Math 128a, Chorin, Spring 2013, computer homework 4

1. Use the centered scheme $u_{i+1} = u_{i-1} + 2hf(x_i, u_i)$ to solve the equations (i)$y' = -y$ and (ii)$y' = y$ for $0 \leq x \leq 3$ with $y(0) = 1$. To start the recursion you need a value for u_1, get it from Euler's scheme. Use $h = 0.025$. In each case, plot the relative error $(u_i - y(x))/y(x)$, where $ih = x$ (you can do it because you know $y(x)$). In the case (i), do another run with $h = 0.025/3$. Use this second run to attempt an extrapolation to $O(h^4)$. Comment on what you see.

2. The scheme $u_{i+1} = -1.5u_i + 3u_{i-1} - 0.5u_{i-2} + 3hf(x_i, u_i)$ has a truncation error $O(h^3)$ (see theory homework). Try to use it to solve $y' = -y$, $y(0) = 1$ in $0 \leq x \leq 3$, and comment on what you see.