#10.1.3 HW#09 Blake Cole p1

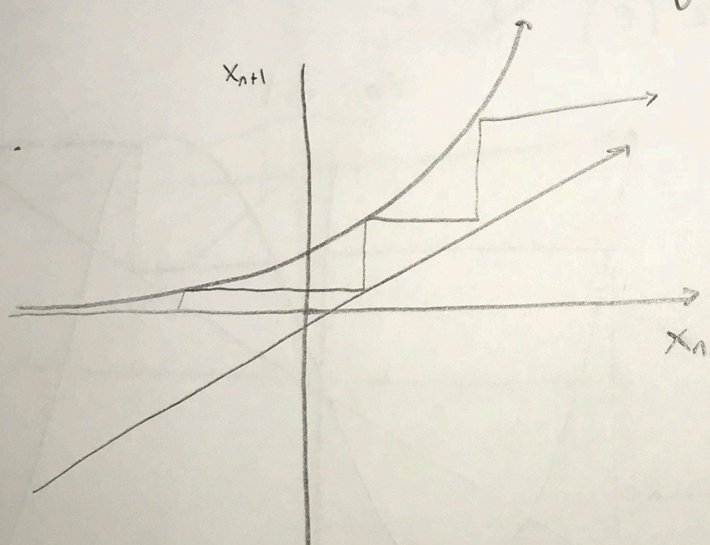
$x_{n+1} = e^{x_n} \geq 0$

lowest possible value $e^{-\infty} = 0 = x_{n+1} \to e^0 = 1 \to e^1 = e \to e^e$

this function continuously grows exponentially from a minimum value of zero.

Fixed points occur when: $x_n = x_{n+1} = e^x$

which is not true for all values of x_n so there are no fixed points and unstable trajectories only



#10.1.11 HW'09 Blake Cole

P2

$x_{n+1} = 3x_n - x_n^3$

fixed point: $x_n = 3x_n - x^3$

$1 = 3 - x^2$

$x_n = \pm\sqrt{2}, 0$

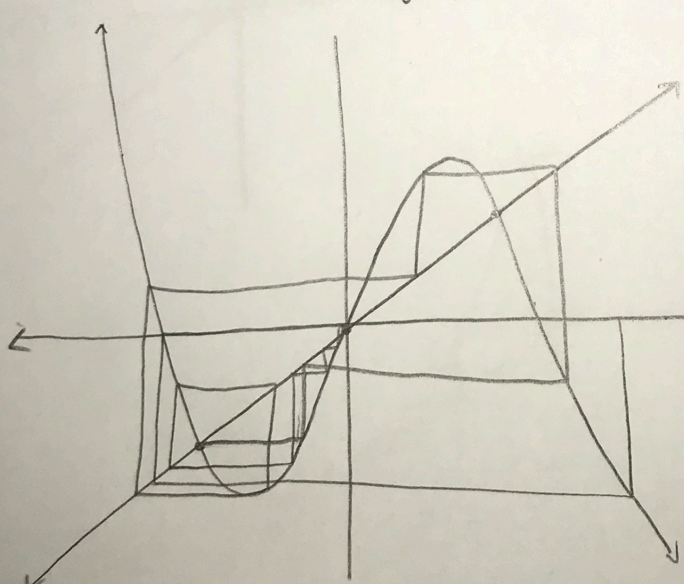
$f'(x_n) = 3 - 3x^2$

$f'(\sqrt{2}) = 3 - 6 = -3$

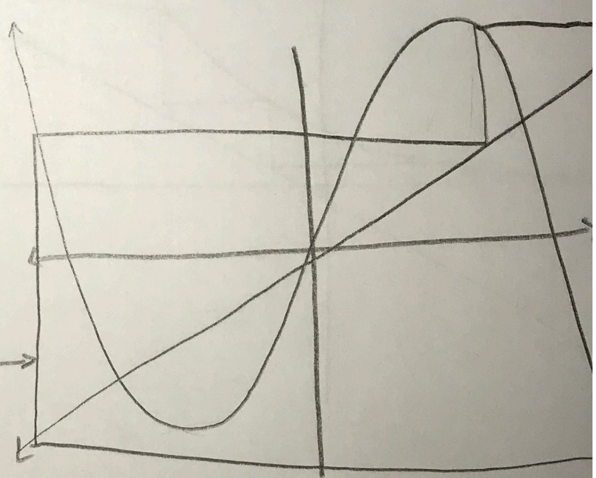
$|-3| > 1$ unstable $(\pm\sqrt{2})$

$f'(0) = 3 - 0 = 3 > 1$ unstable (0)

$x_0 = 1.9$



$x_0 = 2.1$



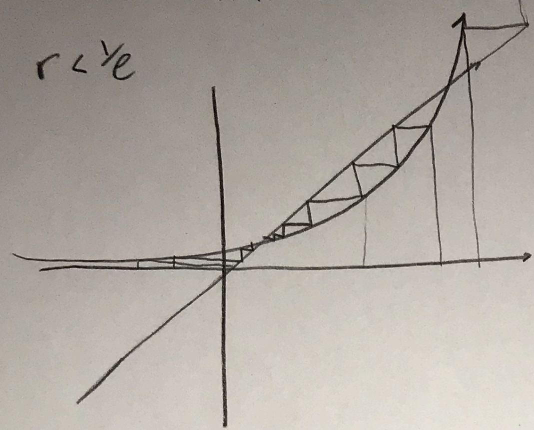
Starting above $x_0 = 2$, the trajectory falls outside the bounded region, seen for $x_0 = 1.9$, which gets caught in bounded orbits

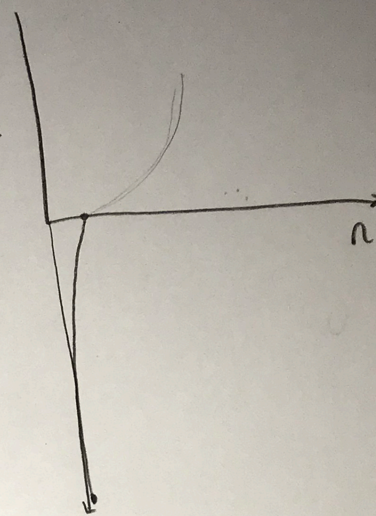
10.4.1

BC
p3

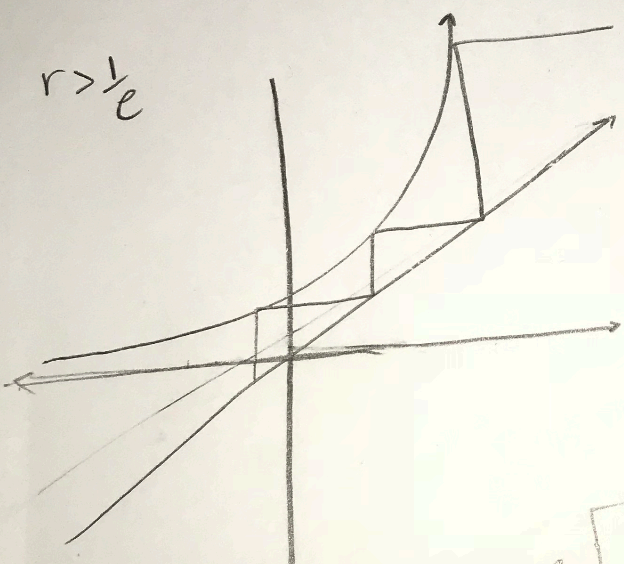
$x_{n+1} = re^{x_n}$ for $r>0$

$r < 1/e$

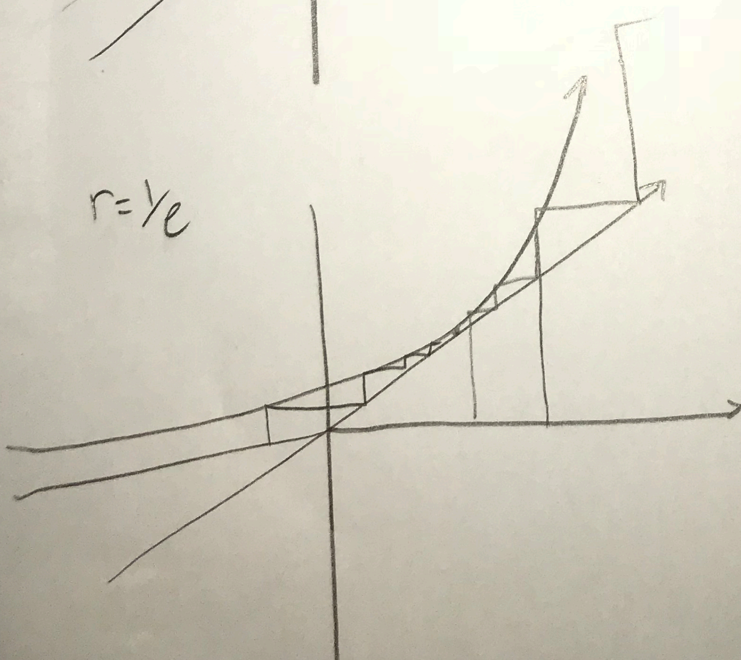


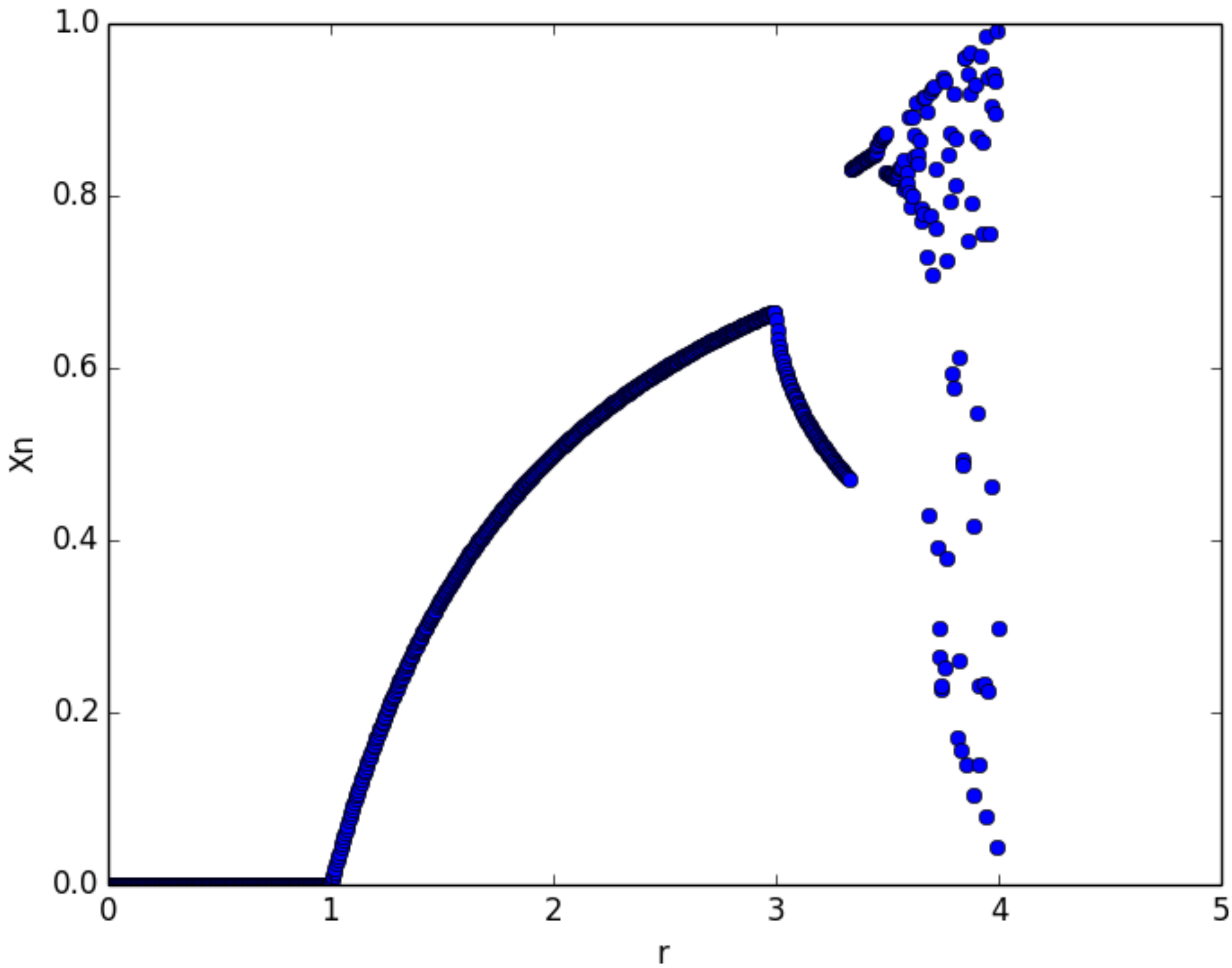


$r > 1/e$

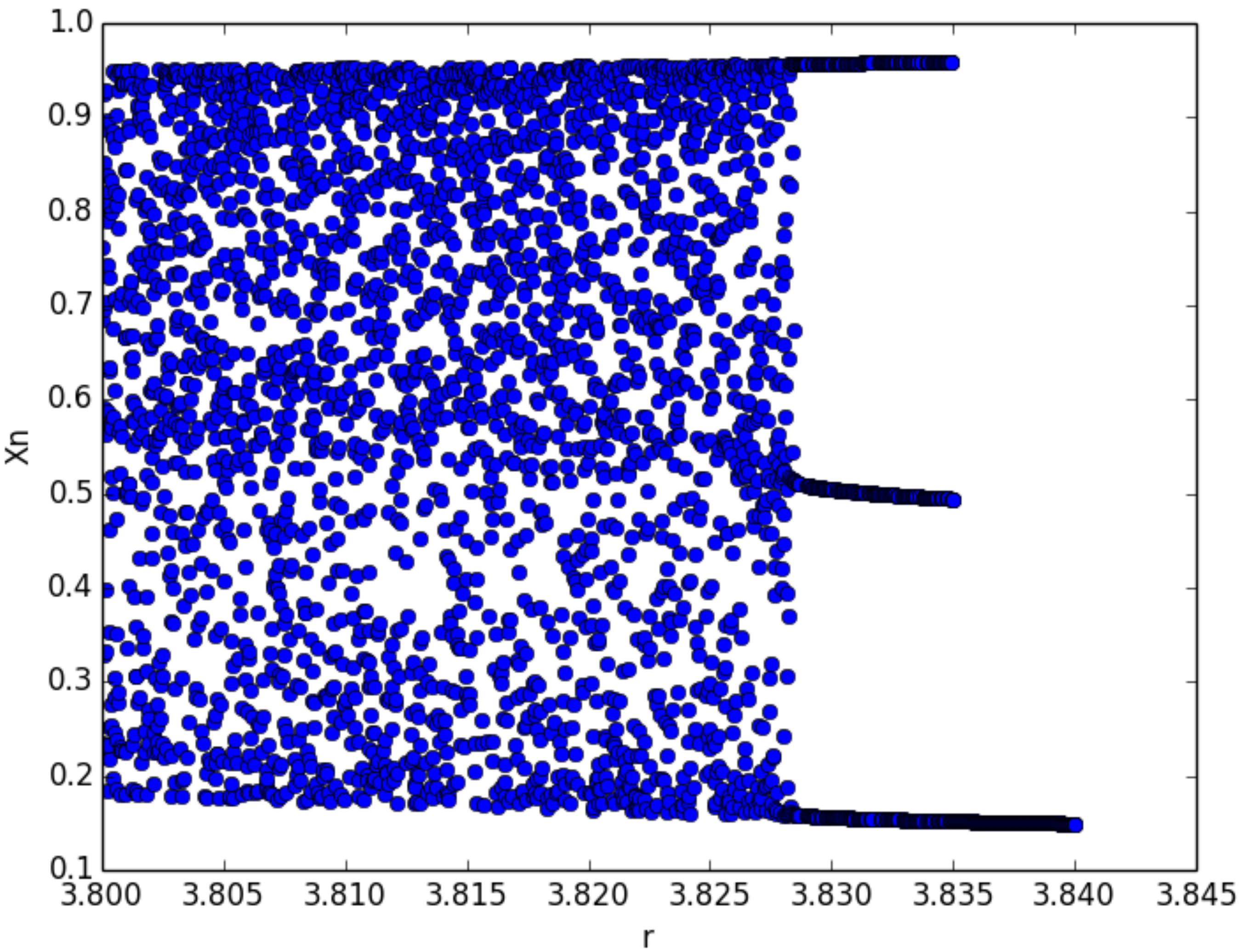


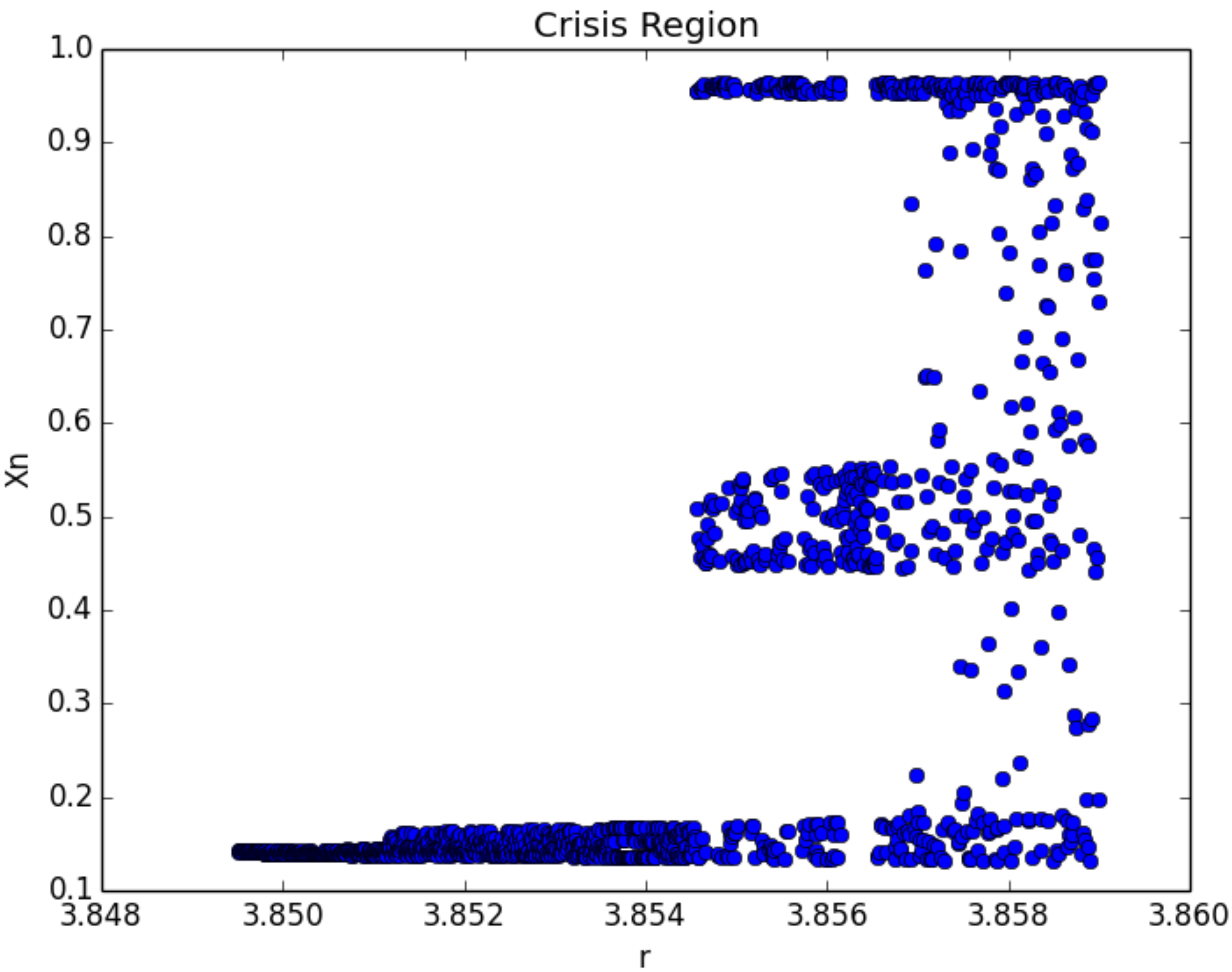
$r = 1/e$





1.0
0.8
0.6
0.4
0.2
0.0
Xn
0
1
2
3
4
5
r


1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Xn
3.800
3.805
3.810
3.815
3.820
3.825
3.830
3.835
3.840
3.845
r


Crisis Region
Xn
r
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
3.848
3.850
3.852
3.854
3.856
3.858
3.860

```
##written in python 2.7##

import matplotlib.pyplot as plt

## fixed initial value of r
r=3.8495
##

x_list=[]

def function(r):
        x0=0.001      ##initial x value to seed
        for i in range(0,500):
                xn=r*x0*(1-x0)     #f(x)
                x_list.append(xn)    #adds value to list
                x0 = xn            ##restarts loop using the value of xn
        plt.plot(r,x_list[-1],'--bo')     ##plots last value of xn vs r
while r<3.859:             ##adjusted this value to "zoom in" without losing point resolution
        r+= .000007
        function(r)     #call the function for iterating values of r


plt.xlabel("r")
plt.ylabel("Xn")
plt.title("Crisis Region")
plt.show()
~
~
```