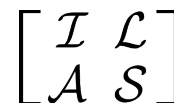


# IMAGE



Serving the International Linear Algebra Community

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**MATHEMATICAL PRELUDE**

**Another Proof of the Two-sidedness of Matrix Inverses**

Oskar Maria Baksalary<sup>1</sup> and Götz Trenkler<sup>2</sup>

Let  $A$  and  $B$  be  $n \times n$  complex matrices and let  $I_n$  denote the identity matrix of order  $n$ . Inspired by [1] and [2], we provide a concise proof of the known fact that when  $AB = I_n$ , then  $BA = I_n$ .

Let  $AB = I_n$  and let  $\text{rk}(\cdot)$  be the rank of a matrix argument. Then  $n = \text{rk}(I_n) = \text{rk}(AB) \leq \text{rk}(A) \leq n$ . Hence  $\text{rk}(A) = n$ . But  $\text{rk}(A) = \text{rk}(A^\dagger A)$ , where  $A^\dagger$  denotes the Moore–Penrose inverse of  $A$ . Since  $A^\dagger A$  is idempotent and an idempotent matrix of full rank necessarily coincides with the identity matrix, we conclude that  $A^\dagger A = I_n$ . On the other hand, the equation  $AB = I_n$  has the solution for  $B$  as  $B = A^\dagger + (I_n - A^\dagger A)Z = A^\dagger$  for some  $n \times n$  complex matrix  $Z$ . In consequence,  $BA = A^\dagger A = I_n$ .

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