D-disjunct matrices with column weight $d + 1$

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Abstract

A binary matrix M is called d-disjunct if any column of M is not covered by the boolean sum of any d other columns. Erdös, Frankl and Füredi shows that if a $t \times n$ d-disjunct matrix M with constant column weight $d+1$ exists then $n \leq t(t-1)/(2d)$. We improve the above bound of n by showing $n \leq \mathrm{Max}(t(t-1)/d(d+1), t-d)$. This inequality is sharp in many pairs (d,t), but is not sharp when $(d,t) = (5,36)$. We construct $t \times n$ d-disjunct matrices with constant column weight $d+1$ for $(d,t,n) = (d,(d+1)m,(d+1)m+1)$, where d is a prime power, and m is an integer satisfying $m = 2d-4$, $m = 2d-3$ or $m \geq 2d-1$. In particular a 5-disjunct matrix of size 36×37 exists.