


```

short nm[26], uflg[26];
short ntb[5][26], csm[5][13];
short nt06[22], nt07[21], nt08[20], nt10[18], nt11[17];
short nt13[15], nt15[13], nt18[10], nt20[8], nt22[6];
//
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 chksm(short x);
void ansprint(void);
void prans(short x);
//
/* Main Program *
int main(){
short n;
printf("\n");
printf("*** Standard Type of Magic Squares of Order 5: **\n");
printf("*** List of Standard Solutions with Check-Sums **\n");
for(n=0;n<26;n++){nm[n]=0; uflg[n]=0;}
LSM=65; cnt=0; cnt3=0;
stp01();      /* Begin The Calculations
if(cnt3>0){prans(cnt3);}
printf(" [Total Count of Solutions = %ld] OK!\n",cnt);
printf("\n");
printf("*** Calculated and Listed by Kanji Setsuda on\n");
printf("      June 2, 2014 with MacOSX 10.9.3 & Xcode 5.1.1 **\n");
printf("\n");
return 0;
}
//
/* Begin The Calculations *
/* Level #1: *
/* Set N1 *
void stp01(){
short a;
for(a=1;a<26;a++){
if(uflg[a]==0){nm[1]=a; cnt2=0;
uflg[a]=1; stp02(); uflg[a]=0;}
}
}
/* Set N25(>N1) *
void stp02(){
short a;
for(a=25;a>nm[1];a--){
if(uflg[a]==0){nm[25]=a; //if(nm[1]<2){cnt2=0;}
uflg[a]=1; stp03(); uflg[a]=0;}
}
}
/* Set N7 *
void stp03(){
short a;
for(a=1;a<26;a++){
if(uflg[a]==0){nm[7]=a; if(nm[1]<2){cnt2=0;}
uflg[a]=1; stp04(); uflg[a]=0;}
}
}
/* Set N19 *
void stp04(){
short a;
for(a=25;a>0;a--){
if(uflg[a]==0){nm[19]=a;
uflg[a]=1; stp05(); uflg[a]=0;}
}
}

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}
/* Set n13=C-n1-n7-n19-n25 *
void stp05(){
  short a;
  a=LSM-nm[1]-nm[7]-nm[19]-nm[25];
  if((0<a)&&(a<26)){
    if(uflg[a]==0){nm[13]=a;
      uflg[a]=1; stp06(); uflg[a]=0;}}
}
// Set N5(>N1)
void stp06(){
  short a,n,m;
  m=1;
  for(n=nm[1]+1;n<26;n++){if(uflg[n]==0){nt06[m]=n; m++;}}
  nt06[m]=0;
  for(n=1;n<m;n++){a=nt06[n];
    nm[5]=a; uflg[a]=1;
    stp07(); uflg[a]=0;
  }
}
// Set N21(>N5)
void stp07(){
  short a,n,m;
  m=1;
  for(n=nm[5]+1;n<26;n++){if(uflg[n]==0){nt07[m]=n; m++;}}
  nt07[m]=0;
  for(n=m-1;n>0;n--){a=nt07[n];
    nm[21]=a; uflg[a]=1;
    stp08(); uflg[a]=0;
  }
}
// Set N17
void stp08(){
  short a,n,m;
  m=1;
  for(n=1;n<26;n++){if(uflg[n]==0){nt08[m]=n; m++;}}
  nt08[m]=0;
  for(n=m-1;n>0;n--){a=nt08[n];
    nm[17]=a; uflg[a]=1;
    stp09(); uflg[a]=0;
  }
}
// Set n9=C-n5-n13-n17-n21
void stp09(){
  short a;
  a=LSM-nm[5]-nm[13]-nm[17]-nm[21];
  if((0<a)&&(a<26)){
    if(uflg[a]==0){nm[9]=a;
      sm5=nm[1]+nm[5]+nm[13]+nm[17]+nm[21];
      uflg[a]=1; stp10(); uflg[a]=0;}}
}
/* Level #2: *
/* Set N2 *
void stp10(){
  short a,n,m;
  m=1;
  for(n=1;n<26;n++){if(uflg[n]==0){nt10[m]=n; m++;}}
  nt10[m]=0;
  for(n=m-1;n>0;n--){a=nt10[n];
    nm[2]=a; uflg[a]=1;
    stp11(); uflg[a]=0;
  }
}
// Set N4
void stp11(){

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short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt11[m]=n; m++;}}
nt11[m]=0;
for(n=m-1;n>0;n--){a=nt11[n];
nm[4]=a; uflg[a]=1;
stp12(); uflg[a]=0;
}
}
// Set n3=C-n1-n2-n4-n5
void stp12(){
short a;
a=LSM-nm[1]-nm[2]-nm[4]-nm[5];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[3]=a;
uflg[a]=1; stp13(); uflg[a]=0;}}
}
// Set N22
void stp13(){
short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt13[m]=n; m++;}}
nt13[m]=0;
for(n=1;n<m;n++){a=nt13[n];
nm[22]=a; uflg[a]=1;
stp14(); uflg[a]=0;
}
}
// Set n12=C-n2-n7-n17-n22
void stp14(){
short a;
a=LSM-nm[2]-nm[7]-nm[17]-nm[22];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[12]=a;
uflg[a]=1; stp15(); uflg[a]=0;}}
}
// Set N24
void stp15(){
short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt15[m]=n; m++;}}
nt15[m]=0;
for(n=1;n<m;n++){a=nt15[n];
nm[24]=a; uflg[a]=1;
stp16(); uflg[a]=0;
}
}
// Set n23=C-n21-n22-n24-n25
void stp16(){
short a;
a=LSM-nm[21]-nm[22]-nm[24]-nm[25];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[23]=a;
uflg[a]=1; stp17(); uflg[a]=0;}}
}
// Set n14=C-n4-n9-n19-n24
void stp17(){
short a;
a=LSM-nm[4]-nm[9]-nm[19]-nm[24];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[14]=a;
uflg[a]=1; stp18(); uflg[a]=0;}}
}
}
/* Level #3: *
/* Set N8 *

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void stp18(){
short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt18[m]=n; m++;}}
nt18[m]=0;
for(n=m-1;n>0;n--){a=nt18[n];
nm[8]=a; uflg[a]=1;
stp19(); uflg[a]=0;
}
}
// Set n18=C-n3-n8-n13-n23
void stp19(){
short a,b;
a=LSM-nm[3]-nm[8]-nm[13]-nm[23];
b=2*sm5-nm[8]-nm[12]-nm[13]-nm[14]-LSM;
if((a==b)&&(0<a)&&(a<26)){
if(uflg[a]==0){nm[18]=a;
uflg[a]=1; stp20(); uflg[a]=0;}}
}
// Set N11
void stp20(){
short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt20[m]=n; m++;}}
nt20[m]=0;
for(n=m-1;n>0;n--){a=nt20[n];
nm[11]=a; uflg[a]=1;
stp21(); uflg[a]=0;
}
}
// Set n15=C-n11-n12-n13-n14
void stp21(){
short a;
a=LSM-nm[11]-nm[12]-nm[13]-nm[14];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[15]=a;
uflg[a]=1; stp22(); uflg[a]=0;}}
}
// Set N6
void stp22(){
short a,n,m;
m=1;
for(n=1;n<26;n++){if(uflg[n]==0){nt22[m]=n; m++;}}
nt22[m]=0;
for(n=m-1;n>0;n--){a=nt22[n];
nm[6]=a; uflg[a]=1;
stp23(); uflg[a]=0;
}
}
// Set n10=C-n6-n7-n8-n9
void stp23(){
short a;
a=LSM-nm[6]-nm[7]-nm[8]-nm[9];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[10]=a;
uflg[a]=1; stp24(); uflg[a]=0;}}
}
// Set n16=C-n1-n6-n11-n21
void stp24(){
short a;
a=LSM-nm[1]-nm[6]-nm[11]-nm[21];
if((0<a)&&(a<26)){
if(uflg[a]==0){nm[16]=a;
uflg[a]=1; stp25(); uflg[a]=0;}}
}
}

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// Set n20=C-n16-n17-n18-n19
void stp25(){
short a,b;
a=LSM-nm[16]-nm[17]-nm[18]-nm[19];
b=LSM-nm[5]-nm[10]-nm[15]-nm[25];
if((0<a)&&(a<26)&&(a==b)){
if(uflg[a]==0){nm[20]=a;
uflg[a]=1; ansprint(); uflg[a]=0;}}
}
//
/** Print the Answers *
void ansprint(){
short n;
cnt++; cnt2++;
if(cnt2==1){
for(n=1;n<26;n++){ntb[cnt3][n]=nm[n];}
cntr[cnt3]=cnt;
chksm(cnt3);
cnt3++; if(cnt3==4){prans(cnt3); cnt3=0;}}
}
/**
/** Check the Line-Sums *
void chksm(short x){
csm[x][1]=nm[1]+nm[2]+nm[3]+nm[4]+nm[5];
csm[x][2]=nm[6]+nm[7]+nm[8]+nm[9]+nm[10];
csm[x][3]=nm[11]+nm[12]+nm[13]+nm[14]+nm[15];
csm[x][4]=nm[16]+nm[17]+nm[18]+nm[19]+nm[20];
csm[x][5]=nm[21]+nm[22]+nm[23]+nm[24]+nm[25];
csm[x][6]=nm[1]+nm[6]+nm[11]+nm[16]+nm[21];
csm[x][7]=nm[2]+nm[7]+nm[12]+nm[17]+nm[22];
csm[x][8]=nm[3]+nm[8]+nm[13]+nm[18]+nm[23];
csm[x][9]=nm[4]+nm[9]+nm[14]+nm[19]+nm[24];
csm[x][10]=nm[5]+nm[10]+nm[15]+nm[20]+nm[25];
csm[x][11]=nm[1]+nm[7]+nm[13]+nm[19]+nm[25];
csm[x][12]=nm[5]+nm[9]+nm[13]+nm[17]+nm[21];
}
/**
/** Print the Answers *
void prans(short x){
short l,l5,m;
for(m=0;m<x;m++){
printf("%15ld|%2d\\%2d/", cntr[m],csm[m][11],csm[m][12]);
if((m+1)<x){printf(" ");}}
printf("\n");
for(l=0;l<5;l++){l5=l*5;
for(m=0;m<x;m++){
printf("%3d%3d%3d%3d|%2d|%2d",
ntb[m][l5+1],ntb[m][l5+2],ntb[m][l5+3],ntb[m][l5+4],ntb[m][l5+5],
csm[m][l+1],csm[m][l+6]);
if((m+1)<x){printf(" ");}
}
printf("\n");
}
}
//
** Standard Type of Magic Squares of Order 5: **
** List of Standard Solutions with Check-Sums **
1|65\65/      41093|65\65/      86874|65\65/      154894|65\65/
1 22 21 18 3|65|65|  1 23 21 18 2|65|65|  1 22 21 19 2|65|65|  1 23 21 18 2|65|65|
20 2 15 9 19|65|65|  22 3 15 14 11|65|65|  14 4 20 12 15|65|65|  15 5 17 12 16|65|65|
14 16 13 10 12|65|65|  13 16 12 5 19|65|65|  18 16 11 7 13|65|65|  20 14 10 8 13|65|65|
7 17 11 24 6|65|65|  9 17 7 24 8|65|65|  9 17 5 24 10|65|65|  7 19 6 24 9|65|65|
23 8 5 4 25|65|65|  20 6 10 4 25|65|65|  23 6 8 3 25|65|65|  22 4 11 3 25|65|65|

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22 6 11 2 24 65 65	23 3 13 2 24 65 65	22 5 12 2 24 65 65	23 2 13 3 24 65 65
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16 11 17 14 7 65 65	11 14 5 25 10 65 65	7 16 6 25 11 65 65	11 18 5 25 6 65 65
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11 25 3 24 2|65|65|
1 16 22 17 9|65|65|
20 8 12 4 21|65|65| [Total Count of Solutions = 275305224] [OK!]

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** Calculated and Listed by Kanji Setsuda on
June 2, 2014 with MacOSX 10.9.3 & Xcode 5.1.1 **

4. Here you see several abstract lists of the same object solutions I have recently got.
I tried to have some solutions accompanied with the Decomposition diagrams by
the 5-th increment number system in the first following list.

** Standard Magic Squares of Order 5: List Part 2 of Standard Solutions **

1/	/D5i: H/	L/	2014025/	/D5i: H/	L/
1 22 21 18 3	0 4 4 3 0	0 1 0 2 2	1 21 22 18 3	0 4 4 3 0	0 0 1 2 2
20 2 15 9 19	3 0 2 1 3	4 1 4 3 3	20 2 14 10 19	3 0 2 1 3	4 1 3 4 3
14 16 13 10 12	2 3 2 1 2	3 0 2 4 1	15 17 13 8 12	2 3 2 1 2	4 1 2 2 1
7 17 11 24 6	1 3 2 4 1	1 1 0 3 0	6 16 11 25 7	1 3 2 4 1	0 0 0 4 1
23 8 5 4 25	4 1 0 0 4	2 2 4 3 4	23 9 5 4 24	4 1 0 0 4	2 3 4 3 3
4013925/	/D5i: H/	L/	5996665/	/D5i: H/	L/
1 24 20 17 3	0 4 3 3 0	0 3 4 1 2	1 23 17 21 3	0 4 3 4 0	0 2 1 0 2
19 2 21 8 15	3 0 4 1 2	3 1 0 2 4	16 2 20 9 18	3 0 3 1 3	0 1 4 3 2
16 12 14 10 13	3 2 2 1 2	0 1 3 4 2	13 19 15 6 12	2 3 2 1 2	2 3 4 0 1
7 18 4 25 11	1 3 0 4 2	1 2 3 4 0	11 14 5 25 10	2 2 0 4 1	0 3 4 4 4
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We can also have the abstract list of another style for the same Standard MS55.

**** Abstract List of the Standard Solutions starting with n3=1 ****

(Normalizing Inequality Conditions: $n_3 < n_{23}$; $n_3 < n_{11} < n_{15}$)

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2 14 13 24 12 65 65	2 17 12 23 11 65 65	2 16 13 24 10 65 65	2 19 12 23 9 65 65
21 6 23 10 5 65 65	18 5 24 8 10 65 65	20 4 23 11 7 65 65	6 4 24 14 17 65 65
18 4 25 7 11 65 65	14 4 25 6 16 65 65	17 5 25 6 12 65 65	20 5 25 7 8 65 65
361243#\65/65	373503#\65/65	383617#\65/65	395655#\65/65
9 17 1 16 22 65 65	13 16 1 17 18 65 65	12 17 1 14 21 65 65	11 12 1 18 23 65 65
20 21 3 7 14 65 65	22 15 3 6 19 65 65	22 15 3 16 9 65 65	19 21 3 7 15 65 65
2 18 13 24 8 65 65	2 21 12 23 7 65 65	2 20 13 24 6 65 65	2 20 14 24 5 65 65
15 4 23 12 11 65 65	8 9 24 14 10 65 65	19 5 23 7 11 65 65	16 4 22 10 13 65 65
19 5 25 6 10 65 65	20 4 25 5 11 65 65	10 8 25 4 18 65 65	17 8 25 6 9 65 65
403691#\65/65	411541#\65/65	419067#\65/65	446303#\65/65
14 11 1 18 21 65 65	12 13 1 16 23 65 65	10 21 1 16 17 65 65	17 21 1 14 12 65 65
19 16 3 12 15 65 65	17 18 4 6 20 65 65	19 22 2 13 9 65 65	10 20 2 15 18 65 65
2 22 13 24 4 65 65	2 22 14 24 3 65 65	3 4 14 20 24 65 65	3 4 13 22 23 65 65
20 9 23 5 8 65 65	19 7 21 10 8 65 65	18 6 23 11 7 65 65	19 9 24 8 5 65 65
10 7 25 6 17 65 65	15 5 25 9 11 65 65	15 12 25 5 8 65 65	16 11 25 6 7 65 65
504643#\65/65	527835#\65/65	550823#\65/65	574557#\65/65
11 24 1 16 13 65 65	14 20 1 18 12 65 65	16 21 1 18 9 65 65	9 21 1 18 16 65 65
15 20 2 10 18 65 65	22 19 2 7 15 65 65	17 22 2 11 13 65 65	22 20 2 10 11 65 65
3 5 14 21 22 65 65	3 5 13 23 21 65 65	3 4 14 24 20 65 65	3 7 13 23 19 65 65
17 9 23 12 4 65 65	10 17 24 8 6 65 65	10 12 23 5 15 65 65	17 12 24 8 4 65 65
19 7 25 6 8 65 65	16 4 25 9 11 65 65	19 6 25 7 8 65 65	14 5 25 6 15 65 65
593079#\65/65	610259#\65/65	628961#\65/65	647129#\65/65
13 20 1 16 15 65 65	12 18 1 19 15 65 65	9 22 1 18 15 65 65	7 20 1 18 19 65 65
19 22 2 5 17 65 65	14 22 2 6 21 65 65	21 20 2 12 10 65 65	22 21 2 8 12 65 65
3 6 14 24 18 65 65	3 9 13 23 17 65 65	3 8 14 24 16 65 65	3 11 13 23 15 65 65
9 10 23 12 11 65 65	16 11 24 10 4 65 65	19 11 23 5 7 65 65	17 9 24 10 5 65 65
21 7 25 8 4 65 65	20 5 25 7 8 65 65	13 4 25 6 17 65 65	16 4 25 6 14 65 65
662353#\65/65	678433#\65/65	691619#\65/65	703581#\65/65
7 17 1 18 22 65 65	9 20 1 14 21 65 65	10 24 1 13 17 65 65	8 16 1 21 19 65 65
23 20 2 5 15 65 65	19 23 2 4 17 65 65	19 16 2 8 20 65 65	22 20 2 9 12 65 65
3 8 16 24 14 65 65	3 10 15 24 13 65 65	3 15 14 21 12 65 65	3 15 13 23 11 65 65
19 9 21 12 4 65 65	16 7 22 12 8 65 65	11 4 23 18 9 65 65	18 10 24 7 6 65 65
13 11 25 6 10 65 65	18 5 25 11 6 65 65	22 6 25 5 7 65 65	14 4 25 5 17 65 65
715483#\65/65	727057#\65/65	737273#\65/65	749783#\65/65
12 21 1 11 20 65 65	10 21 1 15 18 65 65	15 17 1 19 13 65 65	9 17 1 16 22 65 65
24 15 2 19 5 65 65	22 14 2 7 20 65 65	9 21 2 11 22 65 65	21 20 2 12 10 65 65
3 16 14 22 10 65 65	3 17 13 23 9 65 65	3 16 14 24 8 65 65	3 19 13 23 7 65 65
18 4 23 7 13 65 65	11 8 24 16 6 65 65	18 7 23 5 12 65 65	18 4 24 8 11 65 65
8 9 25 6 17 65 65	19 5 25 4 12 65 65	20 4 25 6 10 65 65	14 5 25 6 15 65 65
758725#\65/65	767803#\65/65	776685#\65/65	784263#\65/65
12 20 1 11 21 65 65	12 14 1 16 22 65 65	11 17 1 15 21 65 65	10 20 1 18 16 65 65
19 15 2 13 16 65 65	15 19 2 9 20 65 65	22 13 2 12 16 65 65	21 23 2 14 5 65 65
3 18 14 24 6 65 65	3 21 13 23 5 65 65	3 20 14 24 4 65 65	4 3 15 19 24 65 65
22 8 23 7 5 65 65	18 4 24 11 8 65 65	19 8 23 9 6 65 65	17 7 22 8 11 65 65
9 4 25 10 17 65 65	17 7 25 6 10 65 65	10 7 25 5 18 65 65	13 12 25 6 9 65 65
813539#\65/65	836731#\65/65	886463#\65/65	908329#\65/65
12 13 1 22 17 65 65	20 19 1 9 16 65 65	15 19 1 22 8 65 65	10 21 1 18 15 65 65
24 20 2 10 9 65 65	18 21 2 17 7 65 65	24 17 2 13 9 65 65	22 19 2 14 8 65 65
4 3 16 19 23 65 65	4 3 13 23 22 65 65	4 6 14 20 21 65 65	4 5 13 23 20 65 65
18 15 21 6 5 65 65	12 8 24 6 15 65 65	10 18 23 3 11 65 65	17 11 24 7 6 65 65
7 14 25 8 11 65 65	11 14 25 10 5 65 65	12 5 25 7 16 65 65	12 9 25 3 16 65 65
932655#\65/65	953993#\65/65	975217#\65/65	993139#\65/65
11 21 1 12 20 65 65	11 17 1 14 22 65 65	8 19 1 16 21 65 65	8 21 1 20 15 65 65
15 24 2 8 16 65 65	21 19 2 15 8 65 65	20 22 2 10 11 65 65	22 19 2 12 10 65 65
4 6 14 22 19 65 65	4 7 13 23 18 65 65	4 6 14 24 17 65 65	4 9 13 23 16 65 65
17 5 23 13 7 65 65	20 6 24 10 5 65 65	18 5 23 12 7 65 65	17 11 24 7 6 65 65
18 9 25 10 3 65 65	9 16 25 3 12 65 65	15 13 25 3 9 65 65	14 5 25 3 18 65 65

[Total Count of Solutions = 275305224] OK!

** Calculated and Listed by Kanji Setsuda on

Apr.12, 2015 with MacOSX 10.10.3 & Xcode 6.3 **

One more different style of listing is also possible for the same magic squares.

**** Abstract List of the Standard Solutions starting with n13=1 ****

1 65\65/	106145 65\65/	275933 65\65/	527467 65\65/
2 19 22 12 10 65 65	3 17 21 15 9 65 65	4 20 21 13 7 65 65	5 16 22 15 7 65 65
11 13 18 17 6 65 65	11 12 20 14 8 65 65	10 11 17 18 9 65 65	13 10 19 14 9 65 65
21 16 1 7 20 65 65	22 16 1 7 19 65 65	22 15 1 8 19 65 65	21 17 1 8 18 65 65
8 14 15 24 4 65 65	6 18 13 24 4 65 65	6 16 14 24 5 65 65	3 20 12 24 6 65 65
23 3 9 5 25 65 65	23 2 10 5 25 65 65	23 3 12 2 25 65 65	23 2 11 4 25 65 65
841531 65\65/	1250799 65\65/	1731687 65\65/	2268375 65\65/
6 17 22 13 7 65 65	7 16 19 14 9 65 65	8 20 22 6 9 65 65	9 21 18 7 10 65 65
5 9 19 18 14 65 65	18 8 22 11 6 65 65	12 7 13 17 16 65 65	14 6 22 11 12 65 65
21 20 1 8 15 65 65	15 17 1 12 20 65 65	19 21 1 14 10 65 65	17 13 1 19 15 65 65
10 16 11 24 4 65 65	2 21 13 24 5 65 65	3 15 18 24 5 65 65	2 20 16 24 3 65 65
23 3 12 2 25 65 65	23 3 10 4 25 65 65	23 2 11 4 25 65 65	23 5 8 4 25 65 65
2804019 65\65/	3299523 65\65/	3686809 65\65/	3979701 65\65/
10 16 20 8 11 65 65	11 14 21 7 12 65 65	12 15 18 7 13 65 65	13 12 18 8 14 65 65
17 5 22 9 12 65 65	18 4 20 13 10 65 65	20 3 22 11 9 65 65	11 3 24 10 17 65 65
13 19 1 18 14 65 65	8 22 1 19 15 65 65	10 23 1 17 14 65 65	15 22 1 20 7 65 65
2 21 15 24 3 65 65	5 16 17 24 3 65 65	2 19 16 24 4 65 65	5 19 16 23 2 65 65
23 4 7 6 25 65 65	23 9 6 2 25 65 65	21 5 8 6 25 65 65	21 9 6 4 25 65 65
4180035 65\65/	4293575 65\65/	4343109 65\65/	4360227 65\65/
14 21 9 6 15 65 65	15 20 9 5 16 65 65	16 13 11 8 17 65 65	17 15 9 6 18 65 65
10 2 24 17 12 65 65	13 2 23 17 10 65 65	14 3 23 10 15 65 65	14 2 25 11 13 65 65
18 22 1 16 8 65 65	14 24 1 18 8 65 65	12 24 1 22 6 65 65	12 24 1 21 7 65 65
4 13 20 23 5 65 65	4 12 21 22 6 65 65	4 18 21 20 2 65 65	3 16 20 22 4 65 65
19 7 11 3 25 65 65	19 7 11 3 25 65 65	19 7 9 5 25 65 65	19 8 10 5 23 65 65
4365793 65\65/	9830509 65\65/	17490445 65\65/	25325793 65\65/
1 14 23 17 10 65 65	1 19 23 15 7 65 65	1 21 22 15 6 65 65	1 19 21 18 6 65 65
15 13 20 12 5 65 65	10 12 17 18 8 65 65	16 11 17 14 7 65 65	12 10 20 14 9 65 65
21 16 2 8 18 65 65	22 14 3 6 20 65 65	20 13 4 9 19 65 65	16 15 5 7 22 65 65
6 19 9 24 7 65 65	11 16 9 24 5 65 65	5 18 10 24 8 65 65	13 17 8 24 3 65 65
22 3 11 4 25 65 65	21 4 13 2 25 65 65	23 2 12 3 25 65 65	23 4 11 2 25 65 65
35053017 65\65/	45456533 65\65/	57524057 65\65/	69972701 65\65/
1 23 21 16 4 65 65	1 22 21 18 3 65 65	1 22 20 19 3 65 65	1 22 23 17 2 65 65
17 9 14 15 10 65 65	12 8 16 15 14 65 65	13 7 18 15 12 65 65	15 6 18 14 12 65 65
20 12 6 8 19 65 65	20 13 7 6 19 65 65	17 14 8 5 21 65 65	20 13 9 7 16 65 65
5 18 11 24 7 65 65	9 17 11 24 4 65 65	11 16 10 24 4 65 65	8 19 4 24 10 65 65
22 3 13 2 25 65 65	23 5 10 2 25 65 65	23 6 9 2 25 65 65	21 5 11 3 25 65 65
83862861 65\65/	97238997 65\65/	112974269 65\65/	128112741 65\65/
1 23 21 18 2 65 65	1 22 21 19 2 65 65	1 23 21 18 2 65 65	1 22 21 18 3 65 65
15 5 17 12 16 65 65	14 4 20 12 15 65 65	22 3 15 14 11 65 65	20 2 15 9 19 65 65
20 14 10 8 13 65 65	18 16 11 7 13 65 65	13 16 12 5 19 65 65	14 16 13 10 12 65 65
7 19 6 24 9 65 65	9 17 5 24 10 65 65	9 17 7 24 8 65 65	7 17 11 24 6 65 65
22 4 11 3 25 65 65	23 6 8 3 25 65 65	20 6 10 4 25 65 65	23 8 5 4 25 65 65
147192485 65\65/	162330957 65\65/	178066229 65\65/	191442365 65\65/
1 24 20 17 3 65 65	1 23 17 21 3 65 65	1 24 15 22 3 65 65	1 24 16 21 3 65 65
19 2 15 8 21 65 65	18 2 16 9 20 65 65	19 2 18 6 20 65 65	18 2 14 9 22 65 65
12 16 14 13 10 65 65	12 19 15 8 11 65 65	13 14 16 12 10 65 65	8 19 17 11 10 65 65
11 18 7 23 6 65 65	10 14 13 22 6 65 65	9 17 11 21 7 65 65	15 13 12 20 5 65 65
22 5 9 4 25 65 65	24 7 4 5 25 65 65	23 8 5 4 25 65 65	23 7 6 4 25 65 65
205332525 65\65/	217781169 65\65/	229848693 65\65/	240252209 65\65/
1 24 17 20 3 65 65	1 24 16 21 3 65 65	1 23 14 24 3 65 65	1 24 15 22 3 65 65
22 2 16 10 15 65 65	22 2 15 9 17 65 65	22 2 16 6 19 65 65	23 2 18 9 13 65 65
5 21 18 12 9 65 65	7 20 19 13 6 65 65	12 18 20 10 5 65 65	4 19 21 11 10 65 65
14 11 8 19 13 65 65	12 11 10 18 14 65 65	9 15 11 17 13 65 65	17 12 6 16 14 65 65
23 7 6 4 25 65 65	23 8 5 4 25 65 65	21 7 4 8 25 65 65	20 8 5 7 25 65 65

249979433 65\65/	257814781 65\65/	265474717 65\65/	270939433 65\65/
1 23 14 24 3 65 65	1 24 17 20 3 65 65	1 23 18 20 3 65 65	1 21 17 23 3 65 65
18 2 16 8 21 65 65	21 2 12 8 22 65 65	22 2 10 15 16 65 65	22 2 11 12 18 65 65
7 17 22 13 6 65 65	6 15 23 16 5 65 65	7 19 24 11 4 65 65	6 19 25 10 5 65 65
19 12 9 15 10 65 65	19 13 9 14 10 65 65	21 9 5 13 17 65 65	20 9 8 13 15 65 65
20 11 4 5 25 65 65	18 11 4 7 25 65 65	14 12 8 6 25 65 65	16 14 4 7 24 65 65

[Total Count of Solutions = 275305224] OK!

** Calculated and Listed by Kanji Setsuda on
June 9, 2014 with MacOSX 10.9.3 & Xcode 5.1.1 **

5. Though I have known about this count for a long time, I just verified it by my recent calculation, getting as many solutions as 275,305,224 for the Standard MS55.

Recall that there is only one solution for the standard type of MS33 and there are 880 solutions for the standard MS44, you know.

What a great count it is for the solutions of order 5! It is so impressive that we would often call it as the "notorious inflation of solution counts for high orders".

This vast count of solutions means hopeless to be analyzed and classified into any small groups. It is too big for us to deal with. They mean nothing special any more.

We can not help wanting to study about anything rarer and more precious such as (1) Self-complementary type, (2) Pan-diagonal one, or (3) Simultaneous type of MS55.

6. By the way, do you know how many solutions there are for the 'Euler Squares' of order 5 of the standard type? They should be 'Greco-Latin' squares when decomposed by the 5-th increment number system, even for the 2 primary diagonals.

** Abstract List of 'Euler Squares' 5x5 of the Standard Magic Type **

1/ /D5i	73/ /D5i	145/ /D5i
1 18 22 15 9 03421 02143	1 18 22 14 10 03421 02134	1 19 22 13 10 03421 03124
14 7 20 21 3 21340 31402	15 7 19 21 3 21340 41302	15 7 18 21 4 21340 41203
10 24 13 2 16 14203 43210	9 25 13 2 16 14203 34210	8 25 14 2 16 14203 24310
23 5 6 19 12 40132 24031	23 4 6 20 12 40132 23041	24 3 6 20 12 40132 32041
17 11 4 8 25 32014 10324	17 11 5 8 24 32014 10423	17 11 5 9 23 32014 10432
217/ /D5i	289/ /D5i	361/ /D5i
1 19 23 12 10 03421 03214	1 18 25 12 9 03421 02413	1 18 24 12 10 03421 02314
15 8 17 21 4 21340 42103	15 7 4 16 23 21034 41302	14 7 5 16 23 21034 31402
7 25 14 3 16 14203 14320	19 21 13 10 2 34210 30241	20 21 13 9 2 34210 40231
24 2 6 20 13 40132 31042	8 5 17 24 11 10342 24130	8 4 17 25 11 10342 23140
18 11 5 9 22 32014 20431	22 14 6 3 20 42103 13024	22 15 6 3 19 42103 14023
433/ /D5i	505/ /D5i	577/ /D5i
1 19 23 12 10 03421 03214	1 19 22 13 10 03421 03124	1 13 25 17 9 02431 02413
13 7 5 16 24 21034 21403	12 8 5 16 24 21034 12403	20 7 4 11 23 31024 41302
20 21 14 8 2 34210 40321	20 21 14 7 3 34210 40312	14 21 18 10 2 24310 30241
9 3 17 25 11 10342 32140	9 2 18 25 11 10342 31240	8 5 12 24 16 10243 24130
22 15 6 4 18 42103 14032	23 15 6 4 17 42103 24031	22 19 6 3 15 43102 13024
649/ /D5i	721/ /D5i	793/ /D5i
1 13 24 17 10 02431 02314	1 14 23 17 10 02431 03214	1 14 22 18 10 02431 03124
19 7 5 11 23 31024 31402	18 7 5 11 24 31024 21403	17 8 5 11 24 31024 12403
15 21 18 9 2 24310 40231	15 21 19 8 2 24310 40321	15 21 19 7 3 24310 40312
8 4 12 25 16 10243 23140	9 3 12 25 16 10243 32140	9 2 13 25 16 10243 31240
22 20 6 3 14 43102 14023	22 20 6 4 13 43102 14032	23 20 6 4 12 43102 24031
865/ /D5i	937/ /D5i	1009/ /D5i
1 8 25 17 14 01432 02413	1 8 24 17 15 01432 02314	1 9 23 17 15 01432 03214
20 12 4 6 23 32014 41302	19 12 5 6 23 32014 31402	18 12 5 6 24 32014 21403
9 21 18 15 2 14320 30241	10 21 18 14 2 14320 40231	10 21 19 13 2 14320 40321
13 5 7 24 16 20143 24130	13 4 7 25 16 20143 23140	14 3 7 25 16 20143 32140
22 19 11 3 10 43201 13024	22 20 11 3 9 43201 14023	22 20 11 4 8 43201 14032

1081/ /D5i	1153/ /D5i	1225/ /D5i
1 9 22 18 15 01432 03124	2 18 21 15 9 03421 12043	2 18 21 14 10 03421 12034
17 13 5 6 24 32014 12403	14 6 20 22 3 21340 30412	15 6 19 22 3 21340 40312
10 21 19 12 3 14320 40312	10 24 13 1 17 14203 43201	9 25 13 1 17 14203 34201
14 2 8 25 16 20143 31240	23 5 7 19 11 40132 24130	23 4 7 20 11 40132 23140
23 20 11 4 7 43201 24031	16 12 4 8 25 32014 01324	16 12 5 8 24 32014 01423
1297/ /D5i	1369/ /D5i	1441/ /D5i
2 19 21 13 10 03421 13024	2 19 23 11 10 03421 13204	2 18 25 11 9 03421 12403
15 6 18 22 4 21340 40213	15 8 16 22 4 21340 42013	15 6 4 17 23 21034 40312
8 25 14 1 17 14203 24301	6 25 14 3 17 14203 04321	19 22 13 10 1 34210 31240
24 3 7 20 11 40132 32140	24 1 7 20 13 40132 30142	8 5 16 24 12 10342 24031
16 12 5 9 23 32014 01432	18 12 5 9 21 32014 21430	21 14 7 3 20 42103 03124
1513/ /D5i	1585/ /D5i	1657/ /D5i
2 18 24 11 10 03421 12304	2 19 23 11 10 03421 13204	2 19 21 13 10 03421 13024
14 6 5 17 23 21034 30412	13 6 5 17 24 21034 20413	11 8 5 17 24 21034 02413
20 22 13 9 1 34210 41230	20 22 14 8 1 34210 41320	20 22 14 6 3 34210 41302
8 4 16 25 12 10342 23041	9 3 16 25 12 10342 32041	9 1 18 25 12 10342 30241
21 15 7 3 19 42103 04123	21 15 7 4 18 42103 04132	23 15 7 4 16 42103 24130
1729/ /D5i	1801/ /D5i	1873/ /D5i
2 13 25 16 9 02431 12403	2 13 24 16 10 02431 12304	2 14 23 16 10 02431 13204
20 6 4 12 23 31024 40312	19 6 5 12 23 31024 30412	18 6 5 12 24 31024 20413
14 22 18 10 1 24310 31240	15 22 18 9 1 24310 41230	15 22 19 8 1 24310 41320
8 5 11 24 17 10243 24031	8 4 11 25 17 10243 23041	9 3 11 25 17 10243 32041
21 19 7 3 15 43102 03124	21 20 7 3 14 43102 04123	21 20 7 4 13 43102 04132
1945/ /D5i	2017/ /D5i	2089/ /D5i
2 14 21 18 10 02431 13024	2 8 25 16 14 01432 12403	2 8 24 16 15 01432 12304
16 8 5 12 24 31024 02413	20 11 4 7 23 32014 40312	19 11 5 7 23 32014 30412
15 22 19 6 3 24310 41302	9 22 18 15 1 14320 31240	10 22 18 14 1 14320 41230
9 1 13 25 17 10243 30241	13 5 6 24 17 20143 24031	13 4 6 25 17 20143 23041
23 20 7 4 11 43102 24130	21 19 12 3 10 43201 03124	21 20 12 3 9 43201 04123
2161/ /D5i	2233/ /D5i	2305/ /D5i
2 9 23 16 15 01432 13204	2 9 21 18 15 01432 13024	3 17 21 15 9 03421 21043
18 11 5 7 24 32014 20413	16 13 5 7 24 32014 02413	14 6 20 23 2 21340 30421
10 22 19 13 1 14320 41320	10 22 19 11 3 14320 41302	10 24 12 1 18 14203 43102
14 3 6 25 17 20143 32041	14 1 8 25 17 20143 30241	22 5 8 19 11 40132 14230
21 20 12 4 8 43201 04132	23 20 12 4 6 43201 24130	16 13 4 7 25 32014 02314
3457/ /D5i	4609/ /D5i	5761/ /D5i
4 17 21 15 8 03421 31042	5 17 21 14 8 03421 41032	6 18 22 5 14 13402 02143
13 6 20 24 2 21340 20431	13 6 19 25 2 21340 20341	4 12 20 21 8 02341 31402
10 23 12 1 19 14203 42103	9 23 12 1 20 14203 32104	15 24 3 7 16 24013 43210
22 5 9 18 11 40132 14320	22 4 10 18 11 40132 13420	23 10 11 19 2 41230 24031
16 14 3 7 25 32014 03214	16 15 3 7 24 32014 04213	17 1 9 13 25 30124 10324
6049/ /D5i	6337/ /D5i	6625/ /D5i
7 18 21 5 14 13402 12043	8 17 21 5 14 13402 21043	9 17 21 5 13 13402 31042
4 11 20 22 8 02341 30412	4 11 20 23 7 02341 30421	3 11 20 24 7 02341 20431
15 24 3 6 17 24013 43201	15 24 2 6 18 24013 43102	15 23 2 6 19 24013 42103
23 10 12 19 1 41230 24130	22 10 13 19 1 41230 14230	22 10 14 18 1 41230 14320
16 2 9 13 25 30124 01324	16 3 9 12 25 30124 02314	16 4 8 12 25 30124 03214
6913/ /D5i		
10 17 21 4 13 13402 41032		
3 11 19 25 7 02341 20341		
14 23 2 6 20 24013 32104		
22 9 15 18 1 41230 13420		
16 5 8 12 24 30124 04213		

[Count = 7200] OK!

7. How small! It counts just twice as many as Pan-diagonal Magic Squares 5x5.

If you take no such restriction to the contents of those two primary diagonals but constant arithmetic sums, you will have a little more solutions as shown below.

**** Simple 'Euler Squares' 5x5 of the Standard Magic Type ****

1/ /D5i	2435/ /D5i	4999/ /D5i
1 20 22 14 8 03421 04132	2 20 14 21 8 03241 14302	3 22 10 19 11 04132 21430
24 3 10 17 11 40132 32410	15 3 22 9 16 20413 42130	20 1 24 12 8 30421 40312
7 21 13 5 19 14203 10243	6 24 18 5 12 14302 03241	21 9 13 5 17 41203 03241
15 9 16 23 2 21340 43021	23 11 10 17 4 42130 20413	7 15 16 23 4 12340 14023
18 12 4 6 25 32014 21304	19 7 1 13 25 31024 31024	14 18 2 6 25 23014 32104
8765/ /D5i	11233/ /D5i	13577/ /D5i
4 20 8 22 11 03142 34210	5 8 22 19 11 01432 42130	6 20 4 23 12 13042 04321
10 1 24 13 17 10423 40321	23 1 20 12 9 40321 20413	18 2 21 15 9 30421 21043
12 23 16 5 9 24301 12043	16 24 13 10 2 34210 03241	5 24 13 7 16 04213 43210
21 7 15 19 3 41230 01432	7 15 4 21 18 12043 14302	22 11 10 19 3 42130 10432
18 14 2 6 25 32014 23104	14 17 6 3 25 23104 31024	14 8 17 1 25 21304 32104
14539/ /D5i	15589/ /D5i	16963/ /D5i
7 20 21 4 13 13402 14032	8 20 4 22 11 13042 24310	9 20 3 22 11 13042 34210
23 1 17 15 9 40321 20143	17 1 23 15 9 30421 10243	17 1 24 15 8 30421 10342
11 24 10 18 2 24130 03421	5 24 12 6 18 04213 43102	5 23 12 6 19 04213 42103
5 8 14 22 16 01243 42310	21 13 10 19 2 42130 02431	21 14 10 18 2 42130 03421
19 12 3 6 25 32014 31204	14 7 16 3 25 21304 31024	13 7 16 4 25 21304 21034
17897/ /D5i	18747/ /D5i	19007/ /D5i
10 19 3 21 12 13042 43201	11 23 10 4 17 24103 02431	12 23 9 5 16 24103 12340
22 6 20 13 4 41320 10423	22 9 16 15 3 41320 13042	24 6 20 13 2 41320 30421
14 23 7 5 16 24103 32140	8 20 2 21 14 13042 24103	10 17 3 21 14 13042 41203
1 15 24 17 8 02431 04312	5 12 24 18 6 02431 41320	1 15 22 19 8 02431 04132
18 2 11 9 25 30214 21034	19 1 13 7 25 30214 30214	18 4 11 7 25 30214 23014
19205/ /D5i	19341/ /D5i	19417/ /D5i
13 24 5 7 16 24013 23410	14 23 5 7 16 24013 32410	15 22 4 8 16 24013 41320
21 2 18 15 9 40321 01243	21 2 19 15 8 40321 01342	21 3 20 14 7 40321 02431
4 20 6 23 12 03142 34021	3 20 6 24 12 03142 24031	2 19 6 25 13 03142 13042
10 11 22 19 3 12430 40132	10 11 22 18 4 12430 40123	9 11 23 17 5 12430 30214
17 8 14 1 25 31204 12304	17 9 13 1 25 31204 13204	18 10 12 1 24 31204 24103

[Count = 19436] OK!

Section 2 : Standard Magic Cubes of Order 3: Kanji Setsuda

1. Basic Form and Basic Conditions defining every row, column and pillars

1-----10-----19	$n_1+n_2+n_3=C;$	$ $	$n_1+n_{10}+n_{19}=C;$	$ $	$n_1+n_4+n_7=C;$
2 11 20	$n_4+n_5+n_6=C;$	$ $	$n_2+n_{11}+n_{20}=C;$	$ $	$n_2+n_5+n_8=C;$
3---+---12---+---21	$n_7+n_8+n_9=C;$	$ $	$n_3+n_{12}+n_{21}=C;$	$ $	$n_3+n_6+n_9=C;$
4--- -13--- -22	$n_{10}+n_{11}+n_{12}=C;$	$ $	$n_4+n_{13}+n_{22}=C;$	$ $	$n_{10}+n_{13}+n_{16}=C;$
5 14 23	$n_{13}+n_{14}+n_{15}=C;$	$ $	$n_5+n_{14}+n_{23}=C;$	$ $	$n_{11}+n_{14}+n_{17}=C;$
6---+---15---+---24	$n_{16}+n_{17}+n_{18}=C;$	$ $	$n_6+n_{15}+n_{24}=C;$	$ $	$n_{12}+n_{15}+n_{18}=C;$
7--- -16--- -25	$n_{19}+n_{20}+n_{21}=C;$	$ $	$n_7+n_{16}+n_{25}=C;$	$ $	$n_{19}+n_{22}+n_{25}=C;$
8 17 26	$n_{22}+n_{23}+n_{24}=C;$	$ $	$n_8+n_{17}+n_{26}=C;$	$ $	$n_{20}+n_{23}+n_{26}=C;$
9-----18-----27	$n_{25}+n_{26}+n_{27}=C;$	$ $	$n_9+n_{18}+n_{27}=C;$	$ $	$n_{21}+n_{24}+n_{27}=C;$
Primary Triagonals:	$n_1+n_{14}+n_{27}=C;$	$ $	$n_3+n_{14}+n_{25}=C;$	$ $	
	$n_7+n_{14}+n_{21}=C;$	$ $	$n_9+n_{14}+n_{19}=C;$	$ $	

2. We only define the 4 Primary Triagonals should add up to the same constant sum just as above and define nothing about any diagonals on any plane in the three directions: from top to bottom, from left to right, and from back to front.

We must make it up of the natural numbers {1, 2, 3, 4, 5, ..., 25, 26 and 27} using each strictly once, and we must neither use any number twice or more often there, nor un-use any number. It is one of the basic promises that we should usually obey.

We can determine the value C in advance as follows:

$$\begin{aligned}
n1+n2+n3+n4+n5+n6+ \dots +n25+n26+n27 &= 9xC \\
1+2+3+4+5+6+ \dots +25+26+27 &= 9xC \\
(27+1) \times 27 / 2 &= 9xC \\
\text{Therefore } C &= 42
\end{aligned}$$

3. Let's actually build this type of MC333 by dictating a computer program under these definitions and making our machine calculate and count.

Here you see an abstract list of pre-normalized 'Primitive Solutions' for the standard type of MC333, the result of my recent calculation. I did not yet use any 'Normalizing Inequality Conditions' here at all.

**** Standard Magic Cubes of Order 3: List of 'Primitive Solutions' ****

- 1/

1	-----15-----26
	23 7 12
	18-----20----- 4
17	19 6 25
	3 14 25
	22 9 11
24	--- 8-----10
16	21 5
2	-----13-----27
- 2/

1	-----17-----24
	23 3 16
	18-----22----- 2
15	19 8
	7 14 21
	20 9 13
26	--- 6-----10
12	25 5
4	-----11-----27
- 3/

1	-----15-----26
	17 19 6
	24----- 8-----10
23	7 12
	3 14 25
	16 21 5
18	--- 20----- 4
22	9 11
2	-----13-----27
- 4/

1	-----23-----18
	17 3 22
	24-----16----- 2
15	7 20
	19 14 9
	8 21 13
26	--- 12----- 4
6	25 11
10	----- 5-----27
- 5/

1	-----17-----24
	15 19 8
	26----- 6-----10
23	3 16
	7 14 21
	12 25 5
18	--- 22----- 2
20	9 13
4	-----11-----27
- 6/

1	-----23-----18
	15 7 20
	26-----12----- 4
17	3 22
	19 14 9
	6 25 11
24	--- 16----- 2
8	21 13
10	----- 5-----27
- 7/

2	-----15-----25
	24 7 11
	16-----20----- 6
18	19 5
	1 14 27
	23 9 10
22	--- 8-----12
17	21 4
3	-----13-----26
- 8/

2	-----18-----22
	24 1 17
	16-----23----- 3
15	19 8
	7 14 21
	20 9 13
25	--- 5-----12
11	27 4
6	-----10-----26
- 9/

2	-----13-----27
	22 9 11
	18-----20----- 4
16	21 5
	3 14 25
	23 7 12
24	--- 8-----10
17	19 6
1	-----15-----26
- 10/

2	-----16-----24
	22 3 17
	18-----23----- 1
13	21 8
	9 14 19
	20 7 15
27	--- 5-----10
11	25 6
4	-----12-----26
- 11/

2	-----15-----25
	18 19 5
	22----- 8-----12
24	7 11
	1 14 27
	17 21 4
16	--- 20----- 6
23	9 10
3	-----13-----26
- 12/

2	-----24-----16
	18 1 23
	22-----17----- 3
15	7 20
	19 14 9
	8 21 13
25	--- 11----- 6
5	27 10
12	----- 4-----26
- 13/

2	-----13-----27
	16 21 5
	24----- 8-----10
22	9 11
	3 14 25
	17 19 6
18	--- 20----- 4
23	7 12
1	-----15-----26
- 14/

2	-----22-----18
	16 3 23
	24-----17----- 1
13	9 20
	21 14 7
	8 19 15
27	--- 11----- 4
5	25 12
10	----- 6-----26
- 15/

2	-----18-----22
	15 19 8
	25----- 5-----12
24	1 17
	7 14 21
	11 27 4
16	--- 23----- 3
20	9 13
6	-----10-----26
- 16/

2	-----24-----16
	15 7 20
	25-----11----- 6
18	1 23
	19 14 9
	5 27 10
22	--- 17----- 3
8	21 13
12	----- 4-----26
- 17/

2	-----16-----24
	13 21 8
	27----- 5-----10
22	3 17
	9 14 19
	11 25 6
18	--- 23----- 1
20	7 15
4	-----12-----26
- 18/

2	-----22-----18
	13 9 20
	27-----11----- 4
16	3 23
	21 14 7
	5 25 12
24	--- 17----- 1
8	19 15
10	----- 6-----26
- 19/

3	-----13-----26
	23 9 10
	16-----20----- 6
17	21 4
	1 14 27
	24 7 11
22	--- 8-----12
18	19 5
2	-----15-----25
- 20/

3	-----17-----22
	23 1 18
	16-----24----- 2
13	21 8
	9 14 19
	20 7 15
26	--- 4-----12
10	27 5
6	-----11-----25
- 21/

3	-----13-----26
	17 21 4
	22----- 8-----12
23	9 10
	1 14 27
	18 19 5
16	--- 20----- 6
24	7 11
2	-----15-----25
- 22/

3	-----23-----16
	17 1 24
	22-----18----- 2
13	9 20
	21 14 7
	8 19 15
26	--- 10----- 6
4	27 11
12	----- 5-----25
- 23/

3	-----17-----22
	13 21 8
	26----- 4-----12
23	1 18
	9 14 19
	10 27 5
16	--- 24----- 2
20	7 15
6	-----11-----25
- 24/

3	-----23-----16
	13 9 20
	26-----10----- 6
17	1 24
	21 14 7
	4 27 11
22	--- 18----- 2
8	19 15
12	----- 5-----25

25/ 4----17-----21
|26 3 |13
| 12-----22----- 8
18 | 19 5 |
| 1 14 |27 |
| 23 9 | 10
20---| 6-----16 |
15 | 25 2 |
7-----11-----24

26/ 4----18-----20
|26 1 |15
| 12-----23----- 7
17 | 19 6 |
| 3 14 |25 |
| 22 9 | 11
21---| 5-----16 |
13 | 27 2 |
8-----10-----24

27/ 4----11-----27
|20 9 |13
| 18-----22----- 2
12 | 25 5 |
| 7 14 |21 |
| 23 3 | 16
26---| 6-----10 |
15 | 19 8 |
1-----17-----24

28/ 4----12-----26
|20 7 |15
| 18-----23----- 1
11 | 25 6 |
| 9 14 |19 |
| 22 3 | 17
27---| 5-----10 |
13 | 21 8 |
2-----16-----24

29/ 4----17-----21
|18 19 | 5
| 20-----6-----16
26 | 3 13 |
| 1 14 |27 |
| 15 25 | 2
12---| 22----- 8 |
23 | 9 10 |
7-----11-----24

30/ 4----26-----12
|18 1 |23
| 20-----15----- 7
17 | 3 22 |
|19 | 14 | 9 |
| 6 25 | 11
21---| 13----- 8 |
5 | 27 10 |
16-----2-----24

31/ 4----18-----20
|17 19 | 6
| 21-----5-----16
26 | 1 15 |
| 3 14 |25 |
| 13 27 | 2
12---| 23----- 7 |
22 | 9 11 |
8-----10-----24

32/ 4----26-----12
|17 3 |22
| 21-----13----- 8
18 | 1 23 |
|19 | 14 | 9 |
| 5 27 | 10
20---| 15----- 7 |
6 | 25 11 |
16-----2-----24

33/ 4----11-----27
|12 25 | 5
| 26-----6-----10
20 | 9 13 |
| 7 14 |21 |
| 15 19 | 8
18---| 22----- 2 |
23 | 3 16 |
1-----17-----24

34/ 4----20-----18
|12 7 |23
| 26-----15----- 1
11 | 9 22 |
|25 | 14 | 3 |
| 6 19 | 17
27---| 13----- 2 |
5 | 21 16 |
10-----8-----24

35/ 4----12-----26
|11 25 | 6
| 27-----5-----10
20 | 7 15 |
| 9 14 |19 |
| 13 21 | 8
18---| 23----- 1
22 | 3 17 |
2-----16-----24

36/ 4----20-----18
|11 9 |22
| 27-----13----- 2
12 | 7 23 |
|25 | 14 | 3 |
| 5 21 | 16
26---| 15----- 1
6 | 19 17 |
10-----8-----24

37/ 6-----16-----20
|26 3 |13
| 10-----23----- 9
17 | 21 4 |
| 1 14 |27 |
| 24 7 | 11
19---| 5-----18 |
15 | 25 2 |
8-----12-----22

49/ 7-----11-----24
|23 9 |10
| 12-----22----- 8
15 | 25 2 |
| 1 14 |27 |
| 26 3 | 13
20---| 6-----16 |
18 | 19 5 |
4-----17-----21

55/ 8-----12-----22
|24 7 |11
| 10-----23----- 9
15 | 25 2 |
| 1 14 |27 |
| 26 3 | 13
19---| 5-----18 |
17 | 21 4 |
6-----16-----20

67/ 9-----11-----22
|23 7 |12
| 10-----24----- 8
13 | 27 2 |
| 3 14 |25 |
| 26 1 | 15
20---| 4-----18 |
16 | 21 5 |
6-----17-----19

73/ 10-----23----- 9
|26 3 |13
| 6-----16-----20
24 | 7 11 |
| 1 14 |27 |
| 17 21 | 4
8---| 12-----22 |
15 | 25 2 |
19-----5-----18

85/ 12-----22----- 8
|26 3 |13
| 4-----17-----21
23 | 9 10 |
| 1 14 |27 |
| 18 19 | 5
7---| 11-----24 |
15 | 25 2 |
20-----6-----16

97/ 16-----20----- 6
|24 7 |11
| 2-----15-----25
23 | 9 10 |
| 1 14 |27 |
| 18 19 | 5
3---| 13-----26 |
17 | 21 4 |
22-----8-----12

109/ 18-----20----- 4
|23 7 |12
| 1-----15-----26
22 | 9 11 |
| 3 14 |25 |
| 17 19 | 6
2---| 13-----27 |
16 | 21 5 |
24-----8-----10

121/ 19-----5-----18
|17 21 | 4
| 6-----16-----20
15 | 25 2 |
| 1 14 |27 |
| 26 3 | 13
8---| 12-----22 |
24 | 7 11 |
10-----23----- 9

127/ 20-----6-----16
|18 19 | 5
| 4-----17-----21
15 | 25 2 |
| 1 14 |27 |
| 26 3 | 13
7---| 11-----24 |
23 | 9 10 |
12-----22----- 8

139/ 21-----5-----16
|17 19 | 6
| 4-----18-----20
13 | 27 2 |
| 3 14 |25 |
| 26 1 | 15
8---| 10-----24 |
22 | 9 11 |
12-----23----- 7

145/ 22-----8-----12
|18 19 | 5
| 2-----15-----25
17 | 21 4 |
| 1 14 |27 |
| 24 7 | 11
3---| 13-----26 |
23 | 9 10 |
16-----20----- 6

157/ 24-----8-----10
|17 19 | 6
| 1-----15-----26
16 | 21 5 |
| 3 14 |25 |
| 23 7 | 12
2---| 13-----27 |
22 | 9 11 |
18-----20----- 4

169/ 25-----5-----12
|15 19 | 8
| 2-----18-----22
11 | 27 4 |
| 7 14 |21 |
| 24 1 | 17
6---| 10-----26 |
20 | 9 13 |
16-----23----- 3

175/ 26-----6-----10
|15 19 | 8
| 1-----17-----24
12 | 25 5 |
| 7 14 |21 |
| 23 3 | 16
4---| 11-----27 |
20 | 9 13 |
18-----22----- 2

187/ 27-----5-----10
|13 21 | 8
| 2-----16-----24
11 | 25 6 |
| 9 14 |19 |
| 22 3 | 17
4---| 12-----26 |
20 | 7 15 |
18-----23----- 1

[Count = 192] OK!

4. You could probably find some solutions which are 'a little different but almost the same' as each other among the above list, couldn't you? Yes. You are right. For instance, all the solutions any of whose corner top is occupied by the number 1


```

printf("** Standard Magic Cubes of Order 3:");
printf(" List of the Standard Four Solutions **\n");
for(n=0;n<28;n++){nm[n]=0; uflg[n]=0;}
LSM=42; cnt=0; cnt3=0;
step01(); //Begin The Calculations
if(cnt3>0){print2sol();}
printf("\n");
printf(" [Count = %d] OK!\n",cnt);
printf("\n");
printf("** Recompiled and Listed by Kanji Setsuda on\n");
printf(" Mar.24, 2015 with MacOSX 10.10.2 & Xcode 6.2 **\n");
printf("\n");
return 0;
}
/* Begin The Calculations *
/* Set N1 *
void step01(){
short n;
for(n=1;n<28;n++){
if(uflg[n]==0){nm[1]=n;
uflg[n]=1; step02();
uflg[n]=0;}
}
}
/* Set N27(>N1) *
void step02(){
short n;
for(n=27;n>nm[1];n--){
if(uflg[n]==0){nm[27]=n;
uflg[n]=1; step03();
uflg[n]=0;}
}
}
/* Set n14=LSM-n1-n27 *
void step03(){
short n;
n=LSM-nm[1]-nm[27];
if((0<n)&&(n<28)){
if(uflg[n]==0){nm[14]=n;
uflg[n]=1; step04();
uflg[n]=0;}}
}
/* Set N3(>N1) *
void step04(){
short n;
for(n=nm[1]+1;n<28;n++){
if(uflg[n]==0){nm[3]=n;
uflg[n]=1; step05();
uflg[n]=0;}
}
}
/* Set n25=LSM-n3-n14 & N1<n25 *
void step05(){
short n;
n=LSM-nm[3]-nm[14];
if((nm[1]<n)&&(n<28)){
if(uflg[n]==0){nm[25]=n;
uflg[n]=1; step06();
uflg[n]=0;}}
}
/* Set n2=LSM-n1-n3 *
void step06(){
short n;
n=LSM-nm[1]-nm[3];
if((0<n)&&(n<28)){

```

```

        if(uflg[n]==0){nm[2]=n;
            uflg[n]=1; step07();
            uflg[n]=0;}}
    }
    /* Set n26=LSM-n25-n27 *
void step07(){
    short n;
    n=LSM-nm[25]-nm[27];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[26]=n;
            uflg[n]=1; step08();
            uflg[n]=0;}}
    }
    /* Set N7(>N1) *
void step08(){
    short n;
    for(n=nm[1]+1;n<28;n++){
        if(uflg[n]==0){nm[7]=n;
            uflg[n]=1; step09();
            uflg[n]=0;}}
    }
}
    /* Set n4=LSM-n1-n7 & n2>n4 *
void step09(){
    short n;
    n=LSM-nm[1]-nm[7];
    if((0<n)&&(n<nm[2])){
        if(uflg[n]==0){nm[4]=n;
            uflg[n]=1; step10();
            uflg[n]=0;}}
    }
}
    /* Set n21=LSM-n7-n14 & N1<n21 *
void step10(){
    short n;
    n=LSM-nm[7]-nm[14];
    if((nm[1]<n)&&(n<28)){
        if(uflg[n]==0){nm[21]=n;
            uflg[n]=1; step11();
            uflg[n]=0;}}
    }
}
    /* Set n24=LSM-n21-n27 *
void step11(){
    short n;
    n=LSM-nm[21]-nm[27];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[24]=n;
            uflg[n]=1; step12();
            uflg[n]=0;}}
    }
}
    /* Set n12=LSM-n3-n21 *
void step12(){
    short n;
    n=LSM-nm[3]-nm[21];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[12]=n;
            uflg[n]=1; step13();
            uflg[n]=0;}}
    }
}
    /* Set n16=LSM-n7-n25 *
void step13(){
    short n;
    n=LSM-nm[7]-nm[25];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[16]=n;
            uflg[n]=1; step14();

```

```

        uflg[n]=0;}}
}
/** Set N9(>N1) *
void step14(){
    short n;
    for(n=nm[1]+1;n<28;n++){
        if(uflg[n]==0){nm[9]=n;
            uflg[n]=1; step15();
            uflg[n]=0;}}
    }
}
/** Set n19=LSM-n9-n14 & N1<n19 *
void step15(){
    short n;
    n=LSM-nm[9]-nm[14];
    if((nm[1]<n)&&(n<28)){
        if(uflg[n]==0){nm[19]=n;
            uflg[n]=1; step16();
            uflg[n]=0;}}
    }
}
/** Set n6=LSM-n3-n9 *
void step16(){
    short n;
    n=LSM-nm[3]-nm[9];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[6]=n;
            uflg[n]=1; step17();
            uflg[n]=0;}}
    }
}
/** Set n22=LSM-n19-n25 *
void step17(){
    short n;
    n=LSM-nm[19]-nm[25];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[22]=n;
            uflg[n]=1; step18();
            uflg[n]=0;}}
    }
}
/** Set n8=LSM-n7-n9 *
void step18(){
    short n;
    n=LSM-nm[7]-nm[9];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[8]=n;
            uflg[n]=1; step19();
            uflg[n]=0;}}
    }
}
/** Set n20=LSM-n19-n21 *
void step19(){
    short n;
    n=LSM-nm[19]-nm[21];
    if((0<n)&&(n<28)){
        if(uflg[n]==0){nm[20]=n;
            uflg[n]=1; step20();
            uflg[n]=0;}}
    }
}
/** Set n5=LSM-n4-n6 *
void step20(){
    short n,m;
    n=LSM-nm[4]-nm[6];
    m=LSM-nm[2]-nm[8];
    if((0<n)&&(n<28)&&(n==m)){
        if(uflg[n]==0){nm[5]=n;
            uflg[n]=1; step21();
            uflg[n]=0;}}
    }
}

```

```

}
/** Set n23=LSM-n22-n24 *
void step21(){
  short n,m,p;
  n=LSM-nm[22]-nm[24];
  m=LSM-nm[20]-nm[26];
  p=LSM-nm[5]-nm[14];
  if((0<n)&&(n<28)&&(n==m)){
    if((n==p)&&(uflg[n]==0)){nm[23]=n;
      uflg[n]=1; step22();
      uflg[n]=0;}}
}
/** Set n10=LSM-n1-n19 & n4>n10 *
void step22(){
  short n;
  n=LSM-nm[1]-nm[19];
  if((0<n)&&(n<nm[4])){
    if(uflg[n]==0){nm[10]=n;
      uflg[n]=1; step23();
      uflg[n]=0;}}
}
/** Set n18=LSM-n9-n27 *
void step23(){
  short n;
  n=LSM-nm[9]-nm[27];
  if((0<n)&&(n<28)){
    if(uflg[n]==0){nm[18]=n;
      uflg[n]=1; step24();
      uflg[n]=0;}}
}
/** Set n11=LSM-n10-n12 *
void step24(){
  short n,m;
  n=LSM-nm[10]-nm[12];
  m=LSM-nm[2]-nm[20];
  if((0<n)&&(n<28)&&(n==m)){
    if(uflg[n]==0){nm[11]=n;
      uflg[n]=1; step25();
      uflg[n]=0;}}
}
/** Set n13=LSM-n10-n16 *
void step25(){
  short n,m;
  n=LSM-nm[10]-nm[16];
  m=LSM-nm[4]-nm[22];
  if((0<n)&&(n<28)&&(n==m)){
    if(uflg[n]==0){nm[13]=n;
      uflg[n]=1; step26();
      uflg[n]=0;}}
}
/** Set n15=LSM-n13-n14 *
void step26(){
  short n,m,p;
  n=LSM-nm[13]-nm[14];
  m=LSM-nm[12]-nm[18];
  p=LSM-nm[6]-nm[24];
  if((0<n)&&(n<28)&&(n==m)){
    if((n==p)&&(uflg[n]==0)){nm[15]=n;
      uflg[n]=1; step27();
      uflg[n]=0;}}
}
/** Set n17=LSM-n16-n18 *
void step27(){
  short n,m,p;
  n=LSM-nm[16]-nm[18];

```



```

m=LSM-nm[11]-nm[14];
p=LSM-nm[8]-nm[26];
if((0<n)&&(n<28)&&(n==m)){
    if((n==p)&&(uflg[n]==0)){nm[17]=n;
        uflg[n]=1; anssave();
        uflg[n]=0;}}
}
/** Save the Answer *
void anssave(){
    short n;
    cnt++;
    anm[cnt3][0]=cnt;
    for(n=1;n<28;n++){anm[cnt3][n]=nm[n];}
    cnt3++;
    if(cnt3==2){print2sol(); cnt3=0;
        anm[1][0]=0;
        for(n=1;n<28;n++){anm[1][n]=0;}}
}
/** Print 2 Solutions *
void print2sol(){
    printf("%3d/%22d/\n",anm[0][0],anm[1][0]);
    printf("%4d-----%2d-----%2d%9d-----%2d-----%2d\n",
        anm[0][1],anm[0][10],anm[0][19],anm[1][1],anm[1][10],anm[1][19]);
    printf("    |%2d    |%2d    |%2d    |%2d    |%2d    |%2d\n",
        anm[0][2],anm[0][11],anm[0][20],anm[1][2],anm[1][11],anm[1][20]);
    printf("    |%4d-----%2d-----%2d    |%4d-----%2d-----%2d\n",
        anm[0][3],anm[0][12],anm[0][21],anm[1][3],anm[1][12],anm[1][21]);
    printf("%4d    |%2d    |%2d    |%5d    |%2d    |%2d    |\n",
        anm[0][4],anm[0][13],anm[0][22],anm[1][4],anm[1][13],anm[1][22]);
    printf("    |%2d |%2d |%2d |%2d |%2d |%2d |\n",
        anm[0][5],anm[0][14],anm[0][23],anm[1][5],anm[1][14],anm[1][23]);
    printf("    |%4d |%4d |%4d    |%4d |%4d |%4d\n",
        anm[0][6],anm[0][15],anm[0][24],anm[1][6],anm[1][15],anm[1][24]);
    printf("%4d---|-%2d---|-%2d    |%5d---|-%2d---|-%2d    |\n",
        anm[0][7],anm[0][16],anm[0][25],anm[1][7],anm[1][16],anm[1][25]);
    printf("%6d |%5d |%5d |%7d |%5d |%5d |\n",
        anm[0][8],anm[0][17],anm[0][26],anm[1][8],anm[1][17],anm[1][26]);
    printf("%8d-----%2d-----%2d%9d-----%2d-----%2d\n",
        anm[0][9],anm[0][18],anm[0][27],anm[1][9],anm[1][18],anm[1][27]);
}

```

6. Here you see the complete list of 4 Standard Solutions of our object as follows.

* Standard Magic Cubes of Order 3: List of the Standard Four Solutions *

```

1/          2/
1-----15-----26          2-----15-----25
| 23    | 7    | 12          | 24    | 7    | 11
| 18    | 19   | 20   | 4          | 16   | 19   | 20   | 6
17    | 3    | 14    | 25    |          | 18    | 19    | 5    |
| 22    | 9    | 11          | 1    | 14    | 27    |
| 24---| 8---| 10    |          | 23    | 9    | 10    |
    16 | 21 | 5 |          | 22---| 8---| 12    |
    2-----13-----27          17 | 21 | 4 |
    3-----13-----26

3/          4/
4-----17-----21          6-----16-----20
| 26    | 3    | 13          | 26    | 3    | 13
| 12---| 22---| 8          | 10---| 23---| 9
18    | 19    | 5    |          | 17    | 21    | 4    |
| 1    | 14    | 27    |          | 1    | 14    | 27    |
| 23    | 9    | 10    |          | 24    | 7    | 11    |
20---| 6---| 16    |          | 19---| 5---| 18    |
    15 | 25 | 2 |          | 15    | 25    | 2    |
    7-----11-----24          8-----12-----22

```

[Count = 4] OK!

** Recompiled and Listed by Kanji Setsuda on
Mar.24, 2015 with MacOSX 10.10.2 & Xcode 6.2 **

7. Will you watch in the list above if n14 on the cubic center is always occupied by the number 14, and check whether all the 13 pairs situated symmetrically with respect to the cubic center n14 always add up to the same sum 28 or not?

$$1+27=2+26=3+25=4+24=5+23=6+22=7+21=8+20=9+19+10+18=11+17=12+16=13+15=28$$

Do you remember this is just the characteristic property of 'Self-complementary' type? Yes. All solutions are just the 'Self-complementary' Magic Cubes 3x3x3.

What made them so? For we built them as the Standard MC333 under our normal conditions before all. We did never take n14=14 yet in the first definition stage.

8. Let's study why no other type than 'Self-complementary' can be made. Did our first definition necessarily mean the property of 'Self-complementary' MC333?

Let's have some algebraic study, though I am afraid it may be tiresome.

* Basic Form and Basic Conditions for Standard MC333: C=42 *

1-----10-----19	$n1+n2+n3=C;$	$ $	$n1+n10+n19=C;$	$ $	$n1+n4+n7=C;$
2 11 20	$n4+n5+n6=C;$	$ $	$n2+n11+n20=C;$	$ $	$n2+n5+n8=C;$
3-----12-----21	$n7+n8+n9=C;$	$ $	$n3+n12+n21=C;$	$ $	$n3+n6+n9=C;$
4 13 22	$n10+n11+n12=C;$	$ $	$n4+n13+n22=C;$	$ $	$n10+n13+n16=C;$
5 14 23	$n13+n14+n15=C;$	$ $	$n5+n14+n23=C;$	$ $	$n11+n14+n17=C;$
6 15 24	$n16+n17+n18=C;$	$ $	$n6+n15+n24=C;$	$ $	$n12+n15+n18=C;$
7--- -16-----25	$n19+n20+n21=C;$	$ $	$n7+n16+n25=C;$	$ $	$n19+n22+n25=C;$
8 17 26	$n22+n23+n24=C;$	$ $	$n8+n17+n26=C;$	$ $	$n20+n23+n26=C;$
9-----18-----27	$n25+n26+n27=C;$	$ $	$n9+n18+n27=C;$	$ $	$n21+n24+n27=C;$

Primary Triagonals: $n1+n14+n27=C;$ | $n3+n14+n25=C;$ |
 $n7+n14+n21=C;$ | $n9+n14+n19=C;$

All the equations that have n14 within can be transformed like these:

$$n1+n27=C-n14; \quad | \quad n3+n25=C-n14; \quad | \quad n5+n23=C-n14; \quad | \quad n7+n21=C-n14; \quad |$$

$$n9+n19=C-n14; \quad | \quad n11+n17=C-n14; \quad | \quad n13+n15=C-n14;$$

$n1+n2+n3=C;$	$n1+n4+n7=C;$
+) $n25+n26+n27=C;$	+) $n21+n24+n27=C;$
$(n1+n27)+(n2+n26)+(n3+n25)=2*C;$	$(n1+n27)+(n4+n24)+(n7+n21)=2*C;$
$C-n14 + (n2+n26) + C-n14 = 2*C;$	$C-n14 + (n4+n24) + C-n14 = 2*C;$
$n2+n26=2*C-2*(C-n14)$	$n4+n24=2*C-2*(C-n14)$

Therefore $n2+n26=2*n14;$ Therefore $n4+n24=2*n14;$
In the same way $n6+n22=2*n14;$; $n8+n20=2*n14;$; $n10+n18=2*n14;$; $n12+n16=2*n14;$;

It tells us there are two groups of Complementary Pairs according to their sums.

$$n1+n27=n3+n25=n5+n23=n7+n21=n9+n19=n11+n17=n13+n15=C-n14 \quad \dots \quad cc;$$

$$n2+n26=n4+n24=n6+n22=n8+n20=n10+n18=n12+n16=2*n14 \quad \dots \quad dd;$$

We need all those 13 pairs just as above. What pairs can be actually combined according to the value of n14, then? Of course, any pair must be made up of the natural numbers {1, 2, 3, 4, 5, 6, ..., 25, 26 and 27} then, using each strictly once. No number must be used twice nor more often and no one must be un-used, either.

** Make the CD Tables for Standard MC333:(NC denotes n14) **

* Is it possible to make all the 13 Complementary Pairs? *

NC= 2 (cc= 4, dd=40):
C1(1, 3),D1{27,13}; ... Impossible!
NC= 3 (cc= 6, dd=39):

C1(1, 5),D1{27,12}; C2(2, 4),D2{26,13}; ... Impossible!
 NC= 4 (cc= 8, dd=38):
 C1(1, 7),D1{27,11}; C2(2, 6),D2{26,12}; C3(3, 5),D3{25,13}; ... Impossible!
 NC= 5 (cc=10, dd=37):
 C1(1, 9),D1{27,10}; C2(2, 8),D2{26,11}; C3(3, 7),D3{25,12};
 C4(4, 6),D4{24,13}; ... Impossible!
 NC= 6 (cc=12, dd=36):
 C1(1,11),D1{27, 9}; C2(2,10),D2{24,12}; C3(4, 8),D3{23,13};
 C4(5, 7),D4{22,14}; ... Impossible!
 NC= 7 (cc=14, dd=35):
 C1(1,13),D1{27, 8}; C2(2,12),D2{26, 9}; C3(3,11),D3{25,10}; ... Impossible!
 NC= 8 (cc=16, dd=34):
 C1(1,15),D1{27, 7}; C2(2,14),D2{25, 9}; C3(3,13),D3{24,10};
 C4(4,12),D4{23,11}; ... Impossible!
 NC= 9 (cc=18, dd=33):
 C1(1,17),D1{27, 6}; C2(2,16),D2{26, 7}; C3(3,15),D3{25, 8};
 C4(4,14),D4{23,10}; C5(5,13),D5{22,11}; ... Impossible!
 NC=10 (cc=20, dd=32):
 C1(1,19),D1{27, 5}; C2(2,18),D2{26, 6}; C3(3,17),D3{25, 7};
 C4(4,16),D4{24, 8}; C5(9,11), ... Impossible!
 NC=11 (cc=22, dd=31):
 C1(1,21),D1{27, 4}; C2(2,20),D2{26, 5}; C3(3,19),D3{25, 6};
 C4(7,15),D4{18,13}; C5(8,14), ... Impossible!
 NC=12 (cc=24, dd=30):
 C1(1,23),D1{27, 3}; C2(2,22),D2{26, 4}; C3(5,19),D3{21, 9};
 C4(6,18),D4{20,10}; C5(7,17),D5{16,14}; C6(11,13), ... Impossible!
 NC=13 (cc=26, dd=29):
 C1(1,25),D1{27, 2}; C2(3,23),D2{24, 5}; C3(4,22),D3{21, 8};
 C4(6,20),D4{19,10}; C5(9,17),D5{18,11}; C6(12,14), ... Impossible!
NC=14 (cc=28, dd=28):
 C1(1,27),D1{26, 2}; C2(3,25),D2{24, 4}; C3(5,23),D3{22, 6};
 C4(7,21),D4{20, 8}; C5(9,19),D5{18,10}; C6(11,17),D6{16,12};
 C7(13,15) **** Possible! ****
 NC=15 (cc=30, dd=27):
 C1(3,27),D1{25, 2}; C2(4,26),D2{22, 5}; C3(6,24),D3{20, 7};
 C4(9,21),D4{19, 8}; C5(12,18),D5{16,11}; C6(13,17), ... Impossible!
 NC=16 (cc=32, dd=26):
 C1(5,27),D1{23, 3}; C2(6,26),D2{22, 4}; C3(7,25),D3{18, 8};
 C4(11,21),D4{17, 9}; C5(12,20), ... Impossible!
 NC=17 (cc=34, dd=25):
 C1(7,27),D1{21, 4}; C2(8,26),D2{20, 5}; C3(9,25),D3{19, 6};
 C4(10,24),D4{14,11}; C5(12,22), ... Impossible!
 NC=18 (cc=36, dd=24):
 C1(9,27),D1{19, 5}; C2(10,26),D2{17, 7}; C3(11,25),D3{16, 8};
 C4(12,24), ... Impossible!
 NC=19 (cc=38, dd=23):
 C1(11,27),D1{17, 6}; C2(12,26),D2{16, 7}; C3(13,25),D3{15, 8};
 C4(14,24), ... Impossible!
 NC=20 (cc=40, dd=22):
 C1(13,27),D1{15, 7}; C2(14,26),D2{12,10}; C3(16,24), ... Impossible!
 NC=21 (cc=42, dd=21):
 C1(15,27),D1{13, 8}; C2(16,26),D2{12, 9}; C3(17,25),D3{11,10};
 C4(18,24), ... Impossible!
 NC=22 (cc=44, dd=20):
 C1(17,27),D1{11, 9}; C2(18,26), ... Impossible!
 NC=23 (cc=46, dd=19):

```

C1(19,27), ... Impossible!
NC=24 (cc=48, dd=18):
C1(21,27), ... Impossible!
NC=25 (cc=50, dd=17):
C1(23,27), ... Impossible!
NC=26 (cc=52, dd=16):
C1(25,27), ... Impossible!
[OK!]

```

Did you notice that it is the only one case when n14 takes 14 is possible? And all the complementary pairs of 28 must be situated symmetrically with respect to the cubic center n14. This means every standard MC333 should necessarily be nothing but the Self-complementary MC333.

9. Now that we know this fact, we can guess when we make the standard solutions of Self-complementary MC333 originally, we can surely have got just the same solution set with our old standard type. Let's verify our reasoning by making it actually here.

```

/** Magic Cubes of order 3: Self-Complementary Type **
/** File: 'MC333SCn5.c' Dictated by Kanji Setsuda **
/** in 2005, 2007 and Nov.20, 2008 with MacOSX10.5 & Xcode 3.0; **
/** Recompiled on Mar.24, 2015 with MacOSX 10.10.2 & Xcode 6.2; **
//
/** Basic Form and Basic Equations for Definition: C=42; *
// 1-----10-----19      n1+n2+n3=C;      | n1+n10+n19=C; | n1+n4+n7=C;
// | 2      11      120      n4+n5+n6=C;      | n2+n11+n20=C; | n2+n5+n8=C;
// | 3-----12-----21      n7+n8+n9=C;      | n3+n12+n21=C; | n3+n6+n9=C;
// 4 | 13      22 |      n10+n11+n12=C; | n4+n13+n22=C; | n10+n13+n16=C;
// | 5 | 14      123 |      n13+n14+n15=C; | n5+n14+n23=C; | n11+n14+n17=C;
// | 6      15 | 24      n16+n17+n18=C; | n6+n15+n24=C; | n12+n15+n18=C;
// 7---|16-----25 |      n19+n20+n21=C; | n7+n16+n25=C; | n19+n22+n25=C;
// 8 | 17      26 |      n22+n23+n24=C; | n8+n17+n26=C; | n20+n23+n26=C;
// 9-----18-----27      n25+n26+n27=C; | n9+n18+n27=C; | n21+n24+n27=C;
/** Self-complementary Conditions: CC=28; *
// n1+n27=n2+n26=n3+n25=n4+n24=n5+n23=n6+n22=n7+n21=n8+n20
// =n9+n19=n10+n18=n11+n17=n12+n16=n13+n15=n14+n14=CC
//
#include <stdio.h>
//
short LSM, CC;
short cnt, cnt2;
short nm[28], uflg[28];
short anm[3][28];
//
void stp01(void), stp02(void), stp03(void), stp04(void);
void stp05(void), stp06(void), stp07(void), stp08(void);
void stp09(void), stp10(void), stp11(void);
void stp12(void), stp13(void), stp14(void);
void ansrecord(void), print2sol(void);
//
/** Main Program *
int main(){
short n;
printf("\n");
printf("*** Self-Complementary Magic Cubes of Order 3 **\n");
printf("*** Complete List of the Standard 4 Solutions **\n");
for(n=0;n<28;n++){nm[n]=0; uflg[n]=0;}
LSM=42; CC=28; cnt=0; cnt2=0;
nm[14]=14; uflg[14]=1;
stp01(); /* Begin The Calculations
uflg[14]=0;

```

```

    if(cnt2>0){print2sol();}
    printf("\n");
    printf(" [Count = %d] OK!\n",cnt);
    printf("\n");
    printf("*** Recompiled and Listed by Kanji Setsuda on\n");
    printf("    Mar.24, 2015 with MacOSX 10.10.2 & Xcode 6.2 **\n");
    printf("\n");
    return 0;
}
//
/** Begin The Calculations *
/** Set n5 & n23 & n5<n23 *
void stp01(){
    short m,n;
    for(m=1;m<14;m++){n=CC-m;
        if((uflg[m]==0)&&(uflg[n]==0)){
            uflg[m]=1; uflg[n]=1;
            nm[5]=m; nm[23]=n;
            stp02();
            uflg[n]=0; uflg[m]=0;}
        }
    }
/** Set n11(>n5) & n17(>n11) *
void stp02(){
    short m,n;
    for(m=nm[5]+1;m<14;m++){n=CC-m;
        if((uflg[m]==0)&&(uflg[n]==0)){
            uflg[m]=1; uflg[n]=1;
            nm[11]=m; nm[17]=n;
            stp03();
            uflg[n]=0; uflg[m]=0;}
        }
    }
/** Set n15(>n11) & n13(>n15) *
void stp03(){
    short m,n;
    for(m=nm[11]+1;m<14;m++){n=CC-m;
        if((uflg[m]==0)&&(uflg[n]==0)){
            uflg[m]=1; uflg[n]=1;
            nm[15]=m; nm[13]=n;
            stp04();
            uflg[n]=0; uflg[m]=0;}
        }
    }
/** Set n1 & n27 *
void stp04(){
    short m,n;
    for(m=1;m<28;m++){n=CC-m;
        if((uflg[m]==0)&&(uflg[n]==0)){
            uflg[m]=1; uflg[n]=1;
            nm[1]=m; nm[27]=n;
            stp05();
            uflg[n]=0; uflg[m]=0;}
        }
    }
/** Set n2 & n26 *
void stp05(){
    short m,n;
    for(m=27;m>0;m--){n=CC-m;
        if((uflg[m]==0)&&(uflg[n]==0)){
            uflg[m]=1; uflg[n]=1;
            nm[2]=m; nm[26]=n;
            stp06();
            uflg[n]=0; uflg[m]=0;}
        }
    }

```

```

}
/** Set n3=LSM-n1-n2 & n25 */
void stp06(){
  short m,n;
  m=LSM-nm[1]-nm[2];
  n=LSM-nm[27]-nm[26];
  if((0<m)&&(m<28)&&(m+n==CC)){
    if((uflg[m]==0)&&(uflg[n]==0)){
      uflg[m]=1; uflg[n]=1;
      nm[3]=m; nm[25]=n;
      stp07();
      uflg[n]=0; uflg[m]=0;}}
}
/** Set n4 & n24 */
void stp07(){
  short m,n;
  for(m=27;m>0;m--){n=CC-m;
    if((uflg[m]==0)&&(uflg[n]==0)){
      uflg[m]=1; uflg[n]=1;
      nm[4]=m; nm[24]=n;
      stp08();
      uflg[n]=0; uflg[m]=0;}}
}
}
/** Set n7=LSM-n1-n4 & n21 */
void stp08(){
  short m,n;
  m=LSM-nm[1]-nm[4];
  n=LSM-nm[27]-nm[24];
  if((0<m)&&(m<28)&&(m+n==CC)){
    if((uflg[m]==0)&&(uflg[n]==0)){
      uflg[m]=1; uflg[n]=1;
      nm[7]=m; nm[21]=n;
      stp09();
      uflg[n]=0; uflg[m]=0;}}
}
}
/** Set n6=LSM-n4-n5 & n22 */
void stp09(){
  short m,n,o,p;
  m=LSM-nm[4]-nm[5];
  n=LSM-nm[24]-nm[23];
  o=LSM-nm[15]-nm[24];
  p=LSM-nm[13]-nm[4];
  if((0<m)&&(m<28)&&(0<n)&&(n<28)){
    if((m+n==CC)&&(m==o)&&(n==p)){
      if((uflg[m]==0)&&(uflg[n]==0)){
        uflg[m]=1; uflg[n]=1;
        nm[6]=m; nm[22]=n;
        stp10();
        uflg[n]=0; uflg[m]=0;}}}}
}
}
/** Set n8=LSM-n2-n5 & n20 */
void stp10(){
  short m,n,o,p;
  m=LSM-nm[2]-nm[5];
  n=LSM-nm[26]-nm[23];
  o=LSM-nm[17]-nm[26];
  p=LSM-nm[11]-nm[2];
  if((0<m)&&(m<28)&&(0<n)&&(n<28)){
    if((m+n==CC)&&(m==o)&&(n==p)){
      if((uflg[m]==0)&&(uflg[n]==0)){
        uflg[m]=1; uflg[n]=1;
        nm[8]=m; nm[20]=n;
        stp11();
        uflg[n]=0; uflg[m]=0;}}}}
}

```

```

}
/** Set n9=LSM-n7-n8 & n19 *
void stp11(){
short m,n,o,p;
m=LSM-nm[7]-nm[8];
n=LSM-nm[21]-nm[20];
o=LSM-nm[3]-nm[6];
p=LSM-nm[25]-nm[22];
if((0<m)&&(m<28)&&(0<n)&&(n<28)){
if((m+n==CC)&&(m==o)&&(n==p)){
if((uflg[m]==0)&&(uflg[n]==0)){
uflg[m]=1; uflg[n]=1;
nm[9]=m; nm[19]=n;
stp12();
uflg[n]=0; uflg[m]=0;}}}}
}
/** Set n10=LSM-n1-n19 & n18 *
void stp12(){
short m,n;
m=LSM-nm[1]-nm[19];
n=LSM-nm[27]-nm[9];
if((0<m)&&(m<28)&&(m+n==CC)){
if((uflg[m]==0)&&(uflg[n]==0)){
uflg[m]=1; uflg[n]=1;
nm[10]=m; nm[18]=n;
stp13();
uflg[n]=0; uflg[m]=0;}}}}
}
/** Set n12=LSM-n10-n11 & n16 *
void stp13(){
short m,n,o,p;
m=LSM-nm[10]-nm[11];
n=LSM-nm[18]-nm[17];
o=LSM-nm[3]-nm[21];
p=LSM-nm[25]-nm[7];
if((0<m)&&(m<28)&&(0<n)&&(n<28)){
if((m+n==CC)&&(m==o)&&(n==p)){
if((uflg[m]==0)&&(uflg[n]==0)){
uflg[m]=1; uflg[n]=1;
nm[12]=m; nm[16]=n;
stp14();
uflg[n]=0; uflg[m]=0;}}}}}}
}
/** The Last Checks *
void stp14(){
short sm1,sm2;
sm1=nm[12]+nm[15]+nm[18];
sm2=nm[16]+nm[13]+nm[10];
if((sm1==LSM)&&(sm2==LSM)){ansrecord();}
}
/** Record the Answer *
void ansrecord(){
short n;
cnt++;
anm[cnt2][0]=cnt;
for(n=1;n<28;n++){anm[cnt2][n]=nm[n];}
cnt2++;
if(cnt2==2){print2sol(); cnt2=0;
anm[1][0]=0;
for(n=1;n<28;n++){anm[1][n]=0;}
}
}
/** Print 2 Solutions *
void print2sol(){
printf("%3d/%22d/\n",anm[0][0],anm[1][0]);

```

```

printf("%4d-----%2d-----%2d%9d-----%2d-----%2d\n",
      anm[0][1],anm[0][10],anm[0][19],anm[1][1],anm[1][10],anm[1][19]);
printf("   |%2d   |%2d   |%2d   |%2d   |%2d   |%2d\n",
      anm[0][2],anm[0][11],anm[0][20],anm[1][2],anm[1][11],anm[1][20]);
printf("   |%4d-----%2d-----%2d   |%4d-----%2d-----%2d\n",
      anm[0][3],anm[0][12],anm[0][21],anm[1][3],anm[1][12],anm[1][21]);
printf("%4d   |%2d   |%2d   |%5d   |%2d   |%2d   |\n",
      anm[0][4],anm[0][13],anm[0][22],anm[1][4],anm[1][13],anm[1][22]);
printf("   |%2d   |%2d   |%2d   |%2d   |%2d   |%2d   |\n",
      anm[0][5],anm[0][14],anm[0][23],anm[1][5],anm[1][14],anm[1][23]);
printf("   |%4d |%4d |%4d   |%4d |%4d |%4d\n",
      anm[0][6],anm[0][15],anm[0][24],anm[1][6],anm[1][15],anm[1][24]);
printf("%4d---|-%2d---|-%2d   |%5d---|-%2d---|-%2d   |\n",
      anm[0][7],anm[0][16],anm[0][25],anm[1][7],anm[1][16],anm[1][25]);
printf("%6d |%5d |%5d |%7d |%5d |%5d |\n",
      anm[0][8],anm[0][17],anm[0][26],anm[1][8],anm[1][17],anm[1][26]);
printf("%8d-----%2d-----%2d%9d-----%2d-----%2d\n",
      anm[0][9],anm[0][18],anm[0][27],anm[1][9],anm[1][18],anm[1][27]);
}

```

**** Self-Complementary Magic Cubes of Order 3 ****
**** Complete List of the Standard 4 Solutions starting with n5=1 ****

<p>1/ 6-----16-----20 26 3 13 10--- 23--- 9 17 21 4 1 14 27 24 7 11 19--- 5--- 18 15 25 2 8-----12-----22</p>	<p>2/ 4-----17-----21 26 3 13 12--- 22--- 8 18 19 5 1 14 27 23 9 10 20--- 6--- 16 15 25 2 7-----11-----24</p>
<p>3/ 2-----15-----25 24 7 11 16--- 20--- 6 18 19 5 1 14 27 23 9 10 22--- 8--- 12 17 21 4 3-----13-----26</p>	<p>4/ 1-----15-----26 23 7 12 18--- 20--- 4 17 19 6 3 14 25 22 9 11 24--- 8--- 10 16 21 5 2-----13-----27</p>

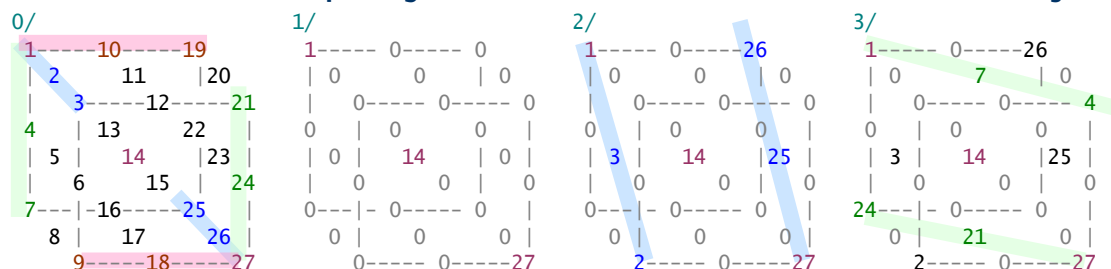
[Count = 4] OK!

**** Recompiled and Listed by Kanji Setsuda on Mar.24, 2015 with MacOSX 10.10.2 & Xcode 6.2 ****

10. At the end of this section I would like to propose you a way of composition by your own hand: How to compose a standard solution of Self-complementary Magic Cube 3x3x3 transforming from the usual Basic Form.

Let me demonstrate it in such the step diagrams as follows:

**** Standard MC333: Step Diagrams: How to Transform Basic Form into Object? ****



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[Step 0] Prepare the Basic Form at the starting point

[Step 1] Copy the most primary triangular {1, 14, 27} of the Basic Form and paste it into the same position of the Object Form.

[Step 2] Copy the first line {1, 2, 3} as {1, 3, 2} and put it into the diagonal positions of the left plane of Object, and place every complementary number of each position on the right .

[Step 3] Copy the second line {1, 4, 7} as {1, 7, 4} and put it into a diagonal of the top plane of Object, and place every complementary number of each position on the bottom.

[Step 4] Copy the third line {1, 10, 19} as {1, 19, 10} and put it into a diagonal of the back plane of Object, and place every complementary number of each position on the front.

[Step 5-7] Values of rest positions can be easily calculated as in $nb=42-na-nc$ in any line:

23=42-1-18; 5=42-27-10(or =28-23); 16=42-24-2; 12=42-4-26(or =28-16);
 17=42-1-24; 11=42-27-4(or =28-17); 22=42-18-2; 6=42-10-26(or =28-22);
 15=42-1-26; 13=42-27-2(or =28-15); 20=42-18-4; 8=42-10-24(or =28-20);

[Step 7] The last form is just what we have wanted to make for our object goal. It is certainly one of the standard solutions of Self-complementary Magic Cubes of Order 3.

(The original written in Japanese in 2000; Revised English Version written by Kanji Setsuda on Nov.21, 2008 working with MacOSX & Xcode3.0; Recompiled on Apr.12, 2015 with MacOSX 10.10.3 & Xcode 6.3;)

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 English_Page_Index : <http://kanjisetuda.1a.coocan.jp/pages/EnglishP1.html>