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BINARY SELF-DUAL CODES OF LENGTH 24

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ABSTRACT. There are 26 distinct indecomposable self-dual codes of length 24 over $GF(2)$, including unique codes of minimum weights 8 and 6, whose groups are, respectively, the Mathieu group M_{24} and the maximal subgroup of index 1771 in M_{24}. For each code we give the order of its group, the number of equivalent codes, and its weight distribution.

1. **Introduction.** An $[n, k]$ code C is a k-dimensional subspace of the vector space of all n-tuples of 0's and 1's with mod 2 addition. The dual code $C^{\perp} = \{u: u \cdot v = 0 \text{ for all } v \in C\}$ is an $[n, n-k]$ code. C is self-orthogonal if $C \subset C^{\perp}$, self-dual if $C = C^{\perp}$. Self-dual codes exist whenever the length n is even. The weight of a vector is the number of its nonzero components, and the minimum weight of C is the minimum weight of any nonzero codeword. The weight distribution of C is the set $\{\alpha_0, \alpha_1, \cdots, \alpha_n\}$, where α_i is the number of codewords of weight i.

The group $\mathcal{G}(C)$ of a code C is the set of all permutations of the coordinates which send C into itself set-wise. Two codes are equivalent if there is a coordinate permutation sending one into the other. The number of codes equivalent to C is $n!/\text{order of } \mathcal{G}(C)$. The direct sum of codes C' and C'', written $C' \oplus C''$, is $\{(u, v): u \in C', v \in C''\}$. If $C = C' \oplus C''$, where C' and C'' are nonzero, then C is decomposable. Otherwise C is indecomposable.

Pless [4] classified all self-dual codes of length $\leqslant 20$, Conway (unpublished) found the 9 self-dual codes of length 24 in which the weight of every codeword is a multiple of 4, and Niemeier [2] found the 24 even unimodular lattices in dimension 24, 9 of which correspond to the codes found by Conway.

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