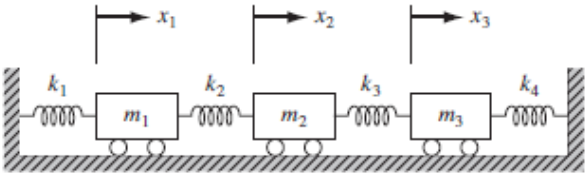
Queens College, CUNY
Physics Department
Physics 275/661 – Scientific Computing
Spring 2023 – Dr. David Goldberg

# FINAL PROJECT

## Coupled-Oscillators: Three Mass System

- Analyze a linearly-coupled system of three masses as shown in the figure. Suppose all the masses are equal and $k_1 = k_4 = k$ and $k_2 = k_3 = \kappa$. Write a system of equations of motion and use the semi-implicit Euler method to numerically solve.




- (Grad students) Solve the system analytically. Describe the normal modes of the system.
- Consider the weakly-coupled case where $\kappa \ll k$ as well as where $\kappa = k$.
- Create a simulation that shows the positions of the three masses (with lines connecting them as springs) as a function of time. Also plot the energies (kinetic, potential and total) as a function of time.
- (Grad students) Describe the normal-modes of the system?

## 2D Heat Equation

- Create a simulation that solves the 2D Heat Equation for the Dirichlet Boundary Condition (BC) and the Neumann BC.
- This should be done on a square or rectangular grid where $\Delta x = \Delta y$. Use simple shapes for initial temperature profiles.

## 1D Wave Equation

- Create a simulation that solves the 1D Wave Equation for the Dirichlet Boundary Condition, and Neumann BC. Grad students also consider the Absorbing BC.
- Consider cases with zero and non-zero initial velocity.

## 2D Laplace Equation

- Create a simulation that solves the 2D Laplace Equation on an equally space, square or rectangular grid using the iterative technique.
- Consider cases of different boundary conditions. Be sure that the values at the boundary are continuous.