1. Answer each of the following statements with "true" or "false."

   (a) If A and B are invertible $n \times n$ matrices, then AB is invertible and
   $$(AB)^{-1} = A^{-1}B^{-1}.$$
   False, $(AB)^{-}1 = B^{-1}A^{-1}$. Any two invertible matrices which do not commute will provide a counterexample.

   (b) If A and B are invertible $n \times n$ matrices, then $A + B$ is invertible as well.
   False. Consider $I + (-I) = 0$.

   (c) Any line through the origin in $\mathbb{R}^3$ is equal to Span$\{\mathbf{u}\}$ for some nonzero $\mathbf{u} \in \mathbb{R}^3$.
   True.

2. Find the inverse of the following matrix.
$$A = \begin{pmatrix} 1 & -1 & 2 \\ 0 & -1 & 1 \\ 2 & 0 & 1 \end{pmatrix}$$

   The inverse can be obtained by row reduction.
$$\begin{pmatrix} 1 & -1 & 2 & 1 & 0 & 0 \\ 0 & -1 & 1 & 0 & 1 & 0 \\ 2 & 0 & 1 & 0 & 0 & 1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & -1 & 2 & 1 & 0 & 0 \\ 0 & 1 & -1 & 0 & -1 & 0 \\ 2 & 0 & 1 & 0 & 0 & 1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & 0 & 1 & 1 & -1 & 0 \\ 0 & 1 & -1 & 0 & -1 & 0 \\ 2 & 0 & 1 & 0 & 0 & 1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & 0 & 1 & 1 & -1 & 0 \\ 0 & 1 & -1 & 0 & -1 & 0 \\ 0 & 0 & -1 & -2 & 2 & 1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & 0 & 1 & 1 & -1 & 0 \\ 0 & 1 & -1 & 0 & -1 & 0 \\ 0 & 0 & 1 & 2 & -2 & -1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & 0 & 1 & 1 & -1 & 0 \\ 0 & 1 & 0 & 2 & -3 & -1 \\ 0 & 0 & 1 & 2 & -2 & -1 \end{pmatrix}$$
$$\begin{pmatrix} 1 & 0 & 0 & -1 & 1 & 1 \\ 0 & 1 & 0 & 2 & -3 & -1 \\ 0 & 0 & 1 & 2 & -2 & -1 \end{pmatrix}$$

   Therefore $A^{-1} = \begin{pmatrix} -1 & 1 & 1 \\ 2 & -3 & -1 \\ 2 & -2 & -1 \end{pmatrix}$.