For Monday (11/13):

Hand in: Exercise 5.43 using LU factorization.
Read: Sections 5.25,26.
Consider: Exercise 5.47, but only 3 intervals.

For Wednesday (11/15):

Hand in: Exercise 5.47.
Read: Sections 7.1-3.
Consider: Show that the classification of a second-order linear PDE is invariant under a coordinate transformation.
Classify the following PDEs:
\[
\frac{\partial^2 u}{\partial x^2} + 4 \frac{\partial^2 u}{\partial y^2} - u = 0,
\]
\[
\frac{\partial^2 u}{\partial x^2} - 4 \frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} + u = 0,
\]
and
\[
\frac{\partial^2 u}{\partial x^2} - x \frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial u}{\partial x} = 0.
\]

For Friday (11/17):

Hand in: Project #5 and
Classify the following partial differential equations as elliptic, parabolic or hyperbolic. If the classification depends on the values of the independent variables \(x\) and \(y\), give the classification for each different region in the \(x-y\) plane.

a. \[
\frac{\partial^2 u}{\partial x^2} + 2 \frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial u}{\partial x} = 0
\]
b. \[
x \frac{\partial^2 u}{\partial x^2} + y \frac{\partial^2 u}{\partial y^2} + x^2 \frac{\partial u}{\partial y} = 0
\]
c. \[
2 \cos x \frac{\partial^2 u}{\partial x^2} + 2 \frac{\partial^2 u}{\partial x \partial y} + \cos x \frac{\partial^2 u}{\partial y^2} + \sin x \left( \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} \right) = 0
\]
Read: Sections 7.4,5.
Consider: Apply the forward difference method to find the solution of the following problem
\[
\frac{\partial^2 u}{\partial t^2} - \frac{1}{4} \frac{\partial^2 u}{\partial x^2} = 0, \quad u(x,0) = 0, \quad \frac{\partial u}{\partial t}(x,0) = \sin 2\pi x, \quad u(0,t) = 0, \quad u(1,t) = 0.
\]
Use \(h = 0.25\) and \(\Delta t = 0.5\) to integrate out to a “time” of 1.0.

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Project #6 (due: 12/1):

The nonlinear piano wire problem: Exercises 5.38 (shooting method) and 5.39 (finite-difference method). Extract the fundamental frequency and the shape of the wire in both cases. Be sure to compare results and estimate the accuracy for each method, and to compare with the solution for the linear string.