

## Problem 5 (due Monday, November 3 )

Two  $n$  by  $n$  matrices  $M, N$  with real entries are called strongly independent if the matrix  $aI + bM + cN$  is invertible for any real numbers  $a, b, c$  which are not all  $0$ .

- a) Show that if  $MN = NM$  then  $M, N$  are not strongly independent.
- b) For any  $n$  which is a multiple of 4 construct two strongly independent matrices of size  $n$ .

(Here  $I$  denotes the identity matrix.)

Three solutions were submitted: by Ashton Keith (Purdue University), Gerald Marchesi, and Alif Miah (a partial solution). For a detailed solution, a generalization of the problem and its connections to some deep results in topology see the following link [Solution](#).

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