Polynomials from $(0, m, s)$-nets and Walsh functions

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Abstract: We consider the problem of integrating a function f over the unit hypercube of dimension s. In practice, a digital net (a discrete breakdown of the continuous interval) can be cast over the unit hypercube in a way such that performing the integration over this net effectively and accurately estimates the integral. In our present work, we consider the integration of the joint probability density function of distinct points randomly chosen from a scrambled $(0, m, s)$-net and multivariate Walsh functions. This idea expands on the work of Wiart and Lemieux (2019). It allows us to simplify the integral into a discrete, symbolic sum containing the parameters m and s. From there, we are able to construct a certain univariate polynomial which can be used to determine how well the integration performs compared to the more widely used Monte-Carlo and other equidistribution methods. The coefficients of this polynomial conveniently contain hypergeometric series in the parameters. In this talk, we illustrate how to use available symbolic computation machinery to simplify such a polynomial into a nice closed form consisting of beta functions, from which we can draw our desired conclusions.