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On novel ways to invert a matrix

Given an $n \times n$ matrix M over a (not necessarily commutative) field F and a candidate inverse M', the n^2 equations $M \cdot M' = I$, if solvable, define an inverse for M in $\mathrm{End}_F(F^n)$. For us, it is a small wonder that

(i) the solution is unique, and

(ii) the solution is the same as one would reach in solving the n^2 **different** equations $M' \cdot M = I$.

We are led to the following question: from the $2 \cdot n^2$ equations mentioned above, which choices of n^2 yield a unique solution M'? The case $n = 2$ is already interesting, involving a (reducible) Coxeter group of order eight, a nice lemma of Cohn's on the roots of noncommutative polynomials, ...