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UNIQUENESS OF WEIGHTED CODE REPRESENTATIONS, II*

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We define a 4-bit weighted BCD code with weights w_1, w_2, w_3, w_4 to be a set C of ten 4-bit numbers of the form $(b_1 b_2 b_3 b_4)$ ($b_i = 0$ or 1) such that each integer n ($0 \leq n \leq 9$) can be expressed as $n = \sum_{i=1}^4 b_i w_i$ for some $(b_1 b_2 b_3 b_4) \in C$. The w_i are real.

Weeg¹ has exhibited all such codes in case the w_i are restricted to integers with $-9 \leq w_i \leq 9$. The purpose of this letter is to show that w_i 's must be integers. This still leaves the possibility that there are additional codes if the w_i are integers outside the range from -9 to 9 . We note that none of Weeg's codes has a 9 for a w . No doubt the fact that no w can be a 9 can be shown by methods other than Weeg's enumeration method.

Denote the set of all integers by I and the remainder of the real numbers by F . Essentially, the proof uses the triviality that if x_1 is in the subgroup I of the group of real numbers under addition and x_2 is in the complement of I , then $x_1 + x_2$ is in the complement of I . Incidentally, the formalization of this property of a subgroup can be used to ^{define} generalize the notion of a subgroup.

Consider a code C . Suppose one of the w 's, say w_1 , is in F . Since at least one member of C must have $b_1 = 1$, another w , say w_2 , must be in F . Suppose $w_3 \in I$ and $w_4 \in I$. Then for any member of C we must have $b_1 = 0, b_2 = 0$ or $b_1 = 1, b_2 = 1$. This allows only 8 members for C . Thus at least one of w_3 and w_4 , say w_3 , must be in F . Suppose $w_4 \in I$. Then none of the six combinations

* ~~Work done under~~ supported by the Atomic Energy Commission

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(1000), (0100), (0010), (1001), (0101) and (0011) can be in C. If $w_1 + w_2 \in I$, then $(1111) \notin C$ and $(1110) \notin C$. Thus $w_1 + w_2 \in F$. In this case $(1100) \notin C$ and $(1101) \notin C$. Thus $w_4 \in F$. So $w_i \in F$, $i = 1, 2, 3, 4$. In this case none of the 4 combinations (1000), (0100), (0010), (0001) are in C. Suppose $w_1 + w_2 \in I$. Then $(1110) \notin C$ and $(1101) \notin C$. If $w_3 + w_4 \in I$, then $(1011) \notin C$ and $(0111) \notin C$. Thus $w_1 + w_2 \in I$ implies $w_3 + w_4 \in F$. In this case $(0011) \notin C$ and $(1111) \notin C$. So $w_1 + w_2 \in F$. Then $(1100) \notin C$. If $w_3 + w_4 \in I$, then $(1111) \notin C$ and $(0111) \notin C$. So $w_3 + w_4 \in F$. By permutation of the w's and repetition of the argument, we obtain that no sums of pairs of w's are in I. Thus none of (1100), (1010), (1001), (0110), (0101), and (0011) are in C. Thus $w_i \in I$ for $i = 1, 2, 3, 4$.

Note that $1/2, 1/2, 2, 4, 8$ are the w's for a 5-bit weighted BCD code.

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*Received _____.

¹G. P. Weeg, "Uniqueness of Weighted Code Representations", I.R.E. Transactions on Electronic Computers, vol. EC-8, pp. 487-489; Dec. 1960.