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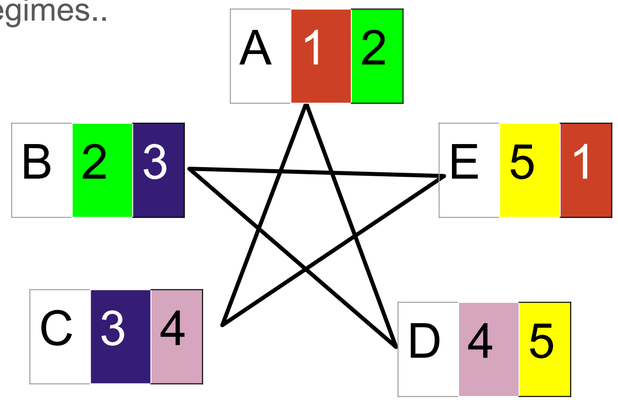
Pliable Index Coding via Conflict-Free Colorings of Hypergraphs

ABSTRACTS

In the pliable index coding (PICOD) problem, a server is to serve multiple clients, each of which possesses a unique subset of the complete message set as side information and requests a new message which it does not have. The goal of the server is to do this using as few transmissions as possible. Here we use a modified hypergraph coloring approach to the PICOD problem. This paper also improves upon known achievability results in PICOD literature, in some parameter regimes..



OBJECTIVE

We define a generalization of the conflict-free coloring called k-fold conflict-free colorings, we show that a k-fold conflict-free coloring of the hypergraph H which represents the given PICOD problem results in a k-vector pliable index code. Thus, the minimum number of colors in any conflict-free coloring, bounds the optimal PICOD length from above

1	0	0	0	0	0	0	0	0	1
0	1	1	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0
0	0	0	0	0	1	1	0	0	0
0	0	0	0	0	0	0	1	1	0

2-fold confict-free Hyper graph coloring (*left*) and corresponding Pliable Index Code's Generator matrix (*above*)

METHOD

The generator matrix **G** (L*mk), for the PICOD problem associated with a k fold hypergraph coloring is as follows:

- ★ Let $C(i) = \{C_{i,1}, \ldots, C_{i,k}\}$ denote the color of the vertex $i \in [m]$
- ★ Consider a standard basis of the L-dimensional vector space over F, denoted by $\{e_1, \ldots, e_L\}$
- ★ For each $i \in [m]$, $j \in [k]$, column $G_{i,j}$ of G is fixed to be $e_{C_{i,j}}$, with columns indexed as: $\{G_{i,j} : i \in [m], j \in [k]\}$. This construction meets a necessary property for PICOD Genererator matrix
- ★ Minimum Length of code (height of G) is upper bounded by chromatic number of hyper-graph coloring

Other contributions by this paper:

- Provides a refined upper bound than the conflict-free chromatic number
- Defines the quantity called local conflict-free chromatic number and tightens the above upper bound

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