Linearization of sparse (incompletely specified) Boolean functions

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Abstract:

Applications of pattern recognition, design of fault tolerant systems and communications have key problems that are naturally described by partially defined (incompletely defined) Boolean functions. Such partially defined functions arising from practical demands usually have a large number of variables and so their direct implementations require complex systems. Thus it is important to have at hand an efficient method to reduce the number of their variables. Here we review a recently developed method to linearly decompose a Boolean function using a transform that can be efficiently implemented as a Galois field deconvolution. We also study the question what are the general bounds for the dimension of the range space for an arbitrary linear transform to reduce a partially defined Boolean function. We derive a new lower bound for the dimension of the range. We show that the transform implementable by Galois field deconvolution asymptotically approaches the bound for an arbitrary linear transform. We also discuss the strength of the derived bound by showing that it implies a well known bound in coding theory.