

## Problem Set 6

(Out Wed 11/20/2019, Due Wed 12/04/2019)

This is a half problem set.

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**Problem 11**

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Consider the steady-state convection-diffusion equation

$$-\varepsilon u_{xx} + u_x = 1$$

in  $] -1, 1[$  with  $u(-1) = 0 = u(1)$ .

- (1) Write a spectral code based on Chebyshev points that approximates the solution. Test your code for  $\varepsilon \in \{10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}\}$ , and show for each value of  $\varepsilon$  the error convergence. Give sufficient attention to small numbers of grid points, and explain the observed error behavior as the resolution increases.
- (2) Design a scheme for this problem that is spectrally accurate, and works with a small number of grid points even for  $\varepsilon \leq 10^{-5}$ .