. can we make for our new object of Order 13, then? By my own preliminary survey I know it is certainly terrible to make any object of such a high order as 13, but I must not stop here. I should study harder to get the fruitful result about it. Let’s go on doing our job with our best effort.

I am now glad to report about the recent result of my investigation as follows.

**1. Definition of Simultaneous MS13: Both Self-complementary and Pan-diagonal**

Let me define at first what we are going to make for our final object as usual:

**\*\* Definitions: Basic Form & Basic Equations: Listed by Kanji Setsuda \*\***

167	168	169	157	158	159	160	161	162	163	164	165	166	167	168	169	157	158	159
11	12	13	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3
24	25	26	14	15	16	17	18	19	20	21	22	23	24	25	26	14	15	16
37	38	39	27	28	29	30	31	32	33	34	35	36	37	38	39	27	28	29
50	51	52	40	41	42	43	44	45	46	47	48	49	50	51	52	40	41	42
63	64	65	53	54	55	56	57	58	59	60	61	62	63	64	65	53	54	55
76	77	78	66	67	68	69	70	71	72	73	74	75	76	77	78	66	67	68
89	90	91	79	80	81	82	83	84	85	86	87	88	89	90	91	79	80	81
102	103	104	92	93	94	95	96	97	98	99	100	101	102	103	104	92	93	94
115	116	117	105	106	107	108	109	110	111	112	113	114	115	116	117	105	106	107
128	129	130	118	119	120	121	122	123	124	125	126	127	128	129	130	118	119	120
141	142	143	131	132	133	134	135	136	137	138	139	140	141	142	143	131	132	133
154	155	156	144	145	146	147	148	149	150	151	152	153	154	155	156	144	145	146
167	168	169	157	158	159	160	161	162	163	164	165	166	167	168	169	157	158	159
11	12	13	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3

**\*\* Basic Conditions for Rows and Columns: C=1105 \*\***

$n1+n2+n3+n4+n5+n6+n7+n8+n9+n10+n11+n12+n13=C$	... row1;
$n14+n15+n16+n17+n18+n19+n20+n21+n22+n23+n24+n25+n26=C$	... row2;
$n27+n28+n29+n30+n31+n32+n33+n34+n35+n36+n37+n38+n39=C$	... row3;
$n40+n41+n42+n43+n44+n45+n46+n47+n48+n49+n50+n51+n52=C$	... row4;
$n53+n54+n55+n56+n57+n58+n59+n60+n61+n62+n63+n64+n65=C$	... row5;
$n66+n67+n68+n69+n70+n71+n72+n73+n74+n75+n76+n77+n78=C$	... row6;
$n79+n80+n81+n82+n83+n84+n85+n86+n87+n88+n89+n90+n91=C$	... row7;
$n92+n93+n94+n95+n96+n97+n98+n99+n100+n101+n102+n103+n104=C$	... row8;
$n105+n106+n107+n108+n109+n110+n111+n112+n113+n114+n115+n116+n117=C$	... row9;
$n118+n119+n120+n121+n122+n123+n124+n125+n126+n127+n128+n129+n130=C$	... row10;
$n131+n132+n133+n134+n135+n136+n137+n138+n139+n140+n141+n142+n143=C$	... row11;
$n144+n145+n146+n147+n148+n149+n150+n151+n152+n153+n154+n155+n156=C$	... row12;
$n157+n158+n159+n160+n161+n162+n163+n164+n165+n166+n167+n168+n169=C$	... row13;

\*\*

$n1+n14+n27+n40+n53+n66+n79+n92+n105+n118+n131+n144+n157=C$	... c1m1;
$n2+n15+n28+n41+n54+n67+n80+n93+n106+n119+n132+n145+n158=C$	... c1m2;
$n3+n16+n29+n42+n55+n68+n81+n94+n107+n120+n133+n146+n159=C$	... c1m3;
$n4+n17+n30+n43+n56+n69+n82+n95+n108+n121+n134+n147+n160=C$	... c1m4;
$n5+n18+n31+n44+n57+n70+n83+n96+n109+n122+n135+n148+n161=C$	... c1m5;
$n6+n19+n32+n45+n58+n71+n84+n97+n110+n123+n136+n149+n162=C$	... c1m6;
$n7+n20+n33+n46+n59+n72+n85+n98+n111+n124+n137+n150+n163=C$	... c1m7;
$n8+n21+n34+n47+n60+n73+n86+n99+n112+n125+n138+n151+n164=C$	... c1m8;
$n9+n22+n35+n48+n61+n74+n87+n100+n113+n126+n139+n152+n165=C$	... c1m9;
$n10+n23+n36+n49+n62+n75+n88+n101+n114+n127+n140+n153+n166=C$	... c1m10;
$n11+n24+n37+n50+n63+n76+n89+n102+n115+n128+n141+n154+n167=C$	... c1m11;
$n12+n25+n38+n51+n64+n77+n90+n103+n116+n129+n142+n155+n168=C$	... c1m12;
$n13+n26+n39+n52+n65+n78+n91+n104+n117+n130+n143+n156+n169=C$	... c1m13;

**\*\* Basic Conditions for Pan-diagonals: C=1105 \*\***

$n1+n15+n29+n43+n57+n71+n85+n99+n113+n127+n141+n155+n169=C$	... pd1;
$n2+n16+n30+n44+n58+n72+n86+n100+n114+n128+n142+n156+n167=C$	... pd2;
$n3+n17+n31+n45+n59+n73+n87+n101+n115+n129+n143+n144+n158=C$	... pd3;
$n4+n18+n32+n46+n60+n74+n88+n102+n116+n130+n131+n145+n159=C$	... pd4;
$n5+n19+n33+n47+n61+n75+n89+n103+n117+n118+n132+n146+n160=C$	... pd5;
$n6+n20+n34+n48+n62+n76+n90+n104+n105+n119+n133+n147+n161=C$	... pd6;
$n7+n21+n35+n49+n63+n77+n91+n92+n106+n120+n134+n148+n162=C$	... pd7;
$n8+n22+n36+n50+n64+n78+n79+n93+n107+n121+n135+n149+n163=C$	... pd8;
$n9+n23+n37+n51+n65+n66+n80+n94+n108+n122+n136+n150+n164=C$	... pd9;
$n10+n24+n38+n52+n53+n67+n81+n95+n109+n123+n137+n151+n165=C$	... pd10;
$n11+n25+n39+n40+n54+n68+n82+n96+n110+n124+n138+n152+n166=C$	... pd11;
$n12+n26+n27+n41+n55+n69+n83+n97+n111+n125+n139+n153+n167=C$	... pd12;
$n13+n14+n28+n42+n56+n70+n84+n98+n112+n126+n140+n154+n168=C$	... pd13;

\*\*

$n1+n26+n38+n50+n62+n74+n86+n98+n110+n122+n134+n146+n158=C$	... pb1;
$n2+n14+n39+n51+n63+n75+n87+n99+n111+n123+n135+n147+n159=C$	... pb2;
$n3+n15+n27+n52+n64+n76+n88+n100+n112+n124+n136+n148+n160=C$	... pb3;
$n4+n16+n28+n40+n65+n77+n89+n101+n113+n125+n137+n149+n161=C$	... pb4;
$n5+n17+n29+n41+n53+n78+n90+n102+n114+n126+n138+n150+n162=C$	... pb5;
$n6+n18+n30+n42+n54+n66+n91+n103+n115+n127+n139+n151+n163=C$	... pb6;
$n7+n19+n31+n43+n55+n67+n79+n104+n116+n128+n140+n152+n164=C$	... pb7;
$n8+n20+n32+n44+n56+n68+n80+n92+n117+n129+n141+n153+n165=C$	... pb8;
$n9+n21+n33+n45+n57+n69+n81+n93+n105+n130+n142+n154+n166=C$	... pb9;
$n10+n22+n34+n46+n58+n70+n82+n94+n106+n118+n143+n155+n167=C$	... pb10;
$n11+n23+n35+n47+n59+n71+n83+n95+n107+n119+n131+n156+n168=C$	... pb11;
$n12+n24+n36+n48+n60+n72+n84+n96+n108+n120+n132+n144+n169=C$	... pb12;
$n13+n25+n37+n49+n61+n73+n85+n97+n109+n121+n133+n145+n157=C$	... pb13;

**\*\* Self-complementary Conditions for Symmetrical Pairs: CS=170 \*\***

$n1+n169=n2+n168=n3+n167=n4+n166=n5+n165=n6+n164=n7+n163=n8+n162=$   
 $n9+n161=n10+n160=n11+n159=n12+n158=n13+n157=n14+n156=n15+n155=n16+n154=$   
 $n17+n153=n18+n152=n19+n151=n20+n150=n21+n149=n22+n148=n23+n147=n24+n146=$   
 $n25+n145=n26+n144=n27+n143=n28+n142=n29+n141=n30+n140=n31+n139=n32+n138=$   
 $n33+n137=n34+n136=n35+n135=n36+n134=n37+n133=n38+n132=n39+n131=n40+n130=$   
 $n41+n129=n42+n128=n43+n127=n44+n126=n45+n125=n46+n124=n47+n123=n48+n122=$   
 $n49+n121=n50+n120=n51+n119=n52+n118=n53+n117=n54+n116=n55+n115=n56+n114=$   
 $n57+n113=n58+n112=n59+n111=n60+n110=n61+n109=n62+n108=n63+n107=n64+n106=$   
 $n65+n105=n66+n104=n67+n103=n68+n102=n69+n101=n70+n100=n71+n99=n72+n98=$   
 $n73+n97=n74+n96=n75+n95=n76+n94=n77+n93=n78+n92=n79+n91=n80+n90=$   
 $n81+n89=n82+n88=n83+n87=n84+n86=n85+n85=CS$ 
... SCC

As the last equation indicates,  $n85$  must take  $85$ , representing the invariable value placed in the center of any Self-complementary magic square of odd orders. We must also take the same value again for our Simultaneous object of Order 13.

## 2. Make 'Latin Squares' for our Complete Euler Squares of Order 13

Let's have all the possible 'Latin Squares' of Order 13 at first by any new method, so that we should be able to use them as every two Decomposed Layer Units to combine and compose all the objective Complete Euler Squares of Order 13.

Latin Squares are defined in such the almost same style as the one above, but we have to change the constant values just as  $C=78$  and  $CS=12$  for them here.

On top of that, Latin Squares must always be made under the strict rules such as:

(1) Any Latin Square must be simply made of 13 numerical letters: {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B and C} ('A' stands for  $10(Dec)$ , 'B'= $11(Dec)$  and 'C'= $12(Dec)$ ).

Each letter should appear as often as 13 times, no more and no less.

(2) Each row, each column and each pan-diagonal of Latin Squares must be made of {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B and C} using each number strictly once. Neither duplication nor lack of any number must be found in it.

These strict conditions should always make the constant sum of each row, column and pan-diagonal of our final object realized:

$$(0+1+2+3+4+5+6+7+8+9+A+B+C) \times 13(Dec) + (0+1+2+3+4+5+6+7+8+9+A+B+C) = 1092(Dec)$$

(in Mathematical Expression of Square)

(3) Each of the 7 Self-complementary pairs should appear 13 times in any Latin Unit:

(0, C), (1, B), (2, A), (3, 9), (4, 8), (5, 7) and (6, 6)

Constituents of any pair must be placed symmetrically to each other with respect to the geometric center  $n85$  as in  $(n1, n169)$ ,  $(n2, n168)$ ,  $(n3, n167)$ ,  $(n4, n166)$ , ...,  $(n82, n88)$ ,  $(n83, n87)$ ,  $(n84, n86)$ . And  $n85$  itself must always take 6.

If you make any Latin Unit under these strict rules, then you can make no one have any 2 same numbers sitting adjacent next to each other in all eight directions. If you have any same numbers there, you should necessarily be against the Rule (2) above, since they must belong to any same row, column or pan-diagonal around there.

## 3. Sample Solutions of 'Latin Squares'

The next list shows some sample solutions of Latin Squares of order 13, all of which I made using the Positional Number System of Base 13.

I want you to watch these samples and check if each of them is successfully made under those strict conditions above. Will you especially examine each content of rows, columns and pan-diagonals? And finally check every two adjacent numbers sitting next in all eight directions to see whether they are same or not.

I also want you to know what members are actually surrounding each of the 13 same numbers in all eight directions in the same Latin Unit.

**\*\* Sample List of 'Latin Squares' for the Simultaneous Magic Squares 13x13 \*\***

1/	2/	3/	4/	5/
0CBA987654321	02468AC13579B	0951A62B73C84	05A27C4916B38	048C37B26A159
210CBA9876543	C13579B02468A	51A62B73C8409	916B3805A27C4	A159048C37B26
43210CBA98765	B02468AC13579	A62B73C840951	5A27C4916B380	7B26A159048C3
6543210CBA987	AC13579B02468	2B73C840951A6	16B3805A27C49	48C37B26A1590
876543210CBA9	9B02468AC1357	73C840951A62B	A27C4916B3805	159048C37B26A
A9876543210CB	8AC13579B0246	C840951A62B73	6B3805A27C491	B26A159048C37
CBA9876543210	79B02468AC135	40951A62B73C8	27C4916B3805A	8C37B26A15904
10CBA98765432	68AC13579B024	951A62B73C840	B3805A27C4916	59048C37B26A1
3210CBA987654	579B02468AC13	1A62B73C84095	7C4916B3805A2	26A159048C37B
543210CBA9876	468AC13579B02	62B73C840951A	3805A27C4916B	C37B26A159048
76543210CBA98	3579B02468AC1	B73C840951A62	C4916B3805A27	9048C37B26A15
9876543210CBA	2468AC13579B0	3C840951A62B7	805A27C4916B3	6A159048C37B2
BA9876543210C	13579B02468AC	840951A62B73C	4916B3805A27C	37B26A159048C
6/	7/	8/	9/	10/
083B6194C72A5	06C5B4A392817	0A741B852C963	0B97531CA8642	0369C258B147A
6194C72A5083B	81706C5B4A392	41B852C9630A7	31CA86420B975	B147A0369C258
C72A5083B6194	39281706C5B4A	852C9630A741B	6420B97531CA8	9C258B147A036
5083B6194C72A	B4A39281706C5	C9630A741B852	97531CA86420B	7A0369C258B14
B6194C72A5083	6C5B4A3928170	30A741B852C96	CA86420B97531	58B147A0369C2
4C72A5083B619	1706C5B4A3928	741B852C9630A	20B97531CA864	369C258B147A0
A5083B6194C72	9281706C5B4A3	B852C9630A741	531CA86420B97	147A0369C258B
3B6194C72A508	4A39281706C5B	2C9630A741B85	86420B97531CA	C258B147A0369
94C72A5083B61	C5B4A39281706	630A741B852C9	B97531CA86420	A0369C258B147
2A5083B6194C7	706C5B4A39281	A741B852C9630	1CA86420B9753	8B147A0369C25
83B6194C72A50	281706C5B4A39	1B852C9630A74	420B97531CA86	69C258B147A03
194C72A5083B6	A39281706C5B4	52C9630A741B8	7531CA86420B9	47A0369C258B1
72A5083B6194C	5B4A39281706C	9630A741B852C	A86420B97531C	258B147A0369C
11/	12/	13/	14/	15/
0CBA985674321	02468AC13759B	0971A62B53C84	07A25C4916B38	048C35B26A179
210CBA9856743	C13759B02468A	71A62B53C8409	916B3807A25C4	A179048C35B26
43210CBA98567	B02468AC13759	A62B53C840971	7A25C4916B380	5B26A179048C3
6743210CBA985	AC13759B02468	2B53C840971A6	16B3807A25C49	48C35B26A1790
856743210CBA9	9B02468AC1375	53C840971A62B	A25C4916B3807	179048C35B26A
A9856743210CB	8AC13759B0246	C840971A62B53	6B3807A25C491	B26A179048C35
CBA9856743210	59B02468AC137	40971A62B53C8	25C4916B3807A	8C35B26A17904
10CBA98567432	68AC13759B024	971A62B53C840	B3807A25C4916	79048C35B26A1
3210CBA985674	759B02468AC13	1A62B53C84097	5C4916B3807A2	26A179048C35B
743210CBA9856	468AC13759B02	62B53C840971A	3807A25C4916B	C35B26A179048
56743210CBA98	3759B02468AC1	B53C840971A62	C4916B3807A25	9048C35B26A17
9856743210CBA	2468AC13759B0	3C840971A62B5	807A25C4916B3	6A179048C35B2
BA9856743210C	13759B02468AC	840971A62B53C	4916B3807A25C	35B26A179048C

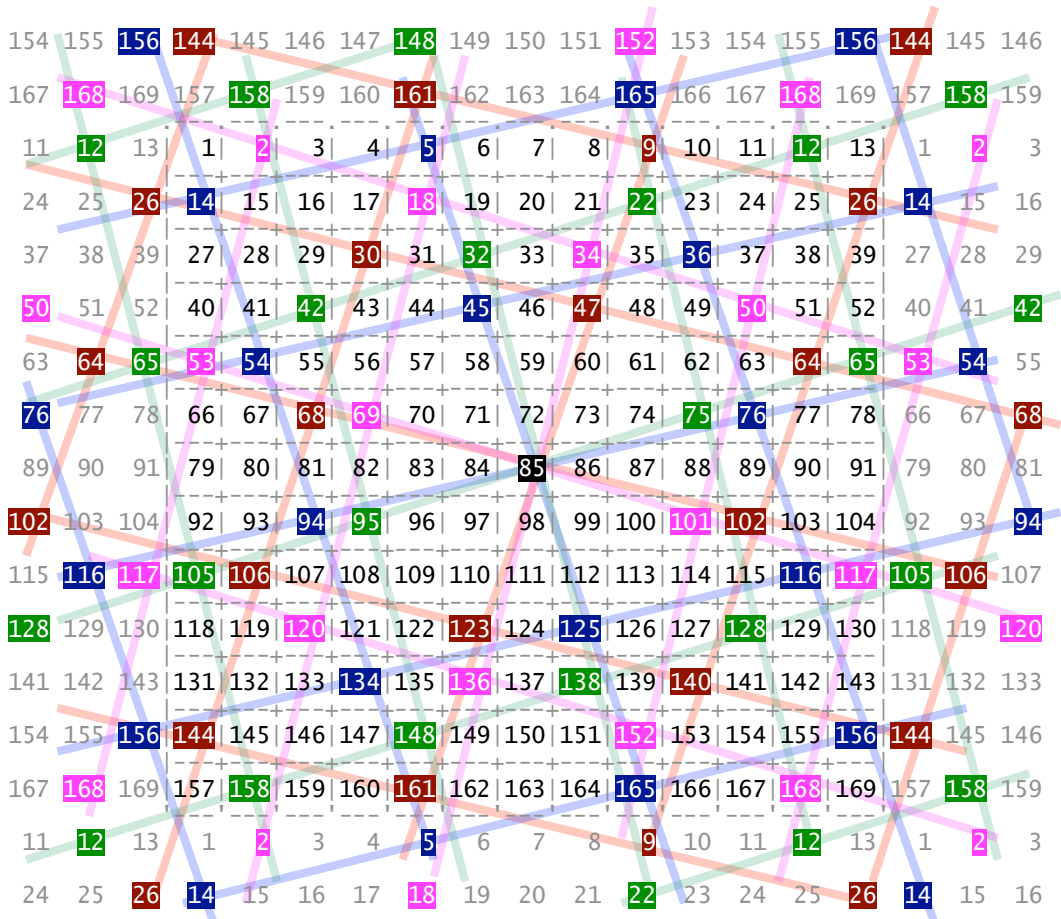
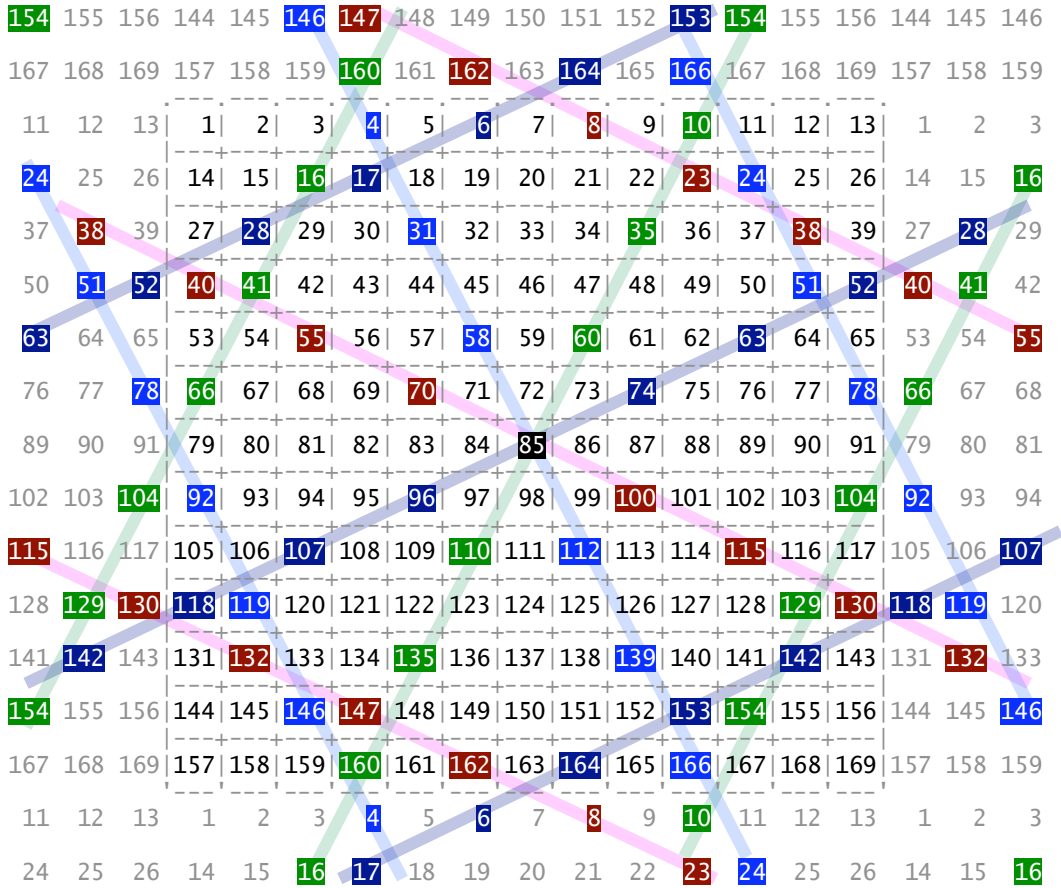
Watch and know how each of every 13 same numbers is actually placed in each Latin Unit. And find any regularity of their placement at last.

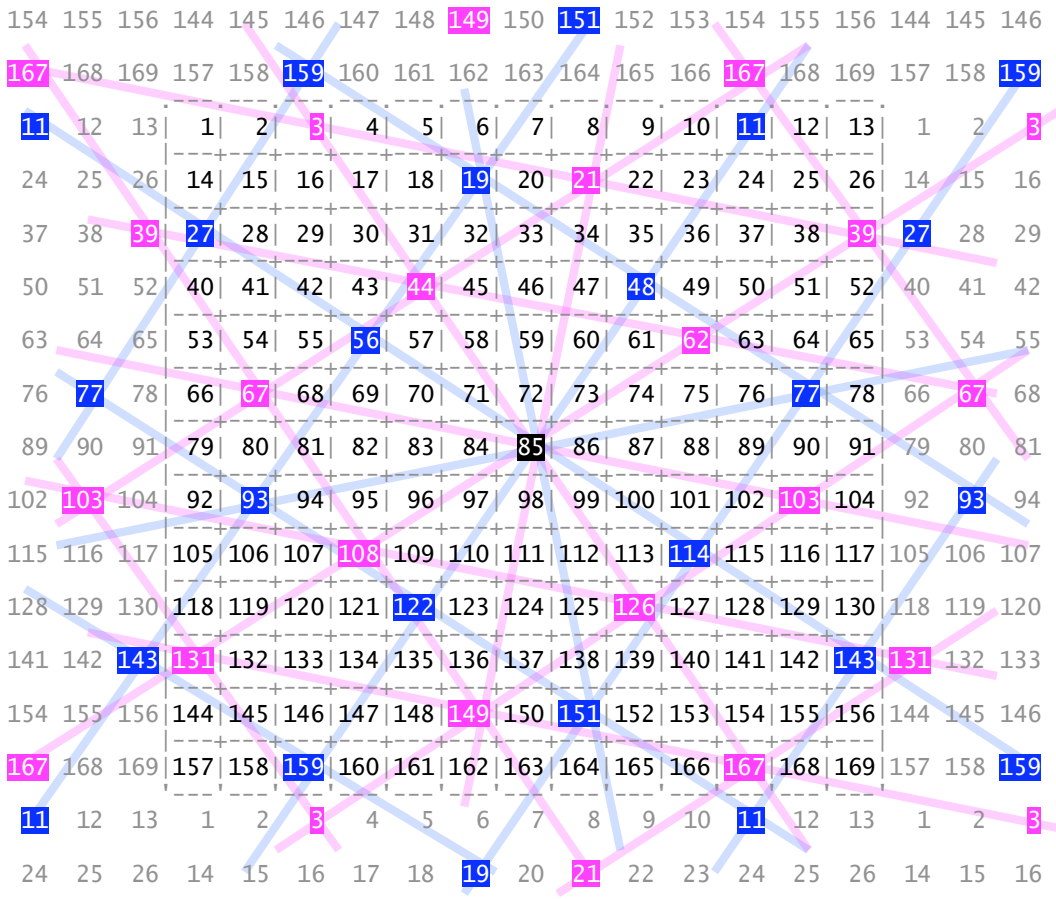
I would always make those samples of Latin Units of Order 5, 7 and 11 by our “New Euler’s Method” in the former sections, but I could not use that method right here in this section, since I found it is too slow to go on our job for Order 13. I had to make them only by my hand using the method called “Knight’s Tour Composition”.

**4. Extended Method of “Knight’s Tour Composition”**

I have found some regularity about the placement patterns of the same numbers, and I have drawn out the rules for making Latin Squares called “Knight’s Tours”.

**\*\* Conceptual Diagrams of "Knight's Tours" for Latin Squares 13x13: \*\***





The 3 diagrams above illustrate the basic patterns showing how the same numbers could actually be placed in Latin Squares. To show them clearly I pointed at the common starter in n85 and showed how it is copied 12 times in the different patterns.

Any other number in the first Primary Diagonal:  $n_1+n_{15}+n_{29}+n_{43}+n_{57}+n_{71}+n_{85}+n_{99}+n_{113}+n_{127}+n_{141}+n_{155}+n_{169}$  ...pd1 should be duplicated in such the same pattern as parallel to the line of n85 in the same Latin Unit.

The first diagram above illustrates the first 4 patterns, the second one another 4 and the last one shows only the rest 2, though it looks too complicated.

I found the ten Basic Patterns in all that are different from each other for the same first Primary Diagonal. No more or no less than ten. Ten might mean too various for the movements of “Knight’s Tour” of game Chess, but I keep using the same name for our extended concept. If you have another Primary Diagonal, you will see another ten patterns. But, the duplication patterns themselves are not different at all, but they are just the same with the ten Basic Patterns, as you know.

## 5. Method of Transformations making Diagonals into Latin Squares

These ten Basic Patterns are certainly universal enough for us to extract the rules of transformation. They tell us how to make ten Latin Squares from a Primary Diagonal.

Whenever you have these rules and some actual data of the first Primary Diagonal, you should always be able to reconstruct all the data of ten Latin Squares.

The next list shows 2 examples of Transformation Rules extracted from the actual two Latin Squares. Each couple has the one-to-one correspondence between them.

```
/** Extract the Transformation Rules after “Knight's Tours” */
void tp1(){
  short v;
  v=p[1]; n[1]=v; n[16]=v; n[31]=v; n[46]=v; n[61]=v; n[76]=v;
```

```

    n[91]=v; n[93]=v; n[108]=v;n[123]=v;n[138]=v;n[153]=v;n[168]=v;
v=p[2]; n[13]=v; n[15]=v; n[30]=v; n[45]=v; n[60]=v; n[75]=v;
    n[90]=v; n[92]=v; n[107]=v;n[122]=v;n[137]=v;n[152]=v;n[167]=v;
v=p[3]; n[12]=v; n[14]=v; n[29]=v; n[44]=v; n[59]=v; n[74]=v;
    n[89]=v; n[104]=v;n[106]=v;n[121]=v;n[136]=v;n[151]=v;n[166]=v;
v=p[4]; n[11]=v; n[26]=v; n[28]=v; n[43]=v; n[58]=v; n[73]=v;
    n[88]=v; n[103]=v;n[105]=v;n[120]=v;n[135]=v;n[150]=v;n[165]=v;
v=p[5]; n[10]=v; n[25]=v; n[27]=v; n[42]=v; n[57]=v; n[72]=v;
    n[87]=v; n[102]=v;n[117]=v;n[119]=v;n[134]=v;n[149]=v;n[164]=v;
v=p[6]; n[9]=v; n[24]=v; n[39]=v; n[41]=v; n[56]=v; n[71]=v;
    n[86]=v; n[101]=v;n[116]=v;n[118]=v;n[133]=v;n[148]=v;n[163]=v;
v=p[7]; n[8]=v; n[23]=v; n[38]=v; n[40]=v; n[55]=v; n[70]=v;
    n[85]=v; n[100]=v;n[115]=v;n[130]=v;n[132]=v;n[147]=v;n[162]=v;
v=p[8]; n[7]=v; n[22]=v; n[37]=v; n[52]=v; n[54]=v; n[69]=v;
    n[84]=v; n[99]=v; n[114]=v;n[129]=v;n[131]=v;n[146]=v;n[161]=v;
v=p[9]; n[6]=v; n[21]=v; n[36]=v; n[51]=v; n[53]=v; n[68]=v;
    n[83]=v; n[98]=v; n[113]=v;n[128]=v;n[143]=v;n[145]=v;n[160]=v;
v=p[10]; n[5]=v; n[20]=v; n[35]=v; n[50]=v; n[65]=v; n[67]=v;
    n[82]=v; n[97]=v; n[112]=v;n[127]=v;n[142]=v;n[144]=v;n[159]=v;
v=p[11]; n[4]=v; n[19]=v; n[34]=v; n[49]=v; n[64]=v; n[66]=v;
    n[81]=v; n[96]=v; n[111]=v;n[126]=v;n[141]=v;n[156]=v;n[158]=v;
v=p[12]; n[3]=v; n[18]=v; n[33]=v; n[48]=v; n[63]=v; n[78]=v;
    n[80]=v; n[95]=v; n[110]=v;n[125]=v;n[140]=v;n[155]=v;n[157]=v;
v=p[13]; n[2]=v; n[17]=v; n[32]=v; n[47]=v; n[62]=v; n[77]=v;
    n[79]=v; n[94]=v; n[109]=v;n[124]=v;n[139]=v;n[154]=v;n[169]=v;
};
/**/

```

1/										2/															
0	C	B	A	9	8	7	6	5	4	3	2	1	0	2	4	6	8	A	C	1	3	5	7	9	B
2	1	0	C	B	A	9	8	7	6	5	4	3	C	1	3	5	7	9	B	0	2	4	6	8	A
4	3	2	1	0	C	B	A	9	8	7	6	5	B	0	2	4	6	8	A	C	1	3	5	7	9
6	5	4	3	2	1	0	C	B	A	9	8	7	A	C	1	3	5	7	9	B	0	2	4	6	8
8	7	6	5	4	3	2	1	0	C	B	A	9	9	B	0	2	4	6	8	A	C	1	3	5	7
A	9	8	7	6	5	4	3	2	1	0	C	B	8	A	C	1	3	5	7	9	B	0	2	4	6
C	B	A	9	8	7	6	5	4	3	2	1	0	7	9	B	0	2	4	6	8	A	C	1	3	5
1	0	C	B	A	9	8	7	6	5	4	3	2	6	8	A	C	1	3	5	7	9	B	0	2	4
3	2	1	0	C	B	A	9	8	7	6	5	4	5	7	9	B	0	2	4	6	8	A	C	1	3
5	4	3	2	1	0	C	B	A	9	8	7	6	4	6	8	A	C	1	3	5	7	9	B	0	2
7	6	5	4	3	2	1	0	C	B	A	9	8	3	5	7	9	B	0	2	4	6	8	A	C	1
9	8	7	6	5	4	3	2	1	0	C	B	A	2	4	6	8	A	C	1	3	5	7	9	B	0
B	A	9	8	7	6	5	4	3	2	1	0	C	1	3	5	7	9	B	0	2	4	6	8	A	C

```

/**/
void tp2C(){
short v;
v=p[1]; n[1]=v; n[21]=v; n[28]=v; n[48]=v; n[55]=v; n[75]=v;
    n[82]=v; n[102]=v;n[109]=v;n[129]=v;n[136]=v;n[156]=v;n[163]=v;
v=p[2]; n[8]=v; n[15]=v; n[35]=v; n[42]=v; n[62]=v; n[69]=v;
    n[89]=v; n[96]=v; n[116]=v;n[123]=v;n[143]=v;n[150]=v;n[157]=v;
v=p[3]; n[2]=v; n[22]=v; n[29]=v; n[49]=v; n[56]=v; n[76]=v;
    n[83]=v; n[103]=v;n[110]=v;n[130]=v;n[137]=v;n[144]=v;n[164]=v;
v=p[4]; n[9]=v; n[16]=v; n[36]=v; n[43]=v; n[63]=v; n[70]=v;
    n[90]=v; n[97]=v; n[117]=v;n[124]=v;n[131]=v;n[151]=v;n[158]=v;
v=p[5]; n[3]=v; n[23]=v; n[30]=v; n[50]=v; n[57]=v; n[77]=v;
    n[84]=v; n[104]=v;n[111]=v;n[118]=v;n[138]=v;n[145]=v;n[165]=v;
v=p[6]; n[10]=v; n[17]=v; n[37]=v; n[44]=v; n[64]=v; n[71]=v;
    n[91]=v; n[98]=v; n[105]=v;n[125]=v;n[132]=v;n[152]=v;n[159]=v;
v=p[7]; n[4]=v; n[24]=v; n[31]=v; n[51]=v; n[58]=v; n[78]=v;
    n[85]=v; n[92]=v; n[112]=v;n[119]=v;n[139]=v;n[146]=v;n[166]=v;
v=p[8]; n[11]=v; n[18]=v; n[38]=v; n[45]=v; n[65]=v; n[72]=v;

```

```

    n[79]=v; n[99]=v; n[106]=v;n[126]=v;n[133]=v;n[153]=v;n[160]=v;
v=p[9]; n[5]=v; n[25]=v; n[32]=v; n[52]=v; n[59]=v; n[66]=v;
    n[86]=v; n[93]=v; n[113]=v;n[120]=v;n[140]=v;n[147]=v;n[167]=v;
v=p[10]; n[12]=v; n[19]=v; n[39]=v; n[46]=v; n[53]=v; n[73]=v;
    n[80]=v; n[100]=v;n[107]=v;n[127]=v;n[134]=v;n[154]=v;n[161]=v;
v=p[11]; n[6]=v; n[26]=v; n[33]=v; n[40]=v; n[60]=v; n[67]=v;
    n[87]=v; n[94]=v; n[114]=v;n[121]=v;n[141]=v;n[148]=v;n[168]=v;
v=p[12]; n[13]=v; n[20]=v; n[27]=v; n[47]=v; n[54]=v; n[74]=v;
    n[81]=v; n[101]=v;n[108]=v;n[128]=v;n[135]=v;n[155]=v;n[162]=v;
v=p[13]; n[7]=v; n[14]=v; n[34]=v; n[41]=v; n[61]=v; n[68]=v;
    n[88]=v; n[95]=v; n[115]=v;n[122]=v;n[142]=v;n[149]=v;n[169]=v;
};
/* ... */

```

If you put the actual data of the first Primary Diagonal onto the array p[13], these transformations would copy the data to every appropriate positions according to the basic patterns, and could finally reconstruct each of our objective Latin Squares.

## 6. How to make the first Primary Diagonals

How do we get the actual data of the first Primary Diagonals of Latin Units, then?

It is the problem of permutation. How do we rearrange the positional order among {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C} in {n1, n15, n29, n43, n57, n71, n85, n99, n113, n127, n141, n155, n169} as different from each other.

Of course, you must always obey the Latin Rules here.

{(n1, n169), (n15, n155), (n29, n141), (n43, n127), (n57, n113), (n71, n99), (n85, n85)} are such the symmetric Self-complementary Pairs that they should take the Complementary Pairs of 12(Decimal) for each. This means the sum of each pair must be equal to the constant value 12(Decimal).

There should be 3840 ways when n1==0:  $5P_5 \times 2^5 = 120 \times 32 = 3840$

There should be 46080 ways for all:  $6P_6 \times 2^6 = 720 \times 64 = 46080$

### \*\* The first Primary Diagonals of Latin Units for Composing CES13Sm1 \*\*

```

1: {0,1,2,3,4,5,6,7,8,9,A,B,C}; 2: {0,1,2,3,4,7,6,5,8,9,A,B,C}; 3: {0,1,2,3,5,4,6,8,7,9,A,B,C};
4: {0,1,2,3,5,8,6,4,7,9,A,B,C}; 5: {0,1,2,3,7,4,6,8,5,9,A,B,C}; 6: {0,1,2,3,7,8,6,4,5,9,A,B,C};
7: {0,1,2,3,8,5,6,7,4,9,A,B,C}; 8: {0,1,2,3,8,7,6,5,4,9,A,B,C}; 9: {0,1,2,4,3,5,6,7,9,8,A,B,C};
10: {0,1,2,4,3,7,6,5,9,8,A,B,C}; 11: {0,1,2,4,5,3,6,9,7,8,A,B,C}; 12: {0,1,2,4,5,9,6,3,7,8,A,B,C};
13: {0,1,2,4,7,3,6,9,5,8,A,B,C}; 14: {0,1,2,4,7,9,6,3,5,8,A,B,C}; 15: {0,1,2,4,9,5,6,7,3,8,A,B,C};
16: {0,1,2,4,9,7,6,5,3,8,A,B,C}; 17: {0,1,2,5,3,4,6,8,9,7,A,B,C}; 18: {0,1,2,5,3,8,6,4,9,7,A,B,C};
19: {0,1,2,5,4,3,6,9,8,7,A,B,C}; 20: {0,1,2,5,4,9,6,3,8,7,A,B,C}; 21: {0,1,2,5,8,3,6,9,4,7,A,B,C};
22: {0,1,2,5,8,9,6,3,4,7,A,B,C}; 23: {0,1,2,5,9,4,6,8,3,7,A,B,C}; 24: {0,1,2,5,9,8,6,4,3,7,A,B,C};
25: {0,1,2,7,3,4,6,8,9,5,A,B,C}; 26: {0,1,2,7,3,8,6,4,9,5,A,B,C}; 27: {0,1,2,7,4,3,6,9,8,5,A,B,C};
28: {0,1,2,7,4,9,6,3,8,5,A,B,C}; 29: {0,1,2,7,8,3,6,9,4,5,A,B,C}; 30: {0,1,2,7,8,9,6,3,4,5,A,B,C};
31: {0,1,2,7,9,4,6,8,3,5,A,B,C}; 32: {0,1,2,7,9,8,6,4,3,5,A,B,C}; 33: {0,1,2,8,3,5,6,7,9,4,A,B,C};
34: {0,1,2,8,3,7,6,5,9,4,A,B,C}; 35: {0,1,2,8,5,3,6,9,7,4,A,B,C}; 36: {0,1,2,8,5,9,6,3,7,4,A,B,C};
37: {0,1,2,8,7,3,6,9,5,4,A,B,C}; 38: {0,1,2,8,7,9,6,3,5,4,A,B,C}; 39: {0,1,2,8,9,5,6,7,3,4,A,B,C};
40: {0,1,2,8,9,7,6,5,3,4,A,B,C}; 41: {0,1,2,9,4,5,6,7,8,3,A,B,C}; 42: {0,1,2,9,4,7,6,5,8,3,A,B,C};
43: {0,1,2,9,5,4,6,8,7,3,A,B,C}; 44: {0,1,2,9,5,8,6,4,7,3,A,B,C}; 45: {0,1,2,9,7,4,6,8,5,3,A,B,C};
46: {0,1,2,9,7,8,6,4,5,3,A,B,C}; 47: {0,1,2,9,8,5,6,7,4,3,A,B,C}; 48: {0,1,2,9,8,7,6,5,4,3,A,B,C};
49: {0,1,3,2,4,5,6,7,8,A,9,B,C}; 50: {0,1,3,2,4,7,6,5,8,A,9,B,C}; 51: {0,1,3,2,5,4,6,8,7,A,9,B,C};
52: {0,1,3,2,5,8,6,4,7,A,9,B,C}; 53: {0,1,3,2,7,4,6,8,5,A,9,B,C}; 54: {0,1,3,2,7,8,6,4,5,A,9,B,C};
55: {0,1,3,2,8,5,6,7,4,A,9,B,C}; 56: {0,1,3,2,8,7,6,5,4,A,9,B,C}; 57: {0,1,3,4,2,5,6,7,A,8,9,B,C};
58: {0,1,3,4,2,7,6,5,A,8,9,B,C}; 59: {0,1,3,4,5,2,6,A,8,9,B,C}; 60: {0,1,3,4,5,A,6,2,7,8,9,B,C};
61: {0,1,3,4,7,2,6,A,5,8,9,B,C}; 62: {0,1,3,4,7,A,6,2,5,8,9,B,C}; 63: {0,1,3,4,A,5,6,7,2,8,9,B,C};
64: {0,1,3,4,A,7,6,5,2,8,9,B,C}; 65: {0,1,3,5,2,4,6,8,A,7,9,B,C}; 66: {0,1,3,5,2,8,6,4,A,7,9,B,C};
67: {0,1,3,5,4,2,6,A,8,7,9,B,C}; 68: {0,1,3,5,4,A,6,2,8,7,9,B,C}; 69: {0,1,3,5,8,2,6,A,4,7,9,B,C};
70: {0,1,3,5,8,A,6,2,4,7,9,B,C}; 71: {0,1,3,5,A,4,6,8,2,7,9,B,C}; 72: {0,1,3,5,A,8,6,4,2,7,9,B,C};
73: {0,1,3,7,2,4,6,8,A,5,9,B,C}; 74: {0,1,3,7,2,8,6,4,A,5,9,B,C}; 75: {0,1,3,7,4,2,6,A,8,5,9,B,C};
76: {0,1,3,7,4,A,6,2,8,5,9,B,C}; 77: {0,1,3,7,8,2,6,A,4,5,9,B,C}; 78: {0,1,3,7,8,A,6,2,4,5,9,B,C};
79: {0,1,3,7,A,4,6,8,2,5,9,B,C}; 80: {0,1,3,7,A,8,6,4,2,5,9,B,C}; 81: {0,1,3,8,2,5,6,7,A,4,9,B,C};
82: {0,1,3,8,2,7,6,5,A,4,9,B,C}; 83: {0,1,3,8,5,2,6,A,7,4,9,B,C}; 84: {0,1,3,8,5,A,6,2,7,4,9,B,C};
85: {0,1,3,8,7,2,6,A,5,4,9,B,C}; 86: {0,1,3,8,7,A,6,2,5,4,9,B,C}; 87: {0,1,3,8,A,5,6,7,2,4,9,B,C};
88: {0,1,3,8,A,7,6,5,2,4,9,B,C}; 89: {0,1,3,A,4,5,6,7,8,2,9,B,C}; 90: {0,1,3,A,4,7,6,5,8,2,9,B,C};

```



91: {0,1,3,A,5,4,6,8,7,2,9,B,C}; 92: {0,1,3,A,5,8,6,4,7,2,9,B,C}; 93: {0,1,3,A,7,4,6,8,5,2,9,B,C};  
 94: {0,1,3,A,7,8,6,4,5,2,9,B,C}; 95: {0,1,3,A,8,5,6,7,4,2,9,B,C}; 96: {0,1,3,A,8,7,6,5,4,2,9,B,C};  
 97: {0,1,4,2,3,5,6,7,9,A,8,B,C}; 98: {0,1,4,2,3,7,6,5,9,A,8,B,C}; 99: {0,1,4,2,5,3,6,9,7,A,8,B,C};  
 382: {0,1,A,9,7,8,6,4,5,3,2,B,C}; 383: {0,1,A,9,8,5,6,7,4,3,2,B,C}; 384: {0,1,A,9,8,7,6,5,4,3,2,B,C};  
 385: {0,2,1,3,4,5,6,7,8,9,B,A,C}; 386: {0,2,1,3,4,7,6,5,8,9,B,A,C}; 387: {0,2,1,3,5,4,6,8,7,9,B,A,C};  
 388: {0,2,1,3,5,8,6,4,7,9,B,A,C}; 389: {0,2,1,3,7,4,6,8,5,9,B,A,C}; 390: {0,2,1,3,7,8,6,4,5,9,B,A,C};  
 391: {0,2,1,3,8,5,6,7,4,9,B,A,C}; 392: {0,2,1,3,8,7,6,5,4,9,B,A,C}; 393: {0,2,1,4,3,5,6,7,9,8,B,A,C};  
 394: {0,2,1,4,3,7,6,5,9,8,B,A,C}; 395: {0,2,1,4,5,3,6,9,7,8,B,A,C}; 396: {0,2,1,4,5,9,6,3,7,8,B,A,C};  
 397: {0,2,1,4,7,3,6,9,5,8,B,A,C}; 398: {0,2,1,4,7,9,6,3,5,8,B,A,C}; 399: {0,2,1,4,9,5,6,7,3,8,B,A,C};  
 766: {0,2,B,9,7,8,6,4,5,3,1,A,C}; 767: {0,2,B,9,8,5,6,7,4,3,1,A,C}; 768: {0,2,B,9,8,7,6,5,4,3,1,A,C};  
 769: {0,3,1,2,4,5,6,7,8,A,B,9,C}; 770: {0,3,1,2,4,7,6,5,8,A,B,9,C}; 771: {0,3,1,2,5,4,6,8,7,A,B,9,C};  
 772: {0,3,1,2,5,8,6,4,7,A,B,9,C}; 773: {0,3,1,2,7,4,6,8,5,A,B,9,C}; 774: {0,3,1,2,7,8,6,4,5,A,B,9,C};  
 1153: {0,4,1,2,3,5,6,7,9,A,B,8,C}; 1154: {0,4,1,2,3,7,6,5,9,A,B,8,C}; 1155: {0,4,1,2,5,3,6,9,7,A,B,8,C};  
 1540: {0,5,1,2,4,9,6,3,8,A,B,7,C}; 1541: {0,5,1,2,8,3,6,9,4,A,B,7,C}; 1542: {0,5,1,2,8,9,6,3,4,A,B,7,C};  
 1918: {0,5,B,A,8,9,6,3,4,2,1,7,C}; 1919: {0,5,B,A,9,4,6,8,3,2,1,7,C}; 1920: {0,5,B,A,9,8,6,4,3,2,1,7,C};  
 1921: {0,7,1,2,3,4,6,8,9,A,B,5,C}; 1922: {0,7,1,2,3,8,6,4,9,A,B,5,C}; 1923: {0,7,1,2,4,3,6,9,8,A,B,5,C};  
 2305: {0,8,1,2,3,5,6,7,9,A,B,4,C}; 2306: {0,8,1,2,3,7,6,5,9,A,B,4,C}; 2307: {0,8,1,2,5,3,6,9,7,A,B,4,C};  
 3832: {0,B,A,8,9,7,6,5,3,4,2,1,C}; 3833: {0,B,A,9,4,5,6,7,8,3,2,1,C}; 3834: {0,B,A,9,4,7,6,5,8,3,2,1,C};  
 3835: {0,B,A,9,5,4,6,8,7,3,2,1,C}; 3836: {0,B,A,9,5,8,6,4,7,3,2,1,C}; 3837: {0,B,A,9,7,4,6,8,5,3,2,1,C};  
 3838: {0,B,A,9,7,8,6,4,5,3,2,1,C}; 3839: {0,B,A,9,8,5,6,7,4,3,2,1,C}; 3840: {0,B,A,9,8,7,6,5,4,3,2,1,C};

## 7. Make all Latin Squares for the Decomposed Layer Units

Since we can make every ten Latin Squares from a single Primary Diagonal, we can make all the 3840 Latin Squares from the 3840 Primary Diagonals by applying those ten transformation methods above, as you guess.

Let me show you the result list of composing all the Latin Units, only a part.

**\*\* The List of Latin Squares for Layer Units Composing CES13Sm1: (when n1==0) \*\***

1/	2/	3/	4/	5/	6/
OCBA987654321	OB97531CA8642	OA741B852C963	O951A62B73C84	O83B6194C72A5	O6C5B4A392817
210CBA9876543	31CA86420B975	41B852C9630A7	51A62B73C8409	6194C72A5083B	81706C5B4A392
43210CBA98765	6420B97531CA8	852C9630A741B	A62B73C840951	C72A5083B6194	39281706C5B4A
6543210CBA987	97531CA86420B	C9630A741B852	2B73C840951A6	5083B6194C72A	B4A39281706C5
876543210CBA9	CA86420B97531	30A741B852C96	783C840951A62B	B6194C72A5083	6C5B4A3928170
A9876543210CB	20B97531CA864	741B852C9630A	C840951A62B73	4C72A5083B619	1706C5B4A3928
CBA9876543210	531CA86420B97	B852C9630A741	40951A62B73C8	A5083B6194C72	9281706C5B4A3
10CBA98765432	86420B97531CA	2C9630A741B85	951A62B73C840	3B6194C72A508	4A39281706C5B
3210CBA987654	B97531CA86420	630A741B852C9	1A62B73C84095	94C72A5083B61	C5B4A39281706
543210CBA9876	1CA86420B9753	A741B852C9630	62B73C840951A	2A5083B6194C7	706C5B4A39281
76543210CBA98	420B97531CA86	1B852C9630A74	B73C840951A62	83B6194C72A50	281706C5B4A39
9876543210CBA	7531CA86420B9	52C9630A741B8	3C840951A62B7	194C72A5083B6	A39281706C5B4
BA9876543210C	A86420B97531C	9630A741B852C	840951A62B73C	72A5083B6194C	5B4A39281706C
3841/	3842/	3843/	3844/	3845/	3846/
OCAB987654312	OA97532CB8641	OB742A851C963	O952B61A73C84	O83A6294C71B5	O6C5A4B391827
120CAB9876543	32CB86410A975	42A851C9630B7	52B61A73C8409	6294C71B5083A	82706C5A4B391
43120CAB98765	6410A97532CB8	851C9630B742A	B61A73C840952	C71B5083A6294	39182706C5A4B
6543120CAB987	97532CB86410A	C9630B742A851	1A73C840952B6	5083A6294C71B	A4B39182706C5
876543120CAB9	CB86410A97532	30B742A851C96	73C840952B61A	A6294C71B5083	6C5A4B3918270
B9876543120CA	10A97532CB864	742A851C9630B	C840952B61A73	4C71B5083A629	2706C5A4B3918
CAB9876543120	532CB86410A97	A851C9630B742	40952B61A73C8	B5083A6294C71	9182706C5A4B3
20CAB98765431	86410A97532CB	1C9630B742A85	952B61A73C840	3A6294C71B508	4B39182706C5A
3120CAB987654	A97532CB86410	630B742A851C9	2B61A73C84095	94C71B5083A62	C5A4B39182706
543120CAB9876	2CB86410A9753	B742A851C9630	61A73C840952B	1B5083A6294C7	706C5A4B39182
76543120CAB98	410A97532CB86	2A851C9630B74	A73C840952B61	83A6294C71B50	182706C5A4B39
9876543120CAB	7532CB86410A9	51C9630B742A8	3C840952B61A7	294C71B5083A6	B39182706C5A4
AB9876543120C	B86410A97532C	9630B742A851C	840952B61A73C	71B5083A6294C	5A4B39182706C
7681/	7682/	7683/	7684/	7685/	7686/
OC9BA87654213	O9A7523CB8641	OB7439851CA62	OA53B61972C84	O82963A4C71B5	O6C594B2A1837
130C9BA876542	23CB864109A75	439851CA620B7	53B61972C840A	63A4C71B50829	83706C594B2A1
42130C9BA8765	64109A7523CB8	851CA620B7439	B61972C840A53	C71B5082963A4	2A183706C594B

6542130C9BA87	A7523CB864109	CA620B7439851	1972C840A53B6	5082963A4C71B	94B2A183706C5
876542130C9BA	CB864109A7523	20B7439851CA6	72C840A53B619	963A4C71B5082	6C594B2A18370
BA876542130C9	109A7523CB864	7439851CA620B	C840A53B61972	4C71B5082963A	3706C594B2A18
C9BA876542130	523CB864109A7	9851CA620B743	40A53B61972C8	B5082963A4C71	A183706C594B2
30C9BA8765421	864109A7523CB	1CA620B743985	A53B61972C840	2963A4C71B508	4B2A183706C59
2130C9BA87654	9A7523CB86410	620B7439851CA	3B61972C840A5	A4C71B5082963	C594B2A183706
542130C9BA876	3CB864109A752	B7439851CA620	61972C840A53B	1B5082963A4C7	706C594B2A183
76542130C9BA8	4109A7523CB86	39851CA620B74	972C840A53B61	82963A4C71B50	183706C594B2A
A876542130C9B	7523CB864109A	51CA620B74398	2C840A53B6197	3A4C71B508296	B2A183706C594
9BA876542130C	B864109A7523C	A620B7439851C	840A53B61972C	71B5082963A4C	594B2A183706C
<u>11521/</u>	<u>11522/</u>	<u>11523/</u>	<u>11524/</u>	<u>11525/</u>	<u>11526/</u>
0C8BA97653214	08A7524CB9631	0B7348951CA62	0A54B61872C93	092864A3C71B5	06C583B2A1947
140C8BA976532	24CB963108A75	348951CA620B7	54B61872C930A	64A3C71B50928	94706C583B2A1
32140C8BA9765	63108A7524CB9	951CA620B7348	B61872C930A54	C71B5092864A3	2A194706C583B
6532140C8BA97	A7524CB963108	CA620B7348951	1872C930A54B6	5092864A3C71B	83B2A194706C5
976532140C8BA	CB963108A7524	20B7348951CA6	72C930A54B618	864A3C71B5092	6C583B2A19470
BA976532140C8	108A7524CB963	7348951CA620B	C930A54B61872	3C71B5092864A	4706C583B2A19
C8BA976532140	524CB963108A7	8951CA620B734	30A54B61872C9	B5092864A3C71	A194706C583B2
40C8BA9765321	963108A7524CB	1CA620B734895	A54B61872C930	2864A3C71B509	3B2A194706C58
2140C8BA97653	8A7524CB96310	620B7348951CA	4B61872C930A5	A3C71B5092864	C583B2A194706
532140C8BA976	4CB963108A752	B7348951CA620	61872C930A54B	1B5092864A3C7	706C583B2A194
76532140C8BA9	3108A7524CB96	48951CA620B73	872C930A54B61	92864A3C71B50	194706C583B2A
A976532140C8B	7524CB963108A	51CA620B73489	2C930A54B6187	4A3C71B509286	B2A194706C583
8BA976532140C	B963108A7524C	A620B7348951C	930A54B61872C	71B5092864A3C	583B2A194706C
<u>15361/</u>	<u>15362/</u>	<u>15363/</u>	<u>15364/</u>	<u>15365/</u>	<u>15366/</u>
0C7BA98643215	07A8425CB9631	0B8357941CA62	0A45B61782C93	092765A3C81B4	06C473B2A1958
150C7BA986432	25CB963107A84	357941CA620B8	45B61782C930A	65A3C81B40927	95806C473B2A1
32150C7BA9864	63107A8425CB9	941CA620B8357	B61782C930A45	C81B4092765A3	2A195806C473B
6432150C7BA98	A8425CB963107	CA620B8357941	1782C930A45B6	4092765A3C81B	73B2A195806C4
986432150C7BA	CB963107A8425	20B8357941CA6	82C930A45B617	765A3C81B4092	6C473B2A19580
BA986432150C7	107A8425CB963	8357941CA620B	C930A45B61782	3C81B4092765A	5806C473B2A19
C7BA986432150	425CB963107A8	7941CA620B835	30A45B61782C9	B4092765A3C81	A195806C473B2
50C7BA9864321	963107A8425CB	1CA620B835794	A45B61782C930	2765A3C81B409	3B2A195806C47
2150C7BA98643	7A8425CB96310	620B8357941CA	5B61782C930A4	A3C81B4092765	C473B2A195806
432150C7BA986	5CB963107A842	B8357941CA620	61782C930A45B	1B4092765A3C8	806C473B2A195
86432150C7BA9	3107A8425CB96	57941CA620B83	782C930A45B61	92765A3C81B40	195806C473B2A
A986432150C7B	8425CB963107A	41CA620B83579	2C930A45B6178	5A3C81B409276	B2A195806C473
7BA986432150C	B963107A8425C	A620B8357941C	930A45B61782C	81B4092765A3C	473B2A195806C
<u>19201/</u>	<u>19202/</u>	<u>19203/</u>	<u>19204/</u>	<u>19205/</u>	<u>19206/</u>
0C5BA98643217	05A8427CB9631	0B8375941CA62	0A47B61582C93	092567A3C81B4	06C453B2A1978
170C5BA986432	27CB963105A84	375941CA620B8	47B61582C930A	67A3C81B40925	97806C453B2A1
32170C5BA9864	63105A8427CB9	941CA620B8375	B61582C930A47	C81B4092567A3	2A197806C453B
6432170C5BA98	A8427CB963105	CA620B8375941	1582C930A47B6	4092567A3C81B	53B2A197806C4
986432170C5BA	CB963105A8427	20B8375941CA6	82C930A47B615	567A3C81B4092	6C453B2A19780
BA986432170C5	105A8427CB963	8375941CA620B	C930A47B61582	3C81B4092567A	7806C453B2A19
C5BA986432170	427CB963105A8	5941CA620B837	30A47B61582C9	B4092567A3C81	A197806C453B2
70C5BA9864321	963105A8427CB	1CA620B837594	A47B61582C930	2567A3C81B409	3B2A197806C45
2170C5BA98643	5A8427CB96310	620B8375941CA	7B61582C930A4	A3C81B4092567	C453B2A197806
432170C5BA986	7CB963105A842	B8375941CA620	61582C930A47B	1B4092567A3C8	806C453B2A197
86432170C5BA9	3105A8427CB96	75941CA620B83	582C930A47B61	92567A3C81B40	197806C453B2A
A986432170C5B	8427CB963105A	41CA620B83759	2C930A47B6158	7A3C81B409256	B2A197806C453
5BA986432170C	B963105A8427C	A620B8375941C	930A47B61582C	81B4092567A3C	453B2A197806C
<u>23041/</u>	<u>23042/</u>	<u>23043/</u>	<u>23044/</u>	<u>23045/</u>	<u>23046/</u>
0C4BA97653218	04A7528CB9631	0B7384951CA62	0A58B61472C93	092468A3C71B5	06C543B2A1987
180C4BA976532	28CB963104A75	384951CA620B7	58B61472C930A	68A3C71B50924	98706C543B2A1
32180C4BA9765	63104A7528CB9	951CA620B7384	B61472C930A58	C71B5092468A3	2A198706C543B
6532180C4BA97	A7528CB963104	CA620B7384951	1472C930A58B6	5092468A3C71B	43B2A198706C5
976532180C4BA	CB963104A7528	20B7384951CA6	72C930A58B614	468A3C71B5092	6C543B2A19870
BA976532180C4	104A7528CB963	7384951CA620B	C930A58B61472	3C71B5092468A	8706C543B2A19
C4BA976532180	528CB963104A7	4951CA620B738	30A58B61472C9	B5092468A3C71	A198706C543B2
80C4BA9765321	963104A7528CB	1CA620B738495	A58B61472C930	2468A3C71B509	3B2A198706C54
2180C4BA97653	4A7528CB96310	620B7384951CA	8B61472C930A5	A3C71B5092468	C543B2A198706
532180C4BA976	8CB963104A752	B7384951CA620	61472C930A58B	1B5092468A3C7	706C543B2A198
76532180C4BA9	3104A7528CB96	84951CA620B73	472C930A58B61	92468A3C71B50	198706C543B2A

A976532180C4B	7528CB963104A	51CA620B73849	2C930A58B6147	8A3C71B509246	B2A198706C543
4BA976532180C	B963104A7528C	A620B7384951C	930A58B61472C	71B5092468A3C	543B2A198706C
26881/	26882/	26883/	26884/	26885/	26886/
0C3BA87654219	03A7529CB8641	0B7493851CA62	0A59B61372C84	082369A4C71B5	06C534B2A1897
190C3BA876542	29CB864103A75	493851CA620B7	59B61372C840A	69A4C71B50823	89706C534B2A1
42190C3BA8765	64103A7529CB8	851CA620B7493	B61372C840A59	C71B5082369A4	2A189706C534B
6542190C3BA87	A7529CB864103	CA620B7493851	1372C840A59B6	5082369A4C71B	34B2A189706C5
876542190C3BA	CB864103A7529	20B7493851CA6	72C840A59B613	369A4C71B5082	6C534B2A18970
BA876542190C3	103A7529CB864	7493851CA620B	C840A59B61372	4C71B5082369A	9706C534B2A18
C3BA876542190	529CB864103A7	3851CA620B749	40A59B61372C8	B5082369A4C71	A189706C534B2
90C3BA8765421	864103A7529CB	1CA620B749385	A59B61372C840	2369A4C71B508	4B2A189706C53
2190C3BA87654	3A7529CB86410	620B7493851CA	9B61372C840A5	A4C71B5082369	C534B2A189706
542190C3BA876	9CB864103A752	B7493851CA620	61372C840A59B	1B5082369A4C7	706C534B2A189
76542190C3BA8	4103A7529CB86	93851CA620B74	372C840A59B61	82369A4C71B50	189706C534B2A
A876542190C3B	7529CB864103A	51CA620B74938	2C840A59B6137	9A4C71B508236	B2A189706C534
3BA876542190C	B864103A7529C	A620B7493851C	840A59B61372C	71B5082369A4C	534B2A189706C
30721/	30722/	30723/	30724/	30725/	30726/
0C2B98765431A	029753ACB8641	0B74A2851C963	095AB61273C84	08326A94C71B5	06C524B3918A7
1A0C2B9876543	3ACB864102975	4A2851C9630B7	5AB61273C8409	6A94C71B50832	8A706C524B391
431A0C2B98765	641029753ACB8	851C9630B74A2	B61273C84095A	C71B508326A94	3918A706C524B
65431A0C2B987	9753ACB864102	C9630B74A2851	1273C84095AB6	508326A94C71B	24B3918A706C5
8765431A0C2B9	CB8641029753A	30B74A2851C96	73C84095AB612	26A94C71B5083	6C524B3918A70
B98765431A0C2	1029753ACB864	74A2851C9630B	C84095AB61273	4C71B508326A9	A706C524B3918
C2B98765431A0	53ACB86410297	2851C9630B74A	4095AB61273C8	B508326A94C71	918A706C524B3
A0C2B98765431	8641029753ACB	1C9630B74A285	95AB61273C840	326A94C71B508	4B3918A706C52
31A0C2B987654	29753ACB86410	630B74A2851C9	AB61273C84095	94C71B508326A	C524B3918A706
5431A0C2B9876	ACB8641029753	B74A2851C9630	61273C84095AB	1B508326A94C7	706C524B3918A
765431A0C2B98	41029753ACB86	A2851C9630B74	273C84095AB61	8326A94C71B50	18A706C524B39
98765431A0C2B	753ACB8641029	51C9630B74A28	3C84095AB6127	A94C71B508326	B3918A706C524
2B98765431A0C	B8641029753AC	9630B74A2851C	84095AB61273C	71B508326A94C	524B3918A706C
34561/	34562/	34563/	34564/	34565/	34566/
0C1A98765432B	019753BCA8642	0A74B1852C963	095BA62173C84	08316B94C72A5	06C514A3928B7
2B0C1A9876543	3BCA864201975	4B1852C9630A7	5BA62173C8409	6B94C72A50831	8B706C514A392
432B0C1A98765	642019753BCA8	852C9630A74B1	A62173C84095B	C72A508316B94	3928B706C514A
65432B0C1A987	9753BCA864201	C9630A74B1852	2173C84095BA6	508316B94C72A	14A3928B706C5
8765432B0C1A9	CA8642019753B	30A74B1852C96	73C84095BA621	16B94C72A5083	6C514A3928B70
A98765432B0C1	2019753BCA864	74B1852C9630A	C84095BA62173	4C72A508316B9	B706C514A3928
C1A98765432B0	53BCA86420197	1852C9630A74B	4095BA62173C8	A508316B94C72	928B706C514A3
B0C1A98765432	8642019753BCA	2C9630A74B185	95BA62173C840	316B94C72A508	4A3928B706C51
32B0C1A987654	19753BCA86420	630A74B1852C9	BA62173C84095	94C72A508316B	C514A3928B706
5432B0C1A9876	BCA8642019753	A74B1852C9630	62173C84095BA	2A508316B94C7	706C514A3928B
765432B0C1A98	42019753BCA86	B1852C9630A74	173C84095BA62	8316B94C72A50	28B706C514A39
98765432B0C1A	753BCA8642019	52C9630A74B18	3C84095BA6217	B94C72A508316	A3928B706C514
1A98765432B0C	A8642019753BC	9630A74B1852C	84095BA62173C	72A508316B94C	514A3928B706C

[Total Count of Latin Units = 38400]

## 8. Combine Latin Units and Compose Complete Euler Squares of Order 13

The last job we have to do is composing the final objects of 'C.E.S.' of Order 13 by combining every two pieces of Latin Units picked up out of those results above.

Suppose you pick up **No.1** solution for high Layer Unit and **No.22** for low Layer one as shown below. Combine those positional data of the two units one after another and calculate the values of corresponding pairs under the next equation **CEuler** and put the result in the corresponding positions of our object in the classical expression:

$$Vh[n] \times 13 + Vl[n] + 1 = Vc[n] \quad (n=1,2,3,4, \dots, 167,168,169) \quad \dots \text{CEuler}$$

We must finally apply some examination processes to every result to check if neither duplication nor lack of any number must be found there. We must also select the correct standard solutions under the list-forming inequality conditions such as  $n1==1$ ; and  $N2>n14$ ; eliminating reflected patterns out of the result.

1/H	22/L	19/
0CBA987654321	0B98431CA7652	1 168 153 139 122 108 93 91 76 60 46 32 16
210CBA9876543	31CA76520B984	30 15 13 167 151 137 123 107 92 90 75 61 44
43210CBA98765	6520B98431CA7	59 45 29 14 12 166 152 135 121 106 104 89 73
6543210CBA987	98431CA76520B	88 74 57 43 28 26 11 164 150 136 120 105 103
876543210CBA9	CA76520B98431	117 102 86 72 58 42 27 25 10 165 148 134 119
A9876543210CB	20B98431CA765	133 118 116 101 87 70 56 41 39 24 8 163 149
CBA9876543210	431CA76520B98	161 147 132 130 115 99 85 71 55 40 38 23 9
10CBA98765432	76520B98431CA	21 7 162 146 131 129 114 100 83 69 54 52 37
3210CBA987654	B98431CA76520	51 36 22 5 160 145 143 128 112 98 84 68 53
543210CBA9876	1CA76520B9843	67 65 50 34 20 6 159 144 142 127 113 96 82
76543210CBA98	520B98431CA76	97 81 66 64 49 35 18 4 158 156 141 125 111
9876543210CBA	8431CA76520B9	126 109 95 80 78 63 47 33 19 3 157 155 140
BA9876543210C	A76520B98431C	154 138 124 110 94 79 77 62 48 31 17 2 169

Vh[n] x 13 + Vl[n] + 1 = Vc[n] (n=1,2,3,4, ..., 167,168,169) ... CEuler

0x13+0+1=1;	Cx13+B+1=168;	Bx13+9+1=153;	Ax13+8+1=139;
9x13+4+1=122;	8x13+3+1=108;	7x13+1+1=93;	6x13+C+1=91;
5x13+A+1=76;	4x13+7+1=60;	3x13+6+1=46;	2x13+5+1=32;
1x13+2+1=16;	. . . . ;	6x13+6+1=85;	. . . . ;
Bx13+A+1=154;	. . . . ;	Cx13+C+1=169;	

## 9. Result List of the final C.E.S. Solutions (Part)

\*\* C.E.S.13x13: Simultaneous Type: Self-Complementary and Pan-diagonal \*\*

1/H	2/L	1 =RowS C1mS\PD1S/PD2S
0CBA987654321	0B97531CA8642	1 168 153 138 123 108 93 91 76 61 46 31 16 =1105 1105\1105/1105
210CBA9876543	31CA86420B975	30 15 13 167 152 137 122 107 92 90 75 60 45 =1105 1105\1105/1105
43210CBA98765	6420B97531CA8	59 44 29 14 12 166 151 136 121 106 104 89 74 =1105 1105\1105/1105
6543210CBA987	97531CA86420B	88 73 58 43 28 26 11 165 150 135 120 105 103 =1105 1105\1105/1105
876543210CBA9	CA86420B97531	117 102 87 72 57 42 27 25 10 164 149 134 119 =1105 1105\1105/1105
A9876543210CB	20B97531CA864	133 118 116 101 86 71 56 41 39 24 9 163 148 =1105 1105\1105/1105
CBA9876543210	531CA86420B97	162 147 132 130 115 100 85 70 55 40 38 23 8 =1105 1105\1105/1105
10CBA98765432	86420B97531CA	22 7 161 146 131 129 114 99 84 69 54 52 37 =1105 1105\1105/1105
3210CBA987654	B97531CA86420	51 36 21 6 160 145 143 128 113 98 83 68 53 =1105 1105\1105/1105
543210CBA9876	1CA86420B9753	67 65 50 35 20 5 159 144 142 127 112 97 82 =1105 1105\1105/1105
76543210CBA98	420B97531CA86	96 81 66 64 49 34 19 4 158 156 141 126 111 =1105 1105\1105/1105
9876543210CBA	7531CA86420B9	125 110 95 80 78 63 48 33 18 3 157 155 140 =1105 1105\1105/1105
BA9876543210C	A86420B97531C	154 139 124 109 94 79 77 62 47 32 17 2 169 =1105 1105\1105/1105

1/H	3/L	2 =RowS C1mS\PD1S/PD2S
0CBA987654321	0A741B852C963	1 167 151 135 119 116 100 84 68 65 49 33 17 =1105 1105\1105/1105
210CBA9876543	41B852C9630A7	31 15 12 165 149 133 130 114 98 82 66 63 47 =1105 1105\1105/1105
43210CBA98765	852C9630A741B	61 45 29 26 10 163 147 131 128 112 96 80 77 =1105 1105\1105/1105
6543210CBA987	C9630A741B852	91 75 59 43 27 24 8 161 145 142 126 110 94 =1105 1105\1105/1105
876543210CBA9	30A741B852C96	108 92 89 73 57 41 38 22 6 159 156 140 124 =1105 1105\1105/1105
A9876543210CB	741B852C9630A	138 122 106 103 87 71 55 52 36 20 4 157 154 =1105 1105\1105/1105
CBA9876543210	B852C9630A741	168 152 136 120 117 101 85 69 53 50 34 18 2 =1105 1105\1105/1105
10CBA98765432	2C9630A741B85	16 13 166 150 134 118 115 99 83 67 64 48 32 =1105 1105\1105/1105
3210CBA987654	630A741B852C9	46 30 14 11 164 148 132 129 113 97 81 78 62 =1105 1105\1105/1105
543210CBA9876	A741B852C9630	76 60 44 28 25 9 162 146 143 127 111 95 79 =1105 1105\1105/1105
76543210CBA98	1B852C9630A74	93 90 74 58 42 39 23 7 160 144 141 125 109 =1105 1105\1105/1105
9876543210CBA	52C9630A741B8	123 107 104 88 72 56 40 37 21 5 158 155 139 =1105 1105\1105/1105
BA9876543210C	9630A741B852C	153 137 121 105 102 86 70 54 51 35 19 3 169 =1105 1105\1105/1105

1/H	4/L	3 =RowS C1mS\PD1S/PD2S
0CBA987654321	0951A62B73C84	1 166 149 132 128 111 94 90 73 56 52 35 18 =1105 1105\1105/1105
210CBA9876543	51A62B73C8409	32 15 11 163 146 142 125 108 104 87 70 53 49 =1105 1105\1105/1105
43210CBA98765	A62B73C840951	63 46 29 25 8 160 156 139 122 105 101 84 67 =1105 1105\1105/1105
6543210CBA987	2B73C840951A6	81 77 60 43 39 22 5 157 153 136 119 115 98 =1105 1105\1105/1105
876543210CBA9	73C840951A62B	112 95 91 74 57 40 36 19 2 167 150 133 129 =1105 1105\1105/1105
A9876543210CB	C840951A62B73	143 126 109 92 88 71 54 50 33 16 12 164 147 =1105 1105\1105/1105
CBA9876543210	40951A62B73C8	161 144 140 123 106 102 85 68 64 47 30 26 9 =1105 1105\1105/1105
10CBA98765432	951A62B73C840	23 6 158 154 137 120 116 99 82 78 61 44 27 =1105 1105\1105/1105
3210CBA987654	1A62B73C84095	41 37 20 3 168 151 134 130 113 96 79 75 58 =1105 1105\1105/1105
543210CBA9876	62B73C840951A	72 55 51 34 17 13 165 148 131 127 110 93 89 =1105 1105\1105/1105
76543210CBA98	B73C840951A62	103 86 69 65 48 31 14 10 162 145 141 124 107 =1105 1105\1105/1105
9876543210CBA	3C840951A62B7	121 117 100 83 66 62 45 28 24 7 159 155 138 =1105 1105\1105/1105
BA9876543210C	840951A62B73C	152 135 118 114 97 80 76 59 42 38 21 4 169 =1105 1105\1105/1105

1/H	5/L	4 =RowS C1mS\PD1S/PD2S																											
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210CBA9876543	6194C72A5083B	33	15	10	161	156	138	120	115	97	79	74	56	51	=1105 1105\1105/1105														
43210CBA98765	C72A5083B6194	65	47	29	24	6	157	152	134	129	111	93	88	70	=1105 1105\1105/1105														
6543210CBA987	5083B6194C72A	84	66	61	43	38	20	2	166	148	143	125	107	102	=1105 1105\1105/1105														
876543210CBA9	B6194C72A5083	116	98	80	75	57	52	34	16	11	162	144	139	121	=1105 1105\1105/1105														
A9876543210CB	4C72A5083B619	135	130	112	94	89	71	53	48	30	25	7	158	153	=1105 1105\1105/1105														
CBA9876543210	A5083B6194C72	167	149	131	126	108	103	85	67	62	44	39	21	3	=1105 1105\1105/1105														
10CBA98765432	3B6194C72A508	17	12	163	145	140	122	117	99	81	76	58	40	35	=1105 1105\1105/1105														
3210CBA987654	94C72A5083B61	49	31	26	8	159	154	136	118	113	95	90	72	54	=1105 1105\1105/1105														
543210CBA9876	2A5083B6194C7	68	63	45	27	22	4	168	150	132	127	109	104	86	=1105 1105\1105/1105														
76543210CBA98	83B6194C72A50	100	82	77	59	41	36	18	13	164	146	141	123	105	=1105 1105\1105/1105														
9876543210CBA	194C72A5083B6	119	114	96	91	73	55	50	32	14	9	160	155	137	=1105 1105\1105/1105														
BA9876543210C	72A5083B6194C	151	133	128	110	92	87	69	64	46	28	23	5	169	=1105 1105\1105/1105														

1/H	6/L	5 =RowS C1mS\PD1S/PD2S																											
OCBA987654321	06C5B4A392817	1	163	156	136	129	109	102	82	75	55	48	28	21	=1105 1105\1105/1105														
210CBA9876543	81706C5B4A392	35	15	8	157	150	143	123	116	96	89	69	62	42	=1105 1105\1105/1105														
43210CBA98765	39281706C5B4A	56	49	29	22	2	164	144	137	130	110	103	83	76	=1105 1105\1105/1105														
6543210CBA987	84A39281706C5	90	70	63	43	36	16	9	158	151	131	124	117	97	=1105 1105\1105/1105														
876543210CBA9	6C5B4A3928170	111	104	84	77	57	50	30	23	3	165	145	138	118	=1105 1105\1105/1105														
A9876543210CB	1706C5B4A3928	132	125	105	98	91	71	64	44	37	17	10	159	152	=1105 1105\1105/1105														
CBA9876543210	9281706C5B4A3	166	146	139	119	112	92	85	78	58	51	31	24	4	=1105 1105\1105/1105														
10CBA98765432	4A39281706C5B	18	11	160	153	133	126	106	99	79	72	65	45	38	=1105 1105\1105/1105														
3210CBA987654	C5B4A39281706	52	32	25	5	167	147	140	120	113	93	86	66	59	=1105 1105\1105/1105														
543210CBA9876	706C5B4A39281	73	53	46	39	19	12	161	154	134	127	107	100	80	=1105 1105\1105/1105														
76543210CBA98	281706C5B4A39	94	87	67	60	40	33	26	6	168	148	141	121	114	=1105 1105\1105/1105														
9876543210CBA	A39281706C5B4	128	108	101	81	74	54	47	27	20	13	162	155	135	=1105 1105\1105/1105														
BA9876543210C	5B4A39281706C	149	142	122	115	95	88	68	61	41	34	14	7	169	=1105 1105\1105/1105														

1/H	7/L	6 =RowS C1mS\PD1S/PD2S																											
OCBA987654321	05A27C4916B38	1	162	154	133	125	117	96	88	67	59	51	30	22	=1105 1105\1105/1105														
210CBA9876543	916B3805A27C4	36	15	7	168	147	139	118	110	102	81	73	65	44	=1105 1105\1105/1105														
43210CBA98765	5A27C4916B380	58	50	29	21	13	161	153	132	124	116	95	87	66	=1105 1105\1105/1105														
6543210CBA987	16B3805A27C49	80	72	64	43	35	14	6	167	146	138	130	109	101	=1105 1105\1105/1105														
876543210CBA9	A27C4916B3805	115	94	86	78	57	49	28	20	12	160	152	131	123	=1105 1105\1105/1105														
A9876543210CB	6B3805A27C491	137	129	108	100	79	71	63	42	34	26	5	166	145	=1105 1105\1105/1105														
CBA9876543210	27C4916B3805A	159	151	143	122	114	93	85	77	56	48	27	19	11	=1105 1105\1105/1105														
10CBA98765432	B3805A27C4916	25	4	165	144	136	128	107	99	91	70	62	41	33	=1105 1105\1105/1105														
3210CBA987654	7C4916B3805A2	47	39	18	10	158	150	142	121	113	92	84	76	55	=1105 1105\1105/1105														
543210CBA9876	3805A27C4916B	69	61	40	32	24	3	164	156	135	127	106	98	90	=1105 1105\1105/1105														
76543210CBA98	C4916B3805A27	104	83	75	54	46	38	17	9	157	149	141	120	112	=1105 1105\1105/1105														
9876543210CBA	805A27C4916B3	126	105	97	89	68	60	52	31	23	2	163	155	134	=1105 1105\1105/1105														
BA9876543210C	4916B3805A27C	148	140	119	111	103	82	74	53	45	37	16	8	169	=1105 1105\1105/1105														

1/H	8/L	7 =RowS C1mS\PD1S/PD2S																											
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210CBA9876543	A159048C37B26	37	15	6	166	144	135	126	117	95	86	77	55	46	=1105 1105\1105/1105														
43210CBA98765	7B26A159048C3	60	51	29	20	11	158	149	140	118	109	100	91	69	=1105 1105\1105/1105														
6543210CBA987	48C37B26A1590	83	74	65	43	34	25	3	163	154	132	123	114	92	=1105 1105\1105/1105														
876543210CBA9	159048C37B26A	106	97	88	66	57	48	39	17	8	168	146	137	128	=1105 1105\1105/1105														
A9876543210CB	B26A159048C37	142	120	111	102	80	71	62	40	31	22	13	160	151	=1105 1105\1105/1105														
CBA9876543210	8C37B26A15904	165	156	134	125	116	94	85	76	54	45	36	14	5	=1105 1105\1105/1105														
10CBA98765432	59048C37B26A1	19	10	157	148	139	130	108	99	90	68	59	50	28	=1105 1105\1105/1105														
3210CBA987654	26A159048C37B	42	33	24	2	162	153	131	122	113	104	82	73	64	=1105 1105\1105/1105														
543210CBA9876	C37B26A159048	78	56	47	38	16	7	167	145	136	127	105	96	87	=1105 1105\1105/1105														
76543210CBA98	9048C37B26A15	101	79	70	61	52	30	21	12	159	150	141	119	110	=1105 1105\1105/1105														
9876543210CBA	6A159048C37B2	124	115	93	84	75	53	44	35	26	4	164	155	133	=1105 1105\1105/1105														
BA9876543210C	37B26A159048C	147	138	129	107	98	89	67	58	49	27	18	9	169	=1105 1105\1105/1105														

1/H	9/L	8 =RowS C1mS\PD1S/PD2S																											
OCBA987654321	0369C258B147A	1	160	150	140	130	107	97	87	77	54	44	34	24	=1105 1105\1105/1105														
210CBA9876543	B147A0369C258	38	15	5	164	154	131	121	111	101	91	68	58	48	=1105 1105\1105/1105														
43210CBA98765	9C258B147A036	62	52	29	19	9	168	145	135	125	115	92	82	72	=1105 1105\1105/1105														
6543210CBA987	7A0369C258B14	86	76	53	43	33	23	13	159	149	139	129	106	96	=1105 1105\1105/1105														
876543210CBA9	58B147A0369C2	110	100	90	67	57	47	37	14	4	163	153	143	120	=1105 1105\1105/1105														
A9876543210CB	369C258B147A0	134	124	114	104	81	71	61	51	28	18	8	167	144	=1105 1105\1105/1105														
CBA9876543210	147A0369C258B	158	148	138	128	105	95	85	75	65	42	32	22	12	=1105 1105\1105/1105														
10CBA98765432	C258B147A0369	26	3	162	152	142	119	109	99	89	66	56	46	36	=1105 1105\1105/1105														
3210CBA987654	A0369C258B147	50	27	17	7	166	156	133	123	113	103	80	70	60	=1105 1105\1105/1105														
543210CBA9876	8B147A0369C25	74	64	41	31	21	11	157	147	137	127	117	94	84	=1105 1105\1105/1105														
76543210CBA98	69C258B147A03	98	88	78	55	45	35	25	2	161	151	141	118	108	=1105 1105\1105/1105														
9876543210CBA	47A0369C258B1	122	112	102	79	69	59	49	39	16	6	165	155	132	=1105 1105\1105/1105														
BA9876543210C	258B147A0369C	146	136	126	116	93	83	73	63	40	30	20	10	169	=1105 1105\1105/1105														



1/H												19/L							17/				1/H						20/L					18/																		
1	160	150	140	130	107	99	87	77	54	44	32	24	1	159	148	137	126	115	104	80	69	60	45	36	25	1	159	148	137	126	115	104	80	69	60	45	36	25	1	159	148	137	126	115	104	80	69	60	45	36	25	
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84	76	53	43	33	23	13	159	151	139	129	106	96	89	78	54	43	34	19	10	168	144	133	122	111	100	89	78	54	43	34	19	10	168	144	133	122	111	100	114	103	79	68	57	46	35	24	13	158	147	138	123	
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134	124	114	104	81	73	61	51	28	18	6	167	144	139	128	117	93	82	73	58	49	38	14	3	161	150	139	128	117	93	82	73	58	49	38	14	3	161	150	162	153	142	118	107	96	85	74	63	52	28	17	8	
158	148	136	128	105	95	85	75	65	42	34	22	12	162	153	142	118	107	96	85	74	63	52	28	17	8	162	153	142	118	107	96	85	74	63	52	28	17	8	20	9	167	156	132	121	112	97	88	77	53	42	31	
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1/H												22/L							19/				1/H						23/L					20/																		
1	168	153	139	122	108	93	91	76	60	46	32	16	1	167	152	136	119	116	99	83	68	65	49	33	17	1	167	152	136	119	116	99	83	68	65	49	33	17	32	15	12	164	148	133	130	114	98	82	66	63	48	
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21	7	162	146	131	129	114	100	83	69	54	52	37	16	13	166	150	134	118	115	100	84	67	64	47	31	16	13	166	150	134	118	115	100	84	67	64	47	31	46	30	14	11	165	149	132	129	112	96	81	78	62	
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154	138	124	110	94	79	77	62	48	31	17	2	169	153	137	121	105	102	87	71	54	51	34	18	3	169	153	137	121	105	102	87	71	54	51	34	18	3	169														
2/H												1/L							34561/				3/H						1/L					69121/																		
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15361/H												2/L						265420801/						17281/H						2/L						298598401/																																																																			
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34561/H				2/L				597196801/				36481/H				2/L				630374401/					
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96	81	66	64	49	34	149	4	158	26	141	126	111	109	81	53	51	36	99	149	4	158	26	76	139	124
125	110	95	80	78	63	48	33	148	3	157	25	140	138	123	108	80	65	50	35	98	148	3	157	25	75
24	139	124	109	94	79	77	62	47	32	147	2	169	24	74	137	122	107	79	64	49	34	97	147	2	169

38399/H				1/L				663517441 =RowS C1mS\PD1S/PD2S															
0963CA741B852	OCBA987654321	1	130	90	50	166	139	99	59	19	148	108	68	28	=1105 1105\1105/1105								
1B8520963CA74	210CBA9876543	16	145	105	78	38	11	127	87	47	163	136	96	56	=1105 1105\1105/1105								
3CA741B852096	43210CBA98765	44	160	133	93	53	26	155	115	75	35	8	124	84	=1105 1105\1105/1105								
520963CA741B8	6543210CBA987	72	32	5	121	81	41	157	143	103	63	23	152	112	=1105 1105\1105/1105								
741B8520963CA	876543210CBA9	100	60	20	149	109	69	29	2	118	91	51	167	140	=1105 1105\1105/1105								
963CA741B8520	A9876543210CB	128	88	48	164	137	97	57	17	146	106	66	39	12	=1105 1105\1105/1105								
B8520963CA741	CBA9876543210	156	116	76	36	9	125	85	45	161	134	94	54	14	=1105 1105\1105/1105								
CA741B8520963	10CBA98765432	158	131	104	64	24	153	113	73	33	6	122	82	42	=1105 1105\1105/1105								
20963CA741B85	3210CBA987654	30	3	119	79	52	168	141	101	61	21	150	110	70	=1105 1105\1105/1105								
41B8520963CA7	543210CBA9876	58	18	147	107	67	27	13	129	89	49	165	138	98	=1105 1105\1105/1105								
63CA741B85209	76543210CBA98	86	46	162	135	95	55	15	144	117	77	37	10	126	=1105 1105\1105/1105								
8520963CA741B	9876543210CBA	114	74	34	7	123	83	43	159	132	92	65	25	154	=1105 1105\1105/1105								
A741B8520963C	BA9876543210C	142	102	62	22	151	111	71	31	4	120	80	40	169	=1105 1105\1105/1105								

[Count(when n1==1): 663552000] OK!  
(Calculated and Listed by Kanji Setsuda on May 11, 2010)

I am very glad I could count all the standard solutions through as shown above.

**663552000** = 38400 x 38400 x (1/2) x (9/10); when n1==1

'38400' means the count of Latin Units, '1/2' means elimination of reflected patterns. '9/10' is the ratio of correct answers to all the combinations.

The total count of all the standard solutions should be calculated as follows:

460800 x 460800 x (1/8) x (9/10) = **23887872000**;

'460800' means the full count of Latin Units, '1/8' means a ratio of standard solutions to all primitive ones. '9/10' stands for the ratio of correct answers to all the combinations.

What a big count of solutions it is! I can hardly imagine how many solutions there should be in all for the ordinary type of our object including "Non-Euler Type".

(English version written by Kanji Setsuda on May 17, 2010 with MacOSX and Xcode3)

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#### Appendix: Core Part of the Program for Making:

```

/** 'Complete Euler Squares' of Order 13 for Simultaneous Type: **/
/** Both Self-Complementary and Pan-diagonal: Composed by "Knight's Tour" **/
/** 'CES13SmLP.c' by Kanji Setsuda on May 11, 2010 with MacOSX & Xcode3.1.2 **/
/**/
#include <stdio.h>
/**/
long int cnt, cnt1;
long cntn[3][3];
long u1, u2;
/**/
short int cnt3, cnt4;
short CC;
short nm[170], flg[170];

```

```

short anm[3][170];
short pdf[14];
short pd[3841][14];
short p[14], n[170];
char tlu[38401][170];
/**/
void stp01(void), stp02(void), stp03(void), stp04(void), stp05(void), stp06(void);
void recpd(void);
void lurecord(void);
short Chk2lunit(long x, long y);
void cmbcmp(void);
void rec2sol(void);
void prsol(void), pr2sol(void);
/**/
void tp1(void), tp2(void), tp3(void), tp4(void), tp5(void);
void tp6(void), tp7(void), tp8(void), tp9(void), tp10(void);
/**/
/* Main Program */
int main(){
short n;
printf("\n** Composing 'Complete Euler Squares' of Order 13: **\n");
printf("** Simultaneous Type of Both Self-Complementary and Pan-diagonal **\n");
for(n=0;n<170;n++){nm[n]=0;}
for(n=0;n<14;n++){pdf[n]=0;}
cnt=0; cnt1=0;
CC=12; cnt3=0;
nm[85]=6; pdf[6]=1;           //Set n85=6;
stp01();                     // Make the Layer-Units
pdf[6]=0;
lurecord();
printf("\n* Result List of Standard Solutions when n1==1 *\n");
cnt=0;
cmbcmp();                   // Combine and Compose
printf(" . . . . \n");
printf(" [Count(when n1==1): %d] OK!\n",cnt);
printf(" (Calculated and Listed by Kanji Setsuda on May 11, 2010)\n");
return 0;
}
/* Make the First Primary Diagonals */
/* Set N1 & n169=CC-N1 */
void stp01(){
short a,b;
for(a=0;a<1;a++){b=CC-a;
if((pdf[a]==0)&&(pdf[b]==0)){
nm[1]=a; nm[169]=b;
pdf[a]=1; pdf[b]=1;
stp02();
pdf[b]=0; pdf[a]=0;}
}
}
/* Set N15 & n155=CC-N15 */
void stp02(){
short a,b;
for(a=0;a<13;a++){b=CC-a;
if((pdf[a]==0)&&(pdf[b]==0)){
nm[15]=a; nm[155]=b;
pdf[a]=1; pdf[b]=1;
stp03();
pdf[b]=0; pdf[a]=0;}
}
}
/* Set N29 & n141=CC-N29 */
void stp03(){
short a,b;
for(a=0;a<13;a++){b=CC-a;

```

```

        if((pdf[a]==0)&&(pdf[b]==0)){
            nm[29]=a; nm[141]=b;
            pdf[a]=1; pdf[b]=1;
            stp04();
            pdf[b]=0; pdf[a]=0;}
    }
}
/* Set N43 & n127=CC-N43 */
void stp04(){
    short a,b;
    for(a=0;a<13;a++){b=CC-a;
        if((pdf[a]==0)&&(pdf[b]==0)){
            nm[43]=a; nm[127]=b;
            pdf[a]=1; pdf[b]=1;
            stp05();
            pdf[b]=0; pdf[a]=0;}
    }
}
/* Set N57 & n113=CC-N57 */
void stp05(){
    short a,b;
    for(a=0;a<13;a++){b=CC-a;
        if((pdf[a]==0)&&(pdf[b]==0)){
            nm[57]=a; nm[113]=b;
            pdf[a]=1; pdf[b]=1;
            stp06();
            pdf[b]=0; pdf[a]=0;}
    }
}
/* Set N71 & n99=CC-N71 */
void stp06(){
    short a,b;
    for(a=0;a<13;a++){b=CC-a;
        if((pdf[a]==0)&&(pdf[b]==0)){
            nm[71]=a; nm[99]=b;
            pdf[a]=1; pdf[b]=1;
            recpd();
            pdf[b]=0; pdf[a]=0;}
    }
}
/**/
/* Record the Data of Primary Diagonal */
void recpd(){
    short n,n14;
    pd[cnt][0]=cnt+1;
    for(n=0;n<13;n++){n14=n*14;
        pd[cnt][n+1]=nm[n14+1];
    }
    cnt++;
}
/**/
/* Record the Compositions of Layer Units */
void lurecord(){
    long i,j;
    for(i=0;i<cnt;i++){
        for(j=1;j<14;j++){p[j]=pd[i][j];};
        tp1();
        for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
        tp9();
        for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
        tp8();
        for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
        tp3();
        for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
        tp6();
    }
}

```

```

    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
    tp7();
    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
    tp4();
    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
    tp5();
    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
    tp10();
    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
    tp2();
    for(j=1;j<170;j++){tlu[cnt1][j]=n[j];}; cnt1++;
}
}
/**/
/** Compose Basic Patterns of Layer Units from the same Primary Diagonal **/
void tp1(){
short v;
v=p[1]; n[1]=v; n[16]=v; n[31]=v; n[46]=v; n[61]=v; n[76]=v;
n[91]=v; n[93]=v; n[108]=v; n[123]=v; n[138]=v; n[153]=v; n[168]=v;
v=p[2]; n[13]=v; n[15]=v; n[30]=v; n[45]=v; n[60]=v; n[75]=v;
n[90]=v; n[92]=v; n[107]=v; n[122]=v; n[137]=v; n[152]=v; n[167]=v;
v=p[3]; n[12]=v; n[14]=v; n[29]=v; n[44]=v; n[59]=v; n[74]=v;
n[89]=v; n[104]=v; n[106]=v; n[121]=v; n[136]=v; n[151]=v; n[166]=v;
v=p[4]; n[11]=v; n[26]=v; n[28]=v; n[43]=v; n[58]=v; n[73]=v;
n[88]=v; n[103]=v; n[105]=v; n[120]=v; n[135]=v; n[150]=v; n[165]=v;
v=p[5]; n[10]=v; n[25]=v; n[27]=v; n[42]=v; n[57]=v; n[72]=v;
n[87]=v; n[102]=v; n[117]=v; n[119]=v; n[134]=v; n[149]=v; n[164]=v;
v=p[6]; n[9]=v; n[24]=v; n[39]=v; n[41]=v; n[56]=v; n[71]=v;
n[86]=v; n[101]=v; n[116]=v; n[118]=v; n[133]=v; n[148]=v; n[163]=v;
v=p[7]; n[8]=v; n[23]=v; n[38]=v; n[40]=v; n[55]=v; n[70]=v;
n[85]=v; n[100]=v; n[115]=v; n[130]=v; n[132]=v; n[147]=v; n[162]=v;
v=p[8]; n[7]=v; n[22]=v; n[37]=v; n[52]=v; n[54]=v; n[69]=v;
n[84]=v; n[99]=v; n[114]=v; n[129]=v; n[131]=v; n[146]=v; n[161]=v;
v=p[9]; n[6]=v; n[21]=v; n[36]=v; n[51]=v; n[53]=v; n[68]=v;
n[83]=v; n[98]=v; n[113]=v; n[128]=v; n[143]=v; n[145]=v; n[160]=v;
v=p[10]; n[5]=v; n[20]=v; n[35]=v; n[50]=v; n[65]=v; n[67]=v;
n[82]=v; n[97]=v; n[112]=v; n[127]=v; n[142]=v; n[144]=v; n[159]=v;
v=p[11]; n[4]=v; n[19]=v; n[34]=v; n[49]=v; n[64]=v; n[66]=v;
n[81]=v; n[96]=v; n[111]=v; n[126]=v; n[141]=v; n[156]=v; n[158]=v;
v=p[12]; n[3]=v; n[18]=v; n[33]=v; n[48]=v; n[63]=v; n[78]=v;
n[80]=v; n[95]=v; n[110]=v; n[125]=v; n[140]=v; n[155]=v; n[157]=v;
v=p[13]; n[2]=v; n[17]=v; n[32]=v; n[47]=v; n[62]=v; n[77]=v;
n[79]=v; n[94]=v; n[109]=v; n[124]=v; n[139]=v; n[154]=v; n[169]=v;
};
void tp2(){
short v;
v=p[1]; n[1]=v; n[21]=v; n[28]=v; n[48]=v; n[55]=v; n[75]=v;
n[82]=v; n[102]=v; n[109]=v; n[129]=v; n[136]=v; n[156]=v; n[163]=v;
v=p[2]; n[8]=v; n[15]=v; n[35]=v; n[42]=v; n[62]=v; n[69]=v;
n[89]=v; n[96]=v; n[116]=v; n[123]=v; n[143]=v; n[150]=v; n[157]=v;
v=p[3]; n[2]=v; n[22]=v; n[29]=v; n[49]=v; n[56]=v; n[76]=v;
n[83]=v; n[103]=v; n[110]=v; n[130]=v; n[137]=v; n[144]=v; n[164]=v;
v=p[4]; n[9]=v; n[16]=v; n[36]=v; n[43]=v; n[63]=v; n[70]=v;
n[90]=v; n[97]=v; n[117]=v; n[124]=v; n[131]=v; n[151]=v; n[158]=v;
v=p[5]; n[3]=v; n[23]=v; n[30]=v; n[50]=v; n[57]=v; n[77]=v;
n[84]=v; n[104]=v; n[111]=v; n[118]=v; n[138]=v; n[145]=v; n[165]=v;
v=p[6]; n[10]=v; n[17]=v; n[37]=v; n[44]=v; n[64]=v; n[71]=v;
n[91]=v; n[98]=v; n[105]=v; n[125]=v; n[132]=v; n[152]=v; n[159]=v;
v=p[7]; n[4]=v; n[24]=v; n[31]=v; n[51]=v; n[58]=v; n[78]=v;
n[85]=v; n[92]=v; n[112]=v; n[119]=v; n[139]=v; n[146]=v; n[166]=v;
v=p[8]; n[11]=v; n[18]=v; n[38]=v; n[45]=v; n[65]=v; n[72]=v;
n[79]=v; n[99]=v; n[106]=v; n[126]=v; n[133]=v; n[153]=v; n[160]=v;
v=p[9]; n[5]=v; n[25]=v; n[32]=v; n[52]=v; n[59]=v; n[66]=v;
n[86]=v; n[93]=v; n[113]=v; n[120]=v; n[140]=v; n[147]=v; n[167]=v;
v=p[10]; n[12]=v; n[19]=v; n[39]=v; n[46]=v; n[53]=v; n[73]=v;

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```

    n[80]=v; n[100]=v; n[107]=v; n[127]=v; n[134]=v; n[154]=v; n[161]=v;
v=p[11]; n[6]=v; n[26]=v; n[33]=v; n[40]=v; n[60]=v; n[67]=v;
    n[87]=v; n[94]=v; n[114]=v; n[121]=v; n[141]=v; n[148]=v; n[168]=v;
v=p[12]; n[13]=v; n[20]=v; n[27]=v; n[47]=v; n[54]=v; n[74]=v;
    n[81]=v; n[101]=v; n[108]=v; n[128]=v; n[135]=v; n[155]=v; n[162]=v;
v=p[13]; n[7]=v; n[14]=v; n[34]=v; n[41]=v; n[61]=v; n[68]=v;
    n[88]=v; n[95]=v; n[115]=v; n[122]=v; n[142]=v; n[149]=v; n[169]=v;
};
void tp3(){
short v;
v=p[1]; n[1]=v; n[25]=v; n[36]=v; n[47]=v; n[58]=v; n[69]=v;
    n[80]=v; n[104]=v; n[115]=v; n[126]=v; n[137]=v; n[148]=v; n[159]=v;
v=p[2]; n[4]=v; n[15]=v; n[39]=v; n[50]=v; n[61]=v; n[72]=v;
    n[83]=v; n[94]=v; n[105]=v; n[129]=v; n[140]=v; n[151]=v; n[162]=v;
v=p[3]; n[7]=v; n[18]=v; n[29]=v; n[40]=v; n[64]=v; n[75]=v;
    n[86]=v; n[97]=v; n[108]=v; n[119]=v; n[143]=v; n[154]=v; n[165]=v;
v=p[4]; n[10]=v; n[21]=v; n[32]=v; n[43]=v; n[54]=v; n[78]=v;
    n[89]=v; n[100]=v; n[111]=v; n[122]=v; n[133]=v; n[144]=v; n[168]=v;
v=p[5]; n[13]=v; n[24]=v; n[35]=v; n[46]=v; n[57]=v; n[68]=v;
    n[79]=v; n[103]=v; n[114]=v; n[125]=v; n[136]=v; n[147]=v; n[158]=v;
v=p[6]; n[3]=v; n[14]=v; n[38]=v; n[49]=v; n[60]=v; n[71]=v;
    n[82]=v; n[93]=v; n[117]=v; n[128]=v; n[139]=v; n[150]=v; n[161]=v;
v=p[7]; n[6]=v; n[17]=v; n[28]=v; n[52]=v; n[63]=v; n[74]=v;
    n[85]=v; n[96]=v; n[107]=v; n[118]=v; n[142]=v; n[153]=v; n[164]=v;
v=p[8]; n[9]=v; n[20]=v; n[31]=v; n[42]=v; n[53]=v; n[77]=v;
    n[88]=v; n[99]=v; n[110]=v; n[121]=v; n[132]=v; n[156]=v; n[167]=v;
v=p[9]; n[12]=v; n[23]=v; n[34]=v; n[45]=v; n[56]=v; n[67]=v;
    n[91]=v; n[102]=v; n[113]=v; n[124]=v; n[135]=v; n[146]=v; n[157]=v;
v=p[10]; n[2]=v; n[26]=v; n[37]=v; n[48]=v; n[59]=v; n[70]=v;
    n[81]=v; n[92]=v; n[116]=v; n[127]=v; n[138]=v; n[149]=v; n[160]=v;
v=p[11]; n[5]=v; n[16]=v; n[27]=v; n[51]=v; n[62]=v; n[73]=v;
    n[84]=v; n[95]=v; n[106]=v; n[130]=v; n[141]=v; n[152]=v; n[163]=v;
v=p[12]; n[8]=v; n[19]=v; n[30]=v; n[41]=v; n[65]=v; n[76]=v;
    n[87]=v; n[98]=v; n[109]=v; n[120]=v; n[131]=v; n[155]=v; n[166]=v;
v=p[13]; n[11]=v; n[22]=v; n[33]=v; n[44]=v; n[55]=v; n[66]=v;
    n[90]=v; n[101]=v; n[112]=v; n[123]=v; n[134]=v; n[145]=v; n[169]=v;
};
void tp4(){
short v;
v=p[1]; n[1]=v; n[20]=v; n[39]=v; n[45]=v; n[64]=v; n[70]=v;
    n[89]=v; n[95]=v; n[114]=v; n[120]=v; n[139]=v; n[145]=v; n[164]=v;
v=p[2]; n[9]=v; n[15]=v; n[34]=v; n[40]=v; n[59]=v; n[78]=v;
    n[84]=v; n[103]=v; n[109]=v; n[128]=v; n[134]=v; n[153]=v; n[159]=v;
v=p[3]; n[4]=v; n[23]=v; n[29]=v; n[48]=v; n[54]=v; n[73]=v;
    n[79]=v; n[98]=v; n[117]=v; n[123]=v; n[142]=v; n[148]=v; n[167]=v;
v=p[4]; n[12]=v; n[18]=v; n[37]=v; n[43]=v; n[62]=v; n[68]=v;
    n[87]=v; n[93]=v; n[112]=v; n[118]=v; n[137]=v; n[156]=v; n[162]=v;
v=p[5]; n[7]=v; n[26]=v; n[32]=v; n[51]=v; n[57]=v; n[76]=v;
    n[82]=v; n[101]=v; n[107]=v; n[126]=v; n[132]=v; n[151]=v; n[157]=v;
v=p[6]; n[2]=v; n[21]=v; n[27]=v; n[46]=v; n[65]=v; n[71]=v;
    n[90]=v; n[96]=v; n[115]=v; n[121]=v; n[140]=v; n[146]=v; n[165]=v;
v=p[7]; n[10]=v; n[16]=v; n[35]=v; n[41]=v; n[60]=v; n[66]=v;
    n[85]=v; n[104]=v; n[110]=v; n[129]=v; n[135]=v; n[154]=v; n[160]=v;
v=p[8]; n[5]=v; n[24]=v; n[30]=v; n[49]=v; n[55]=v; n[74]=v;
    n[80]=v; n[99]=v; n[105]=v; n[124]=v; n[143]=v; n[149]=v; n[168]=v;
v=p[9]; n[13]=v; n[19]=v; n[38]=v; n[44]=v; n[63]=v; n[69]=v;
    n[88]=v; n[94]=v; n[113]=v; n[119]=v; n[138]=v; n[144]=v; n[163]=v;
v=p[10]; n[8]=v; n[14]=v; n[33]=v; n[52]=v; n[58]=v; n[77]=v;
    n[83]=v; n[102]=v; n[108]=v; n[127]=v; n[133]=v; n[152]=v; n[158]=v;
v=p[11]; n[3]=v; n[22]=v; n[28]=v; n[47]=v; n[53]=v; n[72]=v;
    n[91]=v; n[97]=v; n[116]=v; n[122]=v; n[141]=v; n[147]=v; n[166]=v;
v=p[12]; n[11]=v; n[17]=v; n[36]=v; n[42]=v; n[61]=v; n[67]=v;
    n[86]=v; n[92]=v; n[111]=v; n[130]=v; n[136]=v; n[155]=v; n[161]=v;
v=p[13]; n[6]=v; n[25]=v; n[31]=v; n[50]=v; n[56]=v; n[75]=v;
    n[81]=v; n[100]=v; n[106]=v; n[125]=v; n[131]=v; n[150]=v; n[169]=v;
};

```

```

};
void tp5(){
short v;
v=p[1]; n[1]=v; n[18]=v; n[35]=v; n[52]=v; n[56]=v; n[73]=v;
n[90]=v; n[94]=v; n[111]=v; n[128]=v; n[132]=v; n[149]=v; n[166]=v;
v=p[2]; n[11]=v; n[15]=v; n[32]=v; n[49]=v; n[53]=v; n[70]=v;
n[87]=v; n[104]=v; n[108]=v; n[125]=v; n[142]=v; n[146]=v; n[163]=v;
v=p[3]; n[8]=v; n[25]=v; n[29]=v; n[46]=v; n[63]=v; n[67]=v;
n[84]=v; n[101]=v; n[105]=v; n[122]=v; n[139]=v; n[156]=v; n[160]=v;
v=p[4]; n[5]=v; n[22]=v; n[39]=v; n[43]=v; n[60]=v; n[77]=v;
n[81]=v; n[98]=v; n[115]=v; n[119]=v; n[136]=v; n[153]=v; n[157]=v;
v=p[5]; n[2]=v; n[19]=v; n[36]=v; n[40]=v; n[57]=v; n[74]=v;
n[91]=v; n[95]=v; n[112]=v; n[129]=v; n[133]=v; n[150]=v; n[167]=v;
v=p[6]; n[12]=v; n[16]=v; n[33]=v; n[50]=v; n[54]=v; n[71]=v;
n[88]=v; n[92]=v; n[109]=v; n[126]=v; n[143]=v; n[147]=v; n[164]=v;
v=p[7]; n[9]=v; n[26]=v; n[30]=v; n[47]=v; n[64]=v; n[68]=v;
n[85]=v; n[102]=v; n[106]=v; n[123]=v; n[140]=v; n[144]=v; n[161]=v;
v=p[8]; n[6]=v; n[23]=v; n[27]=v; n[44]=v; n[61]=v; n[78]=v;
n[82]=v; n[99]=v; n[116]=v; n[120]=v; n[137]=v; n[154]=v; n[158]=v;
v=p[9]; n[3]=v; n[20]=v; n[37]=v; n[41]=v; n[58]=v; n[75]=v;
n[79]=v; n[96]=v; n[113]=v; n[130]=v; n[134]=v; n[151]=v; n[168]=v;
v=p[10]; n[13]=v; n[17]=v; n[34]=v; n[51]=v; n[55]=v; n[72]=v;
n[89]=v; n[93]=v; n[110]=v; n[127]=v; n[131]=v; n[148]=v; n[165]=v;
v=p[11]; n[10]=v; n[14]=v; n[31]=v; n[48]=v; n[65]=v; n[69]=v;
n[86]=v; n[103]=v; n[107]=v; n[124]=v; n[141]=v; n[145]=v; n[162]=v;
v=p[12]; n[7]=v; n[24]=v; n[28]=v; n[45]=v; n[62]=v; n[66]=v;
n[83]=v; n[100]=v; n[117]=v; n[121]=v; n[138]=v; n[155]=v; n[159]=v;
v=p[13]; n[4]=v; n[21]=v; n[38]=v; n[42]=v; n[59]=v; n[76]=v;
n[80]=v; n[97]=v; n[114]=v; n[118]=v; n[135]=v; n[152]=v; n[169]=v;
};
void tp6(){
short v;
v=p[1]; n[1]=v; n[23]=v; n[32]=v; n[41]=v; n[63]=v; n[72]=v;
n[81]=v; n[103]=v; n[112]=v; n[121]=v; n[143]=v; n[152]=v; n[161]=v;
v=p[2]; n[6]=v; n[15]=v; n[37]=v; n[46]=v; n[55]=v; n[77]=v;
n[86]=v; n[95]=v; n[117]=v; n[126]=v; n[135]=v; n[144]=v; n[166]=v;
v=p[3]; n[11]=v; n[20]=v; n[29]=v; n[51]=v; n[60]=v; n[69]=v;
n[91]=v; n[100]=v; n[109]=v; n[118]=v; n[140]=v; n[149]=v; n[158]=v;
v=p[4]; n[3]=v; n[25]=v; n[34]=v; n[43]=v; n[65]=v; n[74]=v;
n[83]=v; n[92]=v; n[114]=v; n[123]=v; n[132]=v; n[154]=v; n[163]=v;
v=p[5]; n[8]=v; n[17]=v; n[39]=v; n[48]=v; n[57]=v; n[66]=v;
n[88]=v; n[97]=v; n[106]=v; n[128]=v; n[137]=v; n[146]=v; n[168]=v;
v=p[6]; n[13]=v; n[22]=v; n[31]=v; n[40]=v; n[62]=v; n[71]=v;
n[80]=v; n[102]=v; n[111]=v; n[120]=v; n[142]=v; n[151]=v; n[160]=v;
v=p[7]; n[5]=v; n[14]=v; n[36]=v; n[45]=v; n[54]=v; n[76]=v;
n[85]=v; n[94]=v; n[116]=v; n[125]=v; n[134]=v; n[156]=v; n[165]=v;
v=p[8]; n[10]=v; n[19]=v; n[28]=v; n[50]=v; n[59]=v; n[68]=v;
n[90]=v; n[99]=v; n[108]=v; n[130]=v; n[139]=v; n[148]=v; n[157]=v;
v=p[9]; n[2]=v; n[24]=v; n[33]=v; n[42]=v; n[64]=v; n[73]=v;
n[82]=v; n[104]=v; n[113]=v; n[122]=v; n[131]=v; n[153]=v; n[162]=v;
v=p[10]; n[7]=v; n[16]=v; n[38]=v; n[47]=v; n[56]=v; n[78]=v;
n[87]=v; n[96]=v; n[105]=v; n[127]=v; n[136]=v; n[145]=v; n[167]=v;
v=p[11]; n[12]=v; n[21]=v; n[30]=v; n[52]=v; n[61]=v; n[70]=v;
n[79]=v; n[101]=v; n[110]=v; n[119]=v; n[141]=v; n[150]=v; n[159]=v;
v=p[12]; n[4]=v; n[26]=v; n[35]=v; n[44]=v; n[53]=v; n[75]=v;
n[84]=v; n[93]=v; n[115]=v; n[124]=v; n[133]=v; n[155]=v; n[164]=v;
v=p[13]; n[9]=v; n[18]=v; n[27]=v; n[49]=v; n[58]=v; n[67]=v;
n[89]=v; n[98]=v; n[107]=v; n[129]=v; n[138]=v; n[147]=v; n[169]=v;
};
void tp7(){
short v;
v=p[1]; n[1]=v; n[17]=v; n[33]=v; n[49]=v; n[65]=v; n[68]=v;
n[84]=v; n[100]=v; n[116]=v; n[119]=v; n[135]=v; n[151]=v; n[167]=v;
v=p[2]; n[12]=v; n[15]=v; n[31]=v; n[47]=v; n[63]=v; n[66]=v;
n[82]=v; n[98]=v; n[114]=v; n[130]=v; n[133]=v; n[149]=v; n[165]=v;
};

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v=p[3]; n[10]=v; n[26]=v; n[29]=v; n[45]=v; n[61]=v; n[77]=v;
n[80]=v; n[96]=v; n[112]=v; n[128]=v; n[131]=v; n[147]=v; n[163]=v;
v=p[4]; n[8]=v; n[24]=v; n[27]=v; n[43]=v; n[59]=v; n[75]=v;
n[91]=v; n[94]=v; n[110]=v; n[126]=v; n[142]=v; n[145]=v; n[161]=v;
v=p[5]; n[6]=v; n[22]=v; n[38]=v; n[41]=v; n[57]=v; n[73]=v;
n[89]=v; n[92]=v; n[108]=v; n[124]=v; n[140]=v; n[156]=v; n[159]=v;
v=p[6]; n[4]=v; n[20]=v; n[36]=v; n[52]=v; n[55]=v; n[71]=v;
n[87]=v; n[103]=v; n[106]=v; n[122]=v; n[138]=v; n[154]=v; n[157]=v;
v=p[7]; n[2]=v; n[18]=v; n[34]=v; n[50]=v; n[53]=v; n[69]=v;
n[85]=v; n[101]=v; n[117]=v; n[120]=v; n[136]=v; n[152]=v; n[168]=v;
v=p[8]; n[13]=v; n[16]=v; n[32]=v; n[48]=v; n[64]=v; n[67]=v;
n[83]=v; n[99]=v; n[115]=v; n[118]=v; n[134]=v; n[150]=v; n[166]=v;
v=p[9]; n[11]=v; n[14]=v; n[30]=v; n[46]=v; n[62]=v; n[78]=v;
n[81]=v; n[97]=v; n[113]=v; n[129]=v; n[132]=v; n[148]=v; n[164]=v;
v=p[10]; n[9]=v; n[25]=v; n[28]=v; n[44]=v; n[60]=v; n[76]=v;
n[79]=v; n[95]=v; n[111]=v; n[127]=v; n[143]=v; n[146]=v; n[162]=v;
v=p[11]; n[7]=v; n[23]=v; n[39]=v; n[42]=v; n[58]=v; n[74]=v;
n[90]=v; n[93]=v; n[109]=v; n[125]=v; n[141]=v; n[144]=v; n[160]=v;
v=p[12]; n[5]=v; n[21]=v; n[37]=v; n[40]=v; n[56]=v; n[72]=v;
n[88]=v; n[104]=v; n[107]=v; n[123]=v; n[139]=v; n[155]=v; n[158]=v;
v=p[13]; n[3]=v; n[19]=v; n[35]=v; n[51]=v; n[54]=v; n[70]=v;
n[86]=v; n[102]=v; n[105]=v; n[121]=v; n[137]=v; n[153]=v; n[169]=v;
};
void tp8(){
short v;
v=p[1]; n[1]=v; n[24]=v; n[34]=v; n[44]=v; n[54]=v; n[77]=v;
n[87]=v; n[97]=v; n[107]=v; n[130]=v; n[140]=v; n[150]=v; n[160]=v;
v=p[2]; n[5]=v; n[15]=v; n[38]=v; n[48]=v; n[58]=v; n[68]=v;
n[91]=v; n[101]=v; n[111]=v; n[121]=v; n[131]=v; n[154]=v; n[164]=v;
v=p[3]; n[9]=v; n[19]=v; n[29]=v; n[52]=v; n[62]=v; n[72]=v;
n[82]=v; n[92]=v; n[115]=v; n[125]=v; n[135]=v; n[145]=v; n[168]=v;
v=p[4]; n[13]=v; n[23]=v; n[33]=v; n[43]=v; n[53]=v; n[76]=v;
n[86]=v; n[96]=v; n[106]=v; n[129]=v; n[139]=v; n[149]=v; n[159]=v;
v=p[5]; n[4]=v; n[14]=v; n[37]=v; n[47]=v; n[57]=v; n[67]=v;
n[90]=v; n[100]=v; n[110]=v; n[120]=v; n[143]=v; n[153]=v; n[163]=v;
v=p[6]; n[8]=v; n[18]=v; n[28]=v; n[51]=v; n[61]=v; n[71]=v;
n[81]=v; n[104]=v; n[114]=v; n[124]=v; n[134]=v; n[144]=v; n[167]=v;
v=p[7]; n[12]=v; n[22]=v; n[32]=v; n[42]=v; n[65]=v; n[75]=v;
n[85]=v; n[95]=v; n[105]=v; n[128]=v; n[138]=v; n[148]=v; n[158]=v;
v=p[8]; n[3]=v; n[26]=v; n[36]=v; n[46]=v; n[56]=v; n[66]=v;
n[89]=v; n[99]=v; n[109]=v; n[119]=v; n[142]=v; n[152]=v; n[162]=v;
v=p[9]; n[7]=v; n[17]=v; n[27]=v; n[50]=v; n[60]=v; n[70]=v;
n[80]=v; n[103]=v; n[113]=v; n[123]=v; n[133]=v; n[156]=v; n[166]=v;
v=p[10]; n[11]=v; n[21]=v; n[31]=v; n[41]=v; n[64]=v; n[74]=v;
n[84]=v; n[94]=v; n[117]=v; n[127]=v; n[137]=v; n[147]=v; n[157]=v;
v=p[11]; n[2]=v; n[25]=v; n[35]=v; n[45]=v; n[55]=v; n[78]=v;
n[88]=v; n[98]=v; n[108]=v; n[118]=v; n[141]=v; n[151]=v; n[161]=v;
v=p[12]; n[6]=v; n[16]=v; n[39]=v; n[49]=v; n[59]=v; n[69]=v;
n[79]=v; n[102]=v; n[112]=v; n[122]=v; n[132]=v; n[155]=v; n[165]=v;
v=p[13]; n[10]=v; n[20]=v; n[30]=v; n[40]=v; n[63]=v; n[73]=v;
n[83]=v; n[93]=v; n[116]=v; n[126]=v; n[136]=v; n[146]=v; n[169]=v;
};
void tp9(){
short v;
v=p[1]; n[1]=v; n[22]=v; n[30]=v; n[51]=v; n[59]=v; n[67]=v;
n[88]=v; n[96]=v; n[117]=v; n[125]=v; n[133]=v; n[154]=v; n[162]=v;
v=p[2]; n[7]=v; n[15]=v; n[36]=v; n[44]=v; n[65]=v; n[73]=v;
n[81]=v; n[102]=v; n[110]=v; n[118]=v; n[139]=v; n[147]=v; n[168]=v;
v=p[3]; n[13]=v; n[21]=v; n[29]=v; n[50]=v; n[58]=v; n[66]=v;
n[87]=v; n[95]=v; n[116]=v; n[124]=v; n[132]=v; n[153]=v; n[161]=v;
v=p[4]; n[6]=v; n[14]=v; n[35]=v; n[43]=v; n[64]=v; n[72]=v;
n[80]=v; n[101]=v; n[109]=v; n[130]=v; n[138]=v; n[146]=v; n[167]=v;
v=p[5]; n[12]=v; n[20]=v; n[28]=v; n[49]=v; n[57]=v; n[78]=v;
n[86]=v; n[94]=v; n[115]=v; n[123]=v; n[131]=v; n[152]=v; n[160]=v;
v=p[6]; n[5]=v; n[26]=v; n[34]=v; n[42]=v; n[63]=v; n[71]=v;

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    n[79]=v; n[100]=v;n[108]=v;n[129]=v;n[137]=v;n[145]=v;n[166]=v;
v=p[7]; n[11]=v; n[19]=v; n[27]=v; n[48]=v; n[56]=v; n[77]=v;
    n[85]=v; n[93]=v; n[114]=v;n[122]=v;n[143]=v;n[151]=v;n[159]=v;
v=p[8]; n[4]=v; n[25]=v; n[33]=v; n[41]=v; n[62]=v; n[70]=v;
    n[91]=v; n[99]=v; n[107]=v;n[128]=v;n[136]=v;n[144]=v;n[165]=v;
v=p[9]; n[10]=v; n[18]=v; n[39]=v; n[47]=v; n[55]=v; n[76]=v;
    n[84]=v; n[92]=v; n[113]=v;n[121]=v;n[142]=v;n[150]=v;n[158]=v;
v=p[10]; n[3]=v; n[24]=v; n[32]=v; n[40]=v; n[61]=v; n[69]=v;
    n[90]=v; n[98]=v; n[106]=v;n[127]=v;n[135]=v;n[156]=v;n[164]=v;
v=p[11]; n[9]=v; n[17]=v; n[38]=v; n[46]=v; n[54]=v; n[75]=v;
    n[83]=v; n[104]=v;n[112]=v;n[120]=v;n[141]=v;n[149]=v;n[157]=v;
v=p[12]; n[2]=v; n[23]=v; n[31]=v; n[52]=v; n[60]=v; n[68]=v;
    n[89]=v; n[97]=v; n[105]=v;n[126]=v;n[134]=v;n[155]=v;n[163]=v;
v=p[13]; n[8]=v; n[16]=v; n[37]=v; n[45]=v; n[53]=v; n[74]=v;
    n[82]=v; n[103]=v;n[111]=v;n[119]=v;n[140]=v;n[148]=v;n[169]=v;
};
void tp10(){
short v;
v=p[1]; n[1]=v; n[19]=v; n[37]=v; n[42]=v; n[60]=v; n[78]=v;
    n[83]=v; n[101]=v;n[106]=v;n[124]=v;n[142]=v;n[147]=v;n[165]=v;
v=p[2]; n[10]=v; n[15]=v; n[33]=v; n[51]=v; n[56]=v; n[74]=v;
    n[79]=v; n[97]=v; n[115]=v;n[120]=v;n[138]=v;n[156]=v;n[161]=v;
v=p[3]; n[6]=v; n[24]=v; n[29]=v; n[47]=v; n[65]=v; n[70]=v;
    n[88]=v; n[93]=v; n[111]=v;n[129]=v;n[134]=v;n[152]=v;n[157]=v;
v=p[4]; n[2]=v; n[20]=v; n[38]=v; n[43]=v; n[61]=v; n[66]=v;
    n[84]=v; n[102]=v;n[107]=v;n[125]=v;n[143]=v;n[148]=v;n[166]=v;
v=p[5]; n[11]=v; n[16]=v; n[34]=v; n[52]=v; n[57]=v; n[75]=v;
    n[80]=v; n[98]=v; n[116]=v;n[121]=v;n[139]=v;n[144]=v;n[162]=v;
v=p[6]; n[7]=v; n[25]=v; n[30]=v; n[48]=v; n[53]=v; n[71]=v;
    n[89]=v; n[94]=v; n[112]=v;n[130]=v;n[135]=v;n[153]=v;n[158]=v;
v=p[7]; n[3]=v; n[21]=v; n[39]=v; n[44]=v; n[62]=v; n[67]=v;
    n[85]=v; n[103]=v;n[108]=v;n[126]=v;n[131]=v;n[149]=v;n[167]=v;
v=p[8]; n[12]=v; n[17]=v; n[35]=v; n[40]=v; n[58]=v; n[76]=v;
    n[81]=v; n[99]=v; n[117]=v;n[122]=v;n[140]=v;n[145]=v;n[163]=v;
v=p[9]; n[8]=v; n[26]=v; n[31]=v; n[49]=v; n[54]=v; n[72]=v;
    n[90]=v; n[95]=v; n[113]=v;n[118]=v;n[136]=v;n[154]=v;n[159]=v;
v=p[10]; n[4]=v; n[22]=v; n[27]=v; n[45]=v; n[63]=v; n[68]=v;
    n[86]=v; n[104]=v;n[109]=v;n[127]=v;n[132]=v;n[150]=v;n[168]=v;
v=p[11]; n[13]=v; n[18]=v; n[36]=v; n[41]=v; n[59]=v; n[77]=v;
    n[82]=v; n[100]=v;n[105]=v;n[123]=v;n[141]=v;n[146]=v;n[164]=v;
v=p[12]; n[9]=v; n[14]=v; n[32]=v; n[50]=v; n[55]=v; n[73]=v;
    n[91]=v; n[96]=v; n[114]=v;n[119]=v;n[137]=v;n[155]=v;n[160]=v;
v=p[13]; n[5]=v; n[23]=v; n[28]=v; n[46]=v; n[64]=v; n[69]=v;
    n[87]=v; n[92]=v; n[110]=v;n[128]=v;n[133]=v;n[151]=v;n[169]=v;
};
/**/
/* Check if the Two Layer Units are Compatible */
short Chk2lunit(long x, long y){
short l,v1,v2,t1,t2;
v1=0; v2=0;
for(l=1;l<170;l++){
    t1=tl[u][x][l]; t2=tl[u][y][l];
    if(t1==t2){v1++;}
    if((t1+t2)==12){v2++;}
}
if(v2<v1){v1=v2;}
return v2;
}
/**/
/* Combine and Compose */
void cmbcomp(){
short n,d,fc;
for(u1=0;u1<cnt1;u1++){cnt4=0;
    if((tl[u1][1]==0)&&(tl[u1][2]>tl[u1][14])){
        for(u2=0;u2<cnt1;u2++){

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