IAM 950 HW1: Numerical simulation of nonlinear PDEs

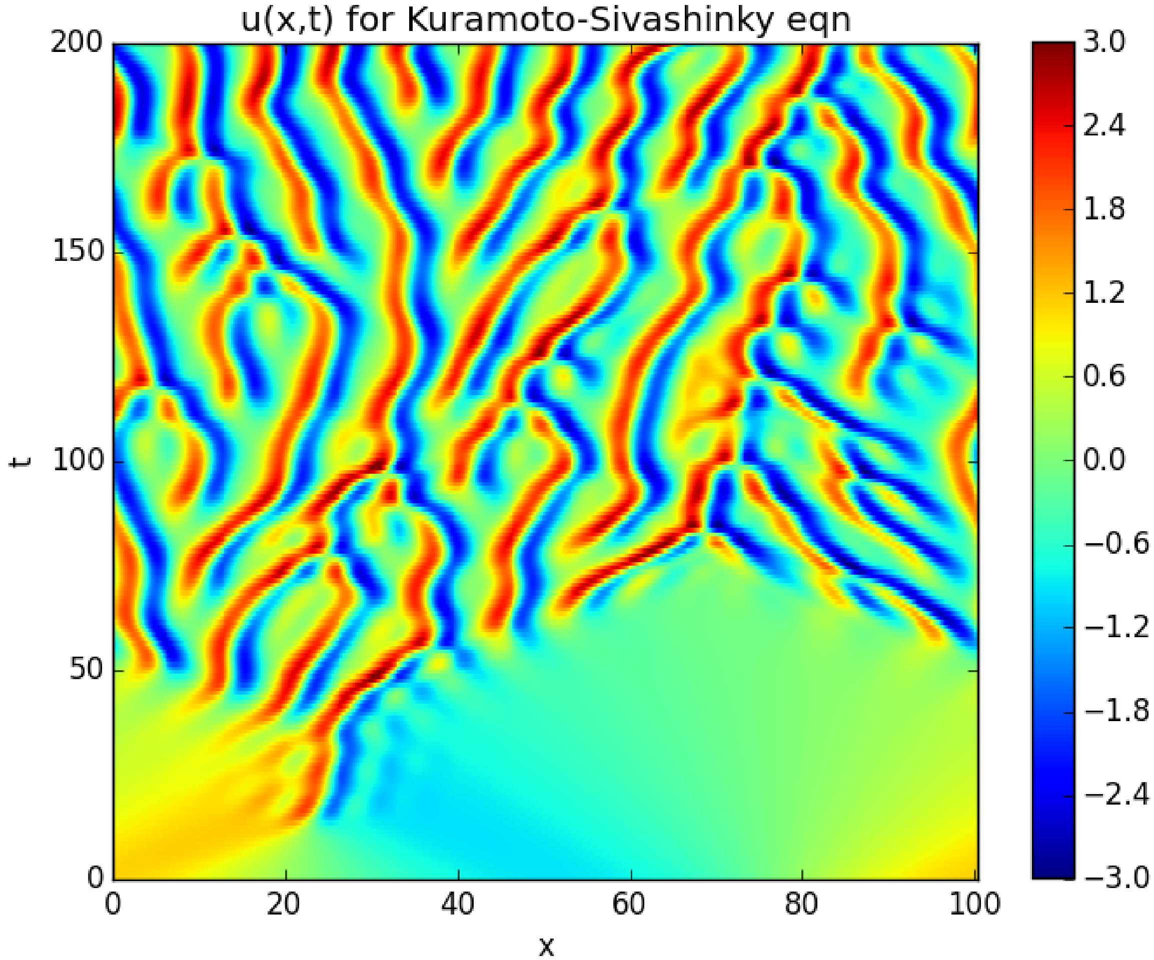
Due Tuesday March 1, 2016. Do the homework by modifying this Julia notebook file. Your complete homework should have Julia code in code cells followed by plots that illustrate correct working behavior of the code. Submit the homework as a Julia notebook file to me via email or Canvas.

Problem 1.

Write a numerical simulation algorithm for the Kuramoto-Sivashinksy equation $u_t = -u_{xx} - u_{xxxx} - uu_x$ on a periodic spatial domain $x \in [0, L]$ with periodic boundary conditions, using Fourier discretization in space and Crank-Nicolson/Adams-Bashforth semi-inplicit temporal discretization. Use the initial condition $u(x, 0) = \cos(ax) + 0.01\cos(2ax)$ where $a = 2\pi/L$, parameter values $r = 0.2, L_x = 100, N_x = 256$, and $\Delta t = 1/16$, and integrate from $t = 0$ to $t = 100$.

Make a colorplot of $u(x, t)$ in the x, t plane, using every x gridpoint but plotting t at a larger interval than Δt, perhaps at intervals of 1/2 or 1. It should look just like the plot below.

In [1]:



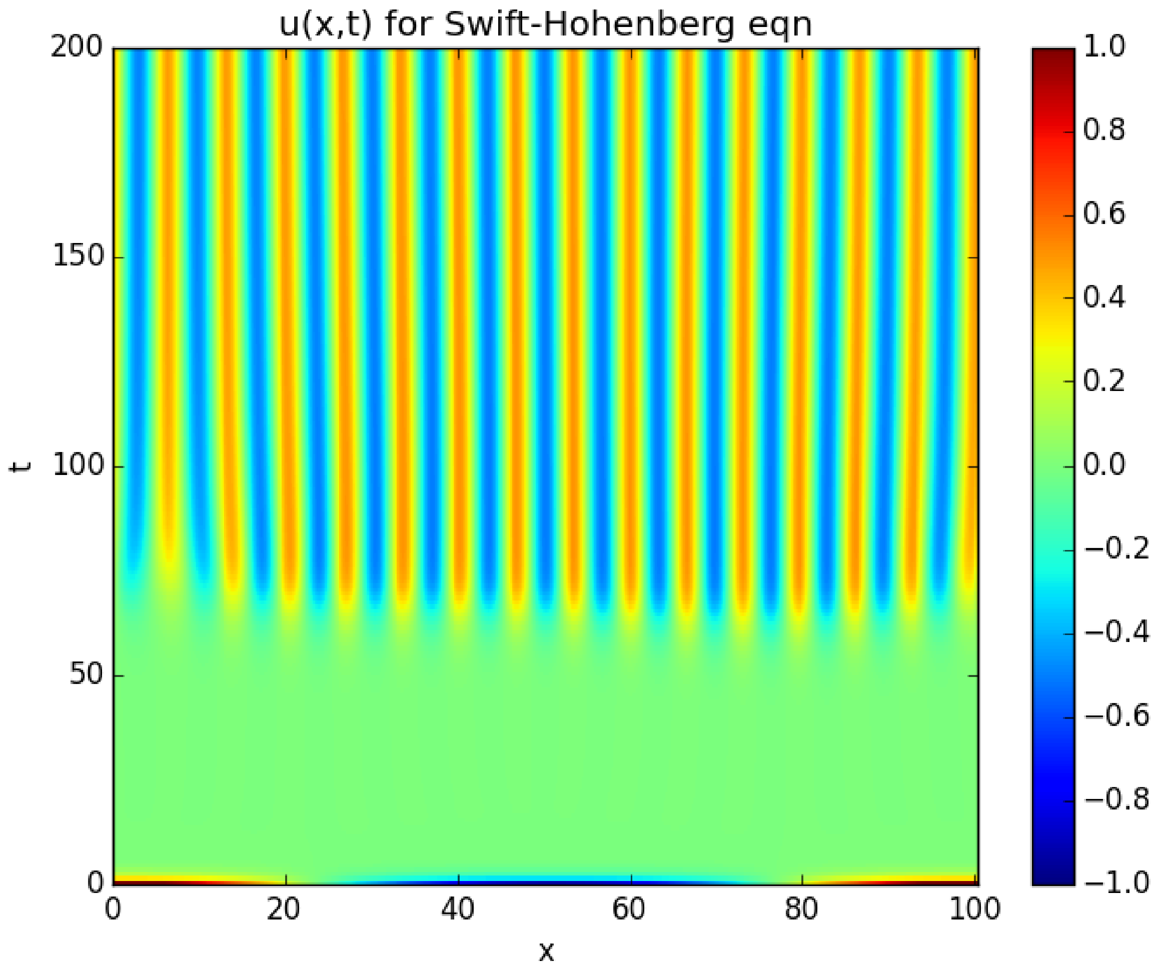

```
Out[1]: PyObject <matplotlib.colorbar.Colorbar instance at 0x7f2301648710
        >

        /home/gibson/.julia/v0.4/Conda/deps/usr/lib/python2.7/site-packag
        es/matplotlib/collections.py:590: FutureWarning: elementwise comp
        arison failed; returning scalar instead, but in the future will p
        erform elementwise comparison
          if self._edgecolors == str('face'):
```

Problem 2.

Revise your code from above to simulate the Swift-Hohenberg equation $u_t = (r-1)u - 2u_{xx} - u_{xxxx} - u^3$ on a periodic spatial domain $x \in [0, L]$ with periodic boundary conditions, at parameter value $r = 0.2$. Use the same discretization methods, parameters, and initial condition as in problem 1, and make the same plot.

In [3]:



Out[3]: PyObject <matplotlib.colorbar.Colorbar instance at 0x7f22febc5b00
>

In [ ]: