MTH 452-552/Winter 2013, Assignment 2, due Monday, 1/21
All students solve all problems.

1. (MATLAB) Wse the difference formulas $D_- f, D_0 f, \tilde{D}_+ f$, where the latter is the one-sided second-order accurate formula discussed in class, to approximate the derivative of $f(x) = \cos(x)$ at $x = .5$. Use h ranging from $1E-1$ down to $1e-12$ (step by the factor of $1/10$). Compare the approximation with the exact value. Discuss behavior of the error (confirm theoretical order of convergence and reveal instability which occurs for very small h). (Use `loglog` plot).

2. (MATLAB) Consider the IVP
   $f(u,t) = \lambda u + sin(t)$, $y(0) = 1$ for $0 \leq t \leq 10$.
   i) Implement FE and BE methods for this problem.
   ii) Plot the exact solution and the approximate solutions obtained with FE, BE with $h = 0.1$ and $h = 0.2$, when $\lambda = -5$. Discuss the behavior of the error from the plot.
   iii) Find the global error for each h by taking $e_h := \max_n\{|U^n - u(t_n)|\}$. Consider $h = 0.1, 0.01, 0.001$. Does the error behave as predicted by theory ? Compare how fast/slow the algorithm runs for various values of h.

3. (EXTRA) Solve 1.1 from text.