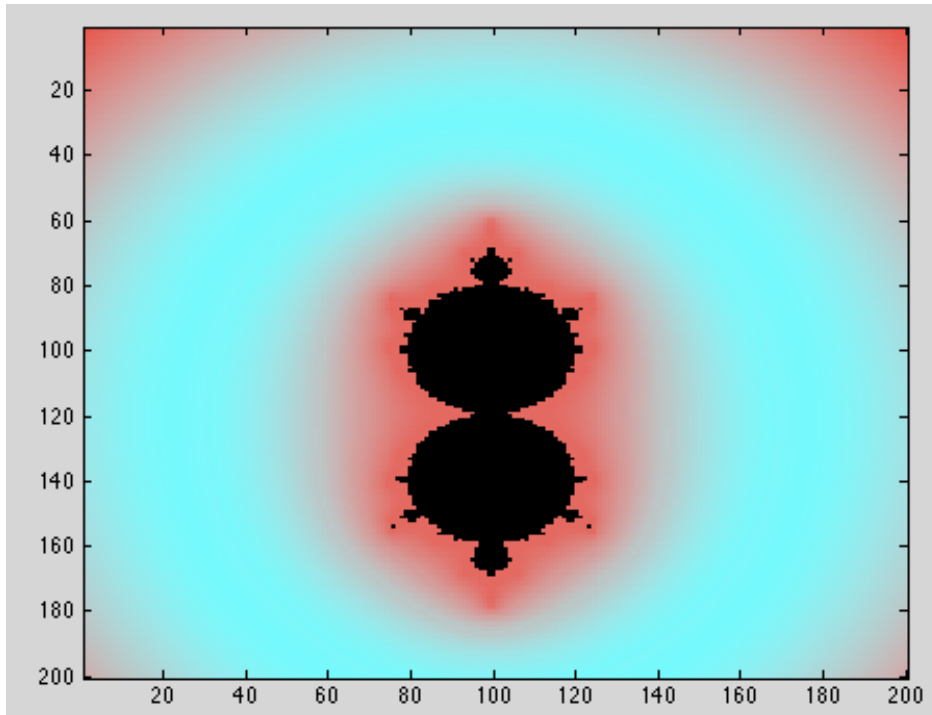# 745 Assignment 2 Solutions

Question 1

```matlab
nx = 200;
ny = 200;
Mset = magic(nx);
ColorMset = zeros(nx,ny,3);
xmin = -5;
xmax = 5;
ymin = -5;
ymax = 5;
maxiter = 200;
wb = waitbar(0,'Please wait...');
for iy = 1:ny
  cy = ymin + iy*(ymax - ymin)/(ny - 1);
  for ix= 1:nx
    cx = xmin + ix*(xmax - xmin)/(nx - 1);
    k = Ass2MSetPot(cx,cy,maxiter);
    Mset(ix,iy) = k;
    if k == 0
        ColorMset(ix,iy,:) = 0;
    else
        ColorMset(ix,iy,1) = abs(sin(5*2^k));
        ColorMset(ix,iy,2) = abs(sin(5*2^k+pi/2));
        ColorMset(ix,iy,3) = abs(cos(5*2^k));
    end
  end
  waitbar(iy/ny,wb)
end
close(wb);
image(ColorMset);

function [potential] = Ass2MSetPot(cx,cy,maxiter)
c = complex(cx,cy);
z = complex(1/2,0);
iter = 0;
while (iter < maxiter)&(abs(z) < 10000)
   z = z*c*(1-z);
   iter = iter+1;
end
if iter < maxiter
    potential = 0.5*log(abs(z))/(2^iter);
else
    potential = 0;
end
```

Question 2

```
>> syms x y z r
>> y=r*x*(1-x);
>> y2=r*y*(1-y)

y2 = r^2*x*(1-x)*(1-r*x*(1-x))

 >> solve(subs(y2,x,1/2)-1/2,r)

ans =

      2
  5^(1/2)+1
 -5^(1/2)+1
```

r = 5^(1/2)+1

fr(1/2) = (5^(1/2)+1)(1/2)(1-1/2) =(5^(1/2)+1)/4

fr((5^(1/2)+1)/4) = (5^(1/2)+1)((5^(1/2)+1)/4)(1-(5^(1/2)+1)/4) = ((5^(1/2)+1)^2)(3- 5^(1/2))/16
= 2(3+5^(1/2))(3- 5^(1/2))/16 =1/2

Question 3

Either: There are 7 smaller figures fitting into the whole so the length is scaled by $1/7^{1/2}$ and each side is replaced by 3 smaller sides.

Hence D = -log 3/log(1/7^(1/2)) = 2log 3/log(7)

Or: long side = $\sqrt{1^2 + (3\sqrt{3})^2} = \sqrt{28} = 2\sqrt{7}$. There are 3 short sides of length = 2

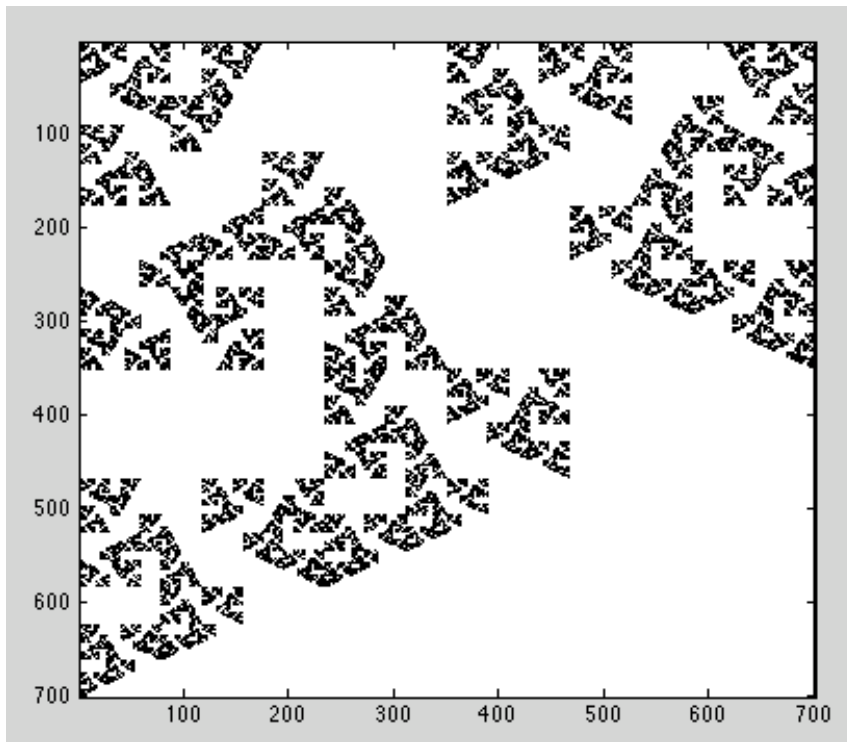Hence D = -log 3/log(1/7^(1/2)) = 2log 3/log(7)

Question 4

p=2/4+2/9;

```
>> M=[-1/2 0 0 1/2 1 1/2 1/4/p;0 -1/2 1/2 0 1/2 1/2 1/4/p;1/3 0 0 1/3 0 0 1/9/p;1/3 0 0 1/3 1/3 1/6 1/9/p]

>> ifs4(M,1000000,0,1,0,1)
```


Question 5

```
>> syms d e
>> e=(1/3)^d+(1/2)^d-1/2

>> subs(e,1.605)

ans =

   2.1842e-04

>> syms d
>> subs(1/3^d+1/2^d-1/2,1.605)

ans =

   2.1842e-04

>> e=1/3^d+1/2^d

e =

1/(3^d)+1/(2^d)


>> solve(e-1/2)

ans =

1.6055248444243280076129998760642
```

Question 6

```
function chirikov2(iter,K);
viewsize=700;
pii=2*pi;
steps=20;
CHimage = ones(viewsize,viewsize,3);
for i=1:steps
    for j=1:steps
        p=i*pii/steps; t=j*pii/steps;
        for k=1:iter
            CHimage(int16(viewsize*(pii-p)/pii)+1,int16(viewsize*t/pii)+1,:) = 0;
            p=p+K*sin(t);
            t=t+p;
            if t<0
                t=t+pii;
            end
            if p<0
                p=p+pii;
            end
            if t>pii
                t=t-pii;
            end
            if p>pii
                p=p-pii;
            end
        end
    end
end
image(CHimage);

>> chirikov2(1000,.97)
```