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Hadamard conjecture

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There exists a Hadamard matrix of order  $n = 4m$ , for all  $m \in \mathbb{Z}^+$ .

A Hadamard matrix of order 428 ( $m=107$ ) has been recently constructed [?].

<http://math.ipm.ac.ir/tayfeh-r/papersandpreprints/h428.pdf> See here.

A Hadamard matrix of order 764 has also recently been constructed [?].

Also, Paley's theorem guarantees that there always exists a Hadamard matrix  $H_n$  when  $n$  is divisible by 4 and of the form  $2^e(p^m + 1)$ , for some positive integers  $e$  and  $m$ , and  $p$  an odd prime and the matrices can be found using Paley construction.

This leaves the order of the lowest unknown Hadamard matrix as 668. There are 13 integers  $m$  less than 500 for which no Hadamard matrix of order  $4m$  is known:

167, 179, 223, 251, 283, 311, 347, 359, 419, 443, 479, 487, 491

and all of them are primes congruent to 3 mod 4.

## References

- [1] H. Kharaghani, B. Tayfeh-Rezaie, *A Hadamard matrix of order 428*, J. Comb. Designs **13**, (2005), 435-440.
- [2] D.Z. Doković, *Hadamard matrices of order 764 exist*, <http://arxiv.org/abs/math/0703312v1> preprint.