# Assignment 1

Henry Mauricio Ortiz Osorio

March 2, 2015

1. (i) Simulate the standard map dynamics taking 100 iterates for each initial condition. Try with different initial conditions.

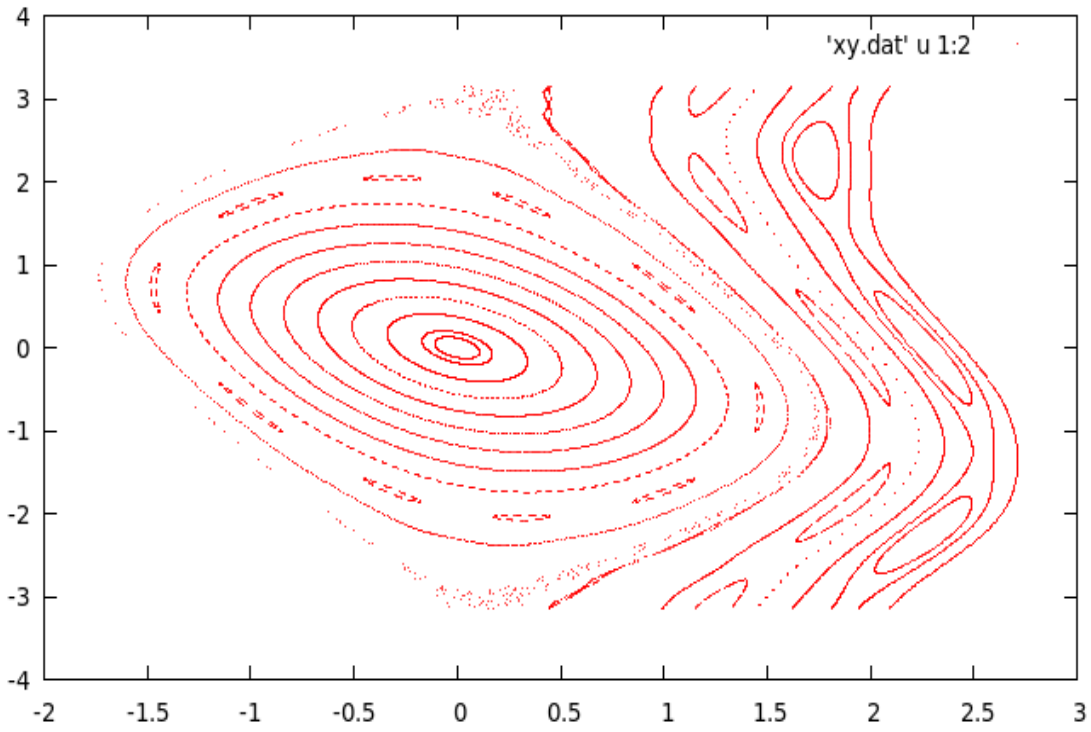


Figure 1: X vs Y, handmade plot

(ii) Modify the code such that the program takes NP initial conditions

on the X axis i.e. (x,0) with x between xmin and xmax.

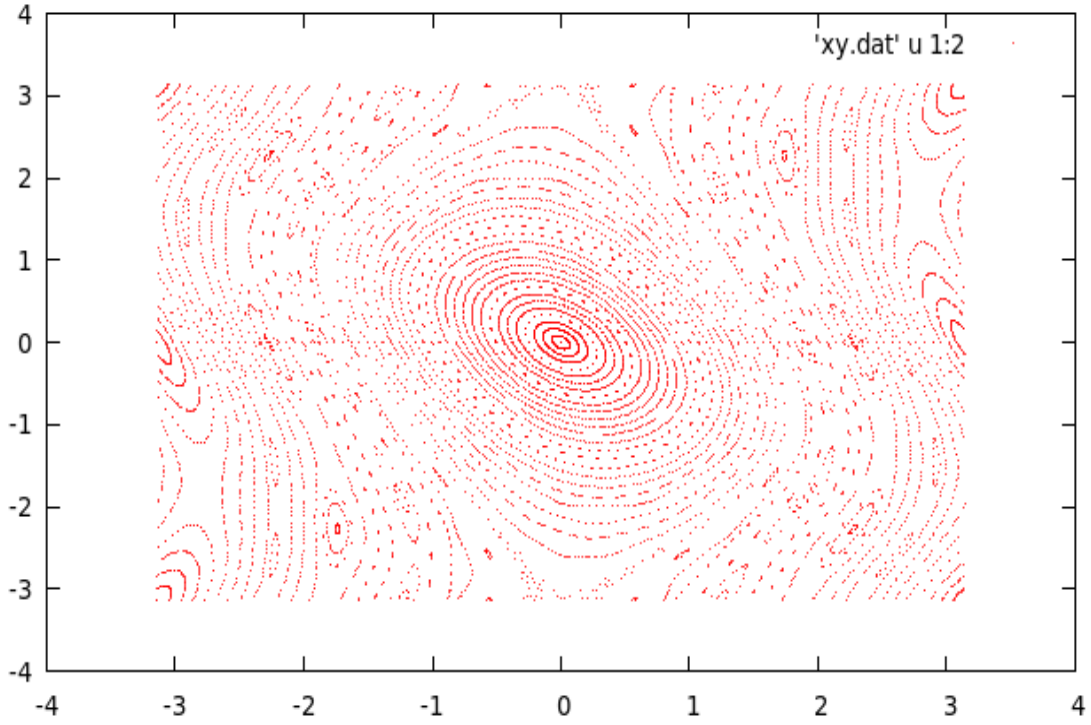


Figure 2: X vs Y

2. Find exact initial condition of a 2-periodic point.

$$\text{for } (x, y) = (-\pi, 0) \text{ and } (\pi, 0)$$

3. Find approxiamte initial condition of a 3-periodic point.

$$\text{for } (x, y) = (2.3, 0)$$

4. Find approxiamte initial condition of a 6-periodic point.

$$\text{for } (x, y) = (1.8, 0)$$

5. Make some comments on the dynamics you see on the plot.

Around to the first center of the graphic $(0, 0)$ we can see a periodic ellipses, this periodic ellipses are broken by a chaos state from, more or less, the points $\pi$ and $-\pi$, for $Y = 0$ we have also 3 fixed points.
After the chaos state (in the x axis) we can see some periodic behavior, there is some small ellipses in three different points,this is the so called 3-periodic point.

6. Code

```
      implicit real *8 (a-h,o-z)
      dpi=8.d0*datan(1.d0)
      pi=dpi/2.d0
      open(10,file='xy.dat',status='unknown')
      a=-0.7d0
      niter=100

      write(*,*)'number of points'
      read(*,*)np
      dx=dpi/np
      do 10 i=1,np
      x=-pi+(i-1)*dx
      y=0.d0

*  2
*           write(*,*)'number of iterates (if 0,stop)'
*           read(*,*)niter
*           if(niter.eq.0)stop
*           write(*,*)'initial condition x,y in (-pi,pi)'
*           read(*,*)x,y
            write(10,*)x,y
            n=0
   1             x1=x+a*dsin(x+y)
              y1=x+y
```

```
              x1=dmod(x1,dpi)
              y1=dmod(y1,dpi)
              if(x1.lt.-pi) x1= x1+dpi
              if(y1.lt.-pi) y1= y1+dpi
              if(x1.gt.pi) x1= x1-dpi
              if(y1.gt.pi) y1= y1-dpi
*             to see the numbers on the screen
*             write(*,*)x,y
              write(10,*)x1,y1
              n=n+1
              x=x1
              y=y1

       if(n.ge.niter)go to 10
       go to 1
 10    continue
       end
```

7. Optional assignment.

Done with Nitin, here we tried to compute the rotation with the *tan* of the modulus of each point.

```
       implicit real *8 (a-h,o-z)
       dpi=8.d0*datan(1.d0)
       pi=dpi/2.d0
       open(10,file='xy.dat',status='unknown')
       a=-0.7d0
       niter=100

       write(*,*)'number of points'
       read(*,*)np
       dx=dpi/np
       do 10 i=1,np
       x=-pi+(i-1)*dx
       y=0.d0

*  2
```

```
*           write(*,*)'number of iterates (if 0,stop)'
*           read(*,*)niter
*           if(niter.eq.0)stop
*           write(*,*)'initial condition x,y in (-pi,pi)'
*           read(*,*)x,y
            write(10,*)x,y
            n=0
   1             x1=x+a*dsin(x+y)
             y1=x+y
             x1=dmod(x1,dpi)
             y1=dmod(y1,dpi)
             if(x1.lt.-pi) x1= x1+dpi
             if(y1.lt.-pi) y1= y1+dpi
             if(x1.gt.pi) x1= x1-dpi
             if(y1.gt.pi) y1= y1-dpi
*            to see the numbers on the screen
*            write(*,*)x,y
*             write(10,*)x1,y1
             phi=dtan(dmod(x1-x)/dmod(y1-y))
             do 10 i=1,np
             phia=sum(phi(i))/np
             end do
             n=n+1
             x=x1
             y=y1
             write(10,*)x1,phia
            if(n.ge.niter)go to 10
    10          continue

            go to 1
            end
```