Putting vertical lines all the way down the columns is as easy as pie. Just *array* to make the matrix and insert a vertical bar between the columns where you want a vertical bar. Note that this is exactly like if you were using a tabular environment. For example

```
$$
 \bigg[\begin{array}{c|c|c|c}
A &Ab &\cdots &A^{n-1}b
\end{array}\bigg]
$$
```

$$
\left[\begin{array}{c|c|c|c} A & Ab & \cdots & A^{n-1}b \end{array}\right]
$$

```
$$
 \left[\begin{array}{cccc|c}
a_{11}&a_{12}&\cdots &a_{1n}&b_1\\
a_{21}&a_{22}&\cdots &a_{2n}&b_2\\
\vdots & &\ddots &\vdots *\vdots\\
a_{n1}&a_{n2}&\cdots &a_{nn}&b_n\\
\end{array}\right]
$$
```

$$
\left[\begin{array}{cccc|c}
a_{11} & a_{12} & \cdots & a_{1n} & b_1 \\
a_{21} & a_{22} & \cdots & a_{2n} & b_2 \\
\vdots & & \ddots & \vdots & \vdots \\
a_{n1} & a_{n2} & \cdots & a_{nn} & b_n
\end{array}\right]
$$

Putting in a horizontal line that spans the whole matrix is no harder. In fact it is exactly the same as it is for a tabular – just insert an `\hline` after the *double backslash*.

```
$$
C=\left[
\begin{array}{cc}
A  &\tempb \\ \hline
 C &\tempd
\end{array}\right]
$$
```

$$
C = \left[\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right]
$$

But suppose you only want to span a few columns. The you need to learn `\cline{n-m}` which puts a horizontal line from column n to m In this example I have also introduced the use of *multicolumn* to just put a vertical bar between two columns in one row. This is the hardest thing.

```
$$
\newcommand*{\tempb}{\multicolumn{1}{|c}{B}}
P=\left[
\begin{array}{ccc}
A &A &\tempb \\ \cline{1-2}
 C &C &D
\end{array}\right]
$$
```

$$
P = \left[\begin{array}{cc|c} A & A & B \\ \cline{1-2} C & C & D \end{array}\right]
$$

```
\renewcommand{\arraystretch}{2}
$$\newcommand*{\temp}{\multicolumn{1}{r|}{}}
A=\left[\begin{array}{cccccc}
1 &2 &3 &\temp & 7& 6\\ \cline{1-6}
2 &4& 6&\temp &5& 4\\
\end{array}\right]
$$
```

$$
A = \left[\begin{array}{ccc|cc}
1 & 2 & 3 & 7 & 6 \\ \hline
2 & 4 & 6 & 5 & 4
\end{array}\right]
$$

```
$$\newcommand*{\temp}{\multicolumn{1}{c|}{0}}
B=\left[\begin{array}{cccccc}
    1 &0 &\ast  & 0 &\ast   &\ast \\ \cline{1-1}
\temp & 1&\ast  & 0 &\ast   &\ast  \\ \cline{2-3}
    0 &0 &\temp & 1 &\ast   &\ast  \\ \cline{4-6}
    0 & 0&      0&  0& 0&0
\end{array}\right]
$$
```

$$
B = \begin{bmatrix}
1 & 0 & * & 0 & * & * \\
0 & 1 & * & 0 & * & * \\
0 & 0 & 0 & 1 & * & * \\
0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
$$

One final tool for doing this kind of block structure is the *hhline* package which must be requested in the preamble with \usepackage{hhline}. The manual is included with this lesson.

```
\setlength{\arrayrulewidth}{.5pt}
$$
G=\left[
\begin{array}{c|c}
A   &B\\  \hhline{-|~}
 C &D \\ \hhline{~|~}
\end{array}\right]
$$
```

$$
G = \left[\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right]
$$

```
\setlength{\arrayrulewidth}{.6pt}
$$
F=\left[\begin{array}{cc}
2 & 0    \\ \cline{2-2}  %\hhline{~|-}
 \temp & \begin{array}{cc}
A   &B\\
 C &D \\
\end{array}  \end{array}\right]
$$
```

$$
F = \begin{bmatrix} 2 & 0 \\ 0 & \begin{array}{cc} A & B \\ C & D \end{array} \end{bmatrix}
$$

PROBLEM:

Give LATEXsyntax to build the matrix $\qquad F = \left[\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right]$