The magic square challange

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1 Specification of the task

Implement the a EA version of the "Magic Square" finder of size N. Test your program from size N= 3 up to 9 (and more if possible) and find 5 new solutions, that differ from wikipedia/internet.

Upload a working project (preferable compilable gnu C++ including a makefile (make test shall test all cases)) with calculated solutions (PDF) and a README.txt (with instructions on how to use it) in a ZIP or TGZ file.

Our group had to implement the following magic square version:

Semi-magic square when its rows and columns sum to give the magic constant.

2 Crossover method

For better understanding of the code, here is a brief description of the used method for Crossover.

Note that every square can be stored as vector of length $n\dot{n}$. As every number from 1 to $n\dot{n}$ must be unique in a magic square a simple crossover methods like one-point, N-point or cut-and-splice are not suitable. These methods would create squares with non unique numbers.

Instead of using one-point crossover directly on the two parent squares we used it on their inversion sequence. As the building of such an inversion sequence (described in the next paragraph) is reversible the created inversion sequence gives us the new child square.

An inversion sequence of an permutation is an array of the same length. The i-th entry of this sequence denotes the number of entries in the original permutation which are higher than i before i itself.

$$2\quad 1\quad 6\quad 4\quad 5\quad 3 \qquad \Rightarrow \qquad 1\quad 0\quad 3\quad 1\quad 1\quad 0$$

3 Results

The following squares were found:

3.1 N=3

4	2	9
8	6	1
3	7	5

7	5	3
6	1	8
2	9	4

8	4	3
6	2	7
1	9	5

3.2 N=4

14	12	7	1
13	11	8	2
3	6	10	15
4	5	9	16

14	2	8	10
3	13	6	12
16	4	9	5
1	15	11	7

7	9	14	4
13	3	8	10
12	16	1	5
2	6	11	15

3.3 N=5

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

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