# AMCS 390 Fall 2017 Homework 5

Come prepared to present your solutions on Monday, September 18th.

1. Consider the centered, 4th-order finite-difference semi-discretization of the heat equation (using $u_{i-2}$ through $u_{i+2}$; you can look it up or work out the coefficients yourself). Is this semi-discretization positive?

   Implement the method (either directly via finite differences or using the FFT) and test it for $0 \leq x \leq 1$ with homogeneous dirichlet boundary conditions and the following initial conditions:

   (a)

   $$x = 1 + \sin(\pi x)$$

   (b)

   $$x = \begin{cases} 1 & x < 1/2 \\ 0 & x > 1/2 \end{cases}$$

   (c)

   $$x = 1/2 - |1/2 - x|$$

2. Prove that no 2nd-order finite difference semi-discretization for the advection equation is positive. This is mostly done for you in H&W, but you will need to understand it, write it in your own terms, and fill in the details.