

**Question 1.** (2 marks) Determine whether the following statement is true or false. If the statement is false provide a counterexample. If the statement is true provide a proof of the statement.

The sum of two invertible matrices of the same size must be invertible.

**Question 2.** (3 marks) Show that if a square matrix  $A$  satisfies the equation  $A^2 + 2A + I = 0$ , then  $A$  must be invertible. What is the inverse?

**Question 3.** (5 marks) Solve for  $X$  given that it satisfies

$$(2A + X^T)^{-1} = I$$

where

$$A = \begin{bmatrix} 1 & 3 \\ 1 & 2 \end{bmatrix}$$