

Some Applications of Inner Product in Combinatorial Structures

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In this paper we present some combinatorial applications of the inner product of vectors. We show that there is an Hadamard matrix of order $n+1$ if and only if there are $n+1$, ± 1 vectors of length n such that the inner product of every two vectors is negative. Also we generalize a result appeared in [1] and prove that if p is a prime number and n, c are two integers and \mathcal{A}, \mathcal{B} are two collections of subsets of $\{1, \dots, n\}$ such that for any $A \in \mathcal{A}$, and for any $B \in \mathcal{B}$, $|A \cap B| \equiv c \pmod{p}$, then for $c \neq 0$, $|\mathcal{A}||\mathcal{B}| \leq 2^{n-1}$, and for $c = 0$, $|\mathcal{A}||\mathcal{B}| \leq 2^n$.