MATH 578 - PSET #2

Due Thursday November 24^{th} 2011.

1. DIFFERENTIATION

1.1. **One-dimension.** For each of the following methods and each of the following functions, produce a convergence plot to assess the order of the method. Report the observed order (asymptotic slope of the error in loglog) in a comprehensive table including the expected order. All derivatives should be evaluated at the origin. Explain your results for the cases with discrepancies.

Methods.

(1) Centered finite difference for u_x (second order)

(2) Centered finite difference for u_x (fourth order)

(3) Compact finite difference for u_x (sixth order) (cf. Lele's paper)

Functions.

- (1) $u(x) = \sin(x)$
- (2) u(x) = x
- (3) $u(x) = x^2$
- (4) $u(x) = x^6$

1.2. **Two-dimension.** Divise using the Vandermonde matrix technique a second order approximation to u_{xy} and produce a convergence plot for each of the following functions to assess the order of the method. Report the observed order (asymptotic slope of of the error in loglog) in a comprehensive table. All derivatives should be evaluated at the origin. Explain your results for the cases with discrepancies.

Functions.

(1)
$$u(x,y) = \sin(x)\cos(y)$$

(2) $u(x,y) = x^2 y^4$
(3) $u(x,y) = \begin{cases} \frac{xy(x^2-y^2)}{x^2+y^2} & , (x,y) \neq (0,0) \\ 0 & , (x,y) = (0,0) \end{cases}$

2. PROJECT PROGRESS REPORT

Write a few paragraphs addressing:

- (1) progress made so far
- (2) time line to complete the project (including remaining tasks)