

ОДЛК, порожденные перестановкой строк

ODLS generated by
rows permutation

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- A Latin square is a table of size $n \times n$, filled with n elements of set M in such way that each row and each column of the table contain every single element of M exactly once.
- A diagonal Latin square is a Latin square which has unique elements both on its main and secondary diagonals.

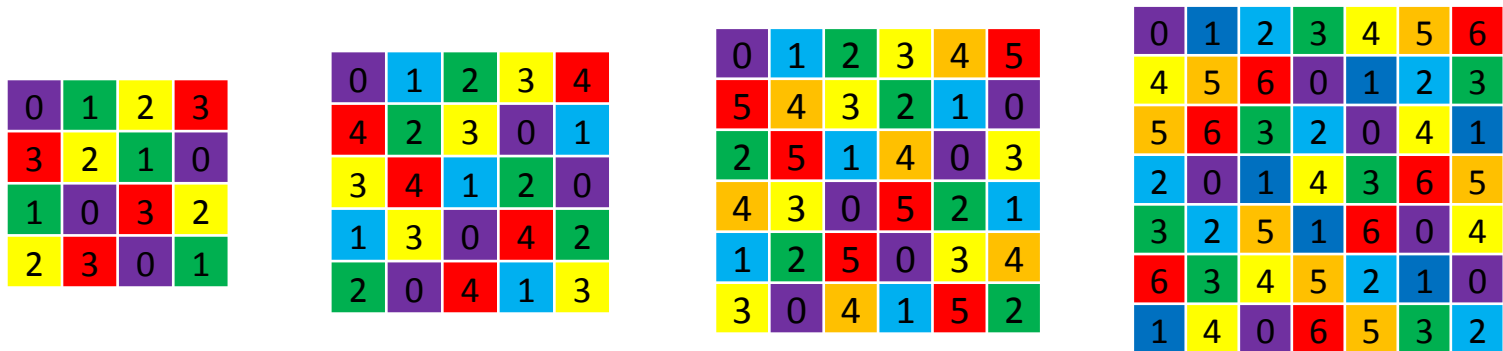


Fig. 1. Examples of diagonal Latin squares of rank 4, 5, 6 and 7

- Two Latin squares $L(l_{ij})$ and $K(k_{ij})$ are called orthogonal, if all ordered pairs (l_{ij}, k_{ij}) are different. Also known as «Euler» or «Greco-Latin» squares.



Fig. 2. Example of a pair of orthogonal Latin squares of rank 7, which are diagonal as well.

- Rank 4 - 1 pair:

0	1	2	3
3	2	1	0
1	0	3	2
2	3	0	1

0	1	2	3
2	3	0	1
3	2	1	0
1	0	3	2

- Rank 5 – 2 pairs:

0	1	2	3	4
4	2	3	0	1
3	4	1	2	0
1	3	0	4	2
2	0	4	1	3

0	1	2	3	4
3	4	1	2	0
4	2	3	0	1
2	0	4	1	3
1	3	0	4	2

0	1	2	3	4
2	3	4	0	1
4	0	1	2	3
1	2	3	4	0
3	4	0	1	2

0	1	2	3	4
3	4	0	1	2
1	2	3	4	0
4	0	1	2	3
2	3	4	0	1

- There exist no ODLS of rank 6.
- Up to rank 7, all pairs of ODLS are generated by rows permutation of a single square!
- A permutation of rows generates either ODLS or a non-diagonal square.
- In order to reduce the set of processed squares, the first row is not being permuted, and we work only with normalized DLS.

- ODLS of rank 7 fall into 2 large groups:
 - 8 quartets – sets of 4 mutually orthogonal DLS that are obtained from each other by rows permutation. A rows permutation of any of squares of any of the quartets generates either one of the MODLS of the quartet, or a non-diagonal LS.
 - 112 pairs of ODLS, among which no one square in a pair can be obtained from another square by rows permutation.
- The computations were performed among already normalized DLS and ODLS.

BOINC FAST BOINC project “Rake Search”

- The first results of search for ODLS of rank 7 and 8 are being prepared for publication
- We are preparing additional processing of search results
- The “rake search” application has been written for BOINC using the BOINC API
- The full “rake search” of DLS of rank 9 with the existing application will take ~ 10500 years of CPU Time
- It is possible that the observed “fractal behavior” of DLS and MODLS will allow to reduce the search time by several times
- It is possible that the application will be improved and work faster
- A Desktop Grid computing project “Rake Search” has been created for searching the permutational ODLS of rank 9
- With use of CluBORun utility, the cluster of Karelian Research Center joined the project
- The “Rake Search” BOINC project has been tested on the permutational ODLS of rank 8

- Rake Search project: <http://82.196.66.12:12179/rakesearch/>
- BOINC.Ru portal: <http://www.boinc.ru/>
- Crystal Dream team: https://vk.com/crystal_dream_team
- BOINC community in VK: <https://vk.com/boinc>
- And all our teams in distributed computing projects!

1. Ватутин Э.И., Заикин О.С., Журавлев А.Д., Манзюк М.О., Кочемазов С.Е., Титов В.С. О влиянии порядка заполнения ячеек на темп генерации диагональных латинских квадратов // Информационно-измерительные диагностирующие и управляющие системы (Диагностика – 2016). Курск: изд-во ЮЗГУ, 2016. С. 33–39. [PDF](#)
2. Ватутин Э.И., Титов В.С., Заикин О.С., Кочемазов С.Е., Валяев С.Ю., Журавлев А.Д., Манзюк М.О. Использование грид-систем для подсчета комбинаторных объектов на примере диагональных латинских квадратов порядка 9 // Информационные технологии и математическое моделирование систем 2016. М.: изд-во Центра информационных технологий в проектировании РАН, 2016. С. 154–157. [PDF](#)
3. Заикин О.С., Кочемазов С.Е., Ватутин Э.И., Титов В.С., Валяев С.Ю., Журавлев А.Д., Манзюк М.О. Подсчет числа комбинаторных объектов на примере диагональных латинских квадратов порядка 9 с использованием добровольных распределенных вычислений // Национальный суперкомпьютерный форум. Переславль-Залесский, 2016. [Презентация](#).
- Манзюк М.О., Ватутин Э.И., Кочемазов С.Е., Заикин О.С. Интересные свойства ортогональных диагональных латинских квадратов 7 и 8 порядка // Оптико-электронные приборы и устройства в системах распознавания образов, обработки изображений и символьной информации (Расознавание – 2017). Курск: изд-во ЮЗГУ, 2017. С. 235–237. [PDF](#)

