



HAKUBI RESEARCHERS' **A**CTIVITIES IN ICR

**Hakubi Project: Fosterage and Support of
Young Researchers, Kyoto University**



Research Topic

Algorithmic Graph Theory with Applications to Bioinformatics



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Outline of Research

One of my research topics this year is fast matrix multiplication. Given two square matrices A and B of size $(n \times n)$ with nonnegative integer entries, the naive algorithm for computing the matrix product AB runs in $O(n^3)$ time. There exist algorithms that run in substantially subcubic time, e.g., a very recent one due to F. Le Gall uses $O(n^{2.3728639})$ time, and a major open question in Theoretical Computer Science is whether it can be done in quadratic time. We have developed a new technique based on interpreting matrices as 3D histograms. To multiply A and B , we decompose their 3D histograms into 3D blocks which are then manipulated in a pairwise manner using the interval tree data structure. This leads to an $O^*(n^2 + rs)$ -time algorithm for matrix multiplication, where r and s denote the minimum number of 3D blocks into which A and B can be partitioned, respectively. In other words, whenever A and B admit a partition into a small number of 3D blocks, our algorithm is very efficient.