COMBINATORICS
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First-Fit is Linear on $(r + s)$-free Posets

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Abstract: First-Fit is an online algorithm that partitions the elements of a poset into chains. When presented with a new element x, First-Fit adds x to the first chain whose elements are all comparable to x. In 2004, Pemmaraju, Raman, and Varadarajan introduced the Column Construction Method to prove that when P is an interval order of width w, First-Fit partitions P into at most $10w$ chains. This bound was subsequently improved to $8w$ by Brightwell, Kierstead, and Trotter, and independently by Narayanaswamy and Babu.

The poset $r + s$ is the disjoint union of a chain of size r and a chain of size s. A poset is an interval order if and only if it does not contain $2 + 2$ as an induced subposet. Bosek, Krawczyk, and Szczypka proved that if P is an $(r + r)$-free poset of width w, then First-Fit partitions P into at most $3rw^2$ chains and asked whether the bound can be improved from $O(w^2)$ to $O(w)$. We answer this question in the affirmative. By generalizing the Column Construction Method, we show that if P is an $(r + s)$-free poset of width w, then First-Fit partitions P into at most $8(r - 1)(s - 1)w$ chains.

This is joint work with Gwenaël Joret.

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