Consider the problem

\[ \bar{u}_t + A\bar{u}_x = 0 \]

where \( \bar{u} = \begin{pmatrix} u \\ v \end{pmatrix} \) and \( A \) is the matrix \( \begin{pmatrix} 4 & 5 \\ 2 & 3 \end{pmatrix} \). The domain is \( 0 < x < 5 \) and \( 0 < t < 1 \) with \( dx = .01 \) and \( dt = .0001 \). Boundary conditions and initial conditions for \( u \) and \( v \) are

\[
\begin{align*}
u(0, t) &= 0 \\
v(0, t) &= 0 \\
u(x, 0) &= \exp \left(-20(x - 1)^2\right) \\
v(x, 0) &= 2\exp \left(-20(x - 3)^2\right)
\end{align*}
\]

Use the linear system form of Lax-Wendroff (option 2 in 3Bc1). Recall the notation discussed in class. Run the code twice. The first time is for your benefit, to see how the waves evolve. Do not use ‘hold on’ the first time through. Plot the initial conditions and the solutions at 5% intervals (\( np = (nmax - 1)/20 \)) using the commands

```matlab
if (mod(n, np)===0)
    plot(x,u(:,2),':k',x,v(:,2),'r')
    legend('u','v')
    axis([0 5 -2 2])
    pause
end
```

The pause will allow you to see the interaction and propagation of the waves. Notice particularly that each wave is composed of 2 traveling waves (with speeds equal to the eigenvalues of \( A \), which happen to be about 6.7 and 0.3). With the pause statement, you should see how the initial conditions are spread to each component \( u \) and \( v \), and you should see a fast component and a slow component in each. Don’t print anything here, just enjoy the show.

The second run of the code is for my benefit. Here, use hold on when you plot the initial conditions, so that all the plots are superposed. This view is hard to interpret, but I can see at a glance if your code is correct. Print the final plot and submit a copy of your code.