On a Computer-Aided Decomposition of the Complete Digraph into Orientations of $K_4 - e$ with a Double Edge

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Abstract

Let D be any of the 5 non-symmetric digraphs obtained by orienting the edges of $K_4 - e$ with a double edge (denoted thereafter by $K_4 - e^*2$). We obtain some (K_n^*, D) designs for small values of n where $n < 36$ aided by a C++ program. The C++ program was able to verify nonexistence results as well as construct new (K_n^*, D) designs. It also used a memoization technique, where previous runs were stored and referenced, in order to reduce runtime. Furthermore, we establish necessary and sufficient conditions for the existence of a (K_n^*, D)-design for some of the general constructions using the aforementioned small cases and a "blow-up" construction. Partial results as well as some nonexistence results are established for the remaining digraphs. Future work on this project may be done by developing more of the partial results and improve the code to reduce both memory usage and runtime, possibly by the use of parallel processing.