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Cardinality of binary operations: a remark on the ubiquitous sum.

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Summary: We establish the sufficient conditions to determine how many binary operations can possibly take place between any two arbitrary elements from a given set, provided that the operation is well defined. If we mark and collect each of such operations in another set S , we call the number P_N the cardinality of the set S of binary operations between any two elements for a given set of N elements. We find that such number P_N is closely related to the sum of consecutive numbers, the Ubiquitous Sum [*S. J. Bezuska and M. Kenney, That ubiquitous sum: Math. Teacher 98, No. 5, 316–321 (2005; ME 2007a.00386)*]. In particular, P_N is simply the combination of selecting from N distinct objects, two at a time. This idea can be generated to look for the cardinality of a set of ternary operations. We have verified that this cardinality is the same as the combination of selecting from N distinct objects, three at a time. The results can be generalized to derive the formulae of factorization, when $T_n = 1^n + 2^n + 3^n + \cdots + N^n, n = 1, 2, 3, \dots$. We also discuss how the formulae are applicable in mathematics pedagogy.

Classification: H20 H40

Keywords: cardinality; binary operations; ubiquitous sum; combination

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