Consider the matrices

\[
A = \begin{bmatrix}
1 & 2 & -3 & 1 \\
2 & -1 & 4 & 0 \\
1 & 0 & 3 & -2 \\
\end{bmatrix}, \quad B = \begin{bmatrix}
2 & 3 & 2 \\
4 & 1 & 0 \\
\end{bmatrix} \quad \text{and} \quad C = \begin{bmatrix}
5 & 2 \\
7 & 3 \\
\end{bmatrix}
\]

1. (5 pts) Which of the products \(AB\), \(BA\), \(AC\), \(CA\), \(BC\) and \(CB\) are defined? Compute the one(s) that is/are.

*The products \(AB\), \(AC\), \(BC\) and \(CA\) are not defined (wrong dimensions).*

\[
BA = \begin{bmatrix}
2 & 3 & 2 \\
4 & 1 & 0 \\
\end{bmatrix} \begin{bmatrix}
1 & 2 & -3 & 1 \\
2 & -1 & 4 & 0 \\
1 & 0 & 3 & -2 \\
\end{bmatrix} = \begin{bmatrix}
10 & 1 & 12 & -2 \\
6 & 7 & -8 & 4 \\
\end{bmatrix}
\]

\[
CB = \begin{bmatrix}
5 & 2 \\
7 & 3 \\
\end{bmatrix} \begin{bmatrix}
2 & 3 & 2 \\
4 & 1 & 0 \\
\end{bmatrix} = \begin{bmatrix}
18 & 17 & 10 \\
26 & 24 & 14 \\
\end{bmatrix}
\]

2. (3 pts) Is the matrix \(C\) invertible? If it is, find its inverse. If not, explain why not.
$C$ is invertible:

\[
C^{-1} = \begin{bmatrix} 5 & 2 \\ 7 & 3 \end{bmatrix}^{-1} = \frac{1}{15 - 14} \begin{bmatrix} 3 & -2 \\ -7 & 5 \end{bmatrix} = \begin{bmatrix} 3 & -2 \\ -7 & 5 \end{bmatrix}
\]

3. (2 pts) Express the linear system below as a matrix equation.

\[
\begin{align*}
3x_1 + 2x_2 + x_3 &= 5 \\
x_1 - 2x_2 + 4x_3 &= 7 \\
2x_1 - 3x_3 &= 1
\end{align*}
\]

\[
\Rightarrow \begin{bmatrix} 3 & 2 & 1 \\ 1 & -2 & 4 \\ 2 & 0 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 7 \\ 1 \end{bmatrix}
\]