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On the covering array number of 3-uniform qualitative independence hypergraphs

Covering arrays (CAs) are well-known combinatorial designs that generalize orthogonal arrays and facilitate efficient test suite generation in software testing. For a positive integer n and a set S of size g, a *covering array on a hypergraph* $H = (V, E)$ of size n and alphabet size g, denoted $CA(n, H, g)$, is an $n \times |V|$ array with entries from S, where columns correspond to the vertices in V, such that for every hyperedge $e \in E$ of size m, the sub-array indexed by the vertices of e contains all the ordered m-tuples from S^m at least once, as a row. The smallest n for which such an array exists is the *covering array number of* H, denoted $CAN(H, g)$. This parameter represents the minimal test suite size for practical applications. For a t-uniform hypergraph H and positive integers g and n, a $CA(n, H, g)$ exists if and only if there is a hypergraph homomorphism from H to t-$QI(n, g)$, a distinctive class of hypergraphs called *qualitative independence hypergraphs*. Consequently, for such a hypergraph H, $CAN(H, g) \leq CAN(t\text{-}QI(n, g), g)$. We develop a technique to determine the strong chromatic number using the existence of Latin squares; and the size of the largest 3-cliques of 3-$QI(n, 2)$, using Colbourn's technique of Derivation [1]. These results are then used to establish that $CAN(3\text{-}QI(n, 2), 2) = n$ for some values of n and obtain the covering array number of certain classes of hypergraphs.

This is joint work with Yasmeen Akhtar.

References

[1] C. J. Colbourn, G. Kèri, P. P. Rivas Soriano, and J.-C. Schlage-Puchta, *Covering and radius-covering arrays: constructions and classification*, Discrete Applied Mathematics 158(11), 2010, pp. 1158–1180.