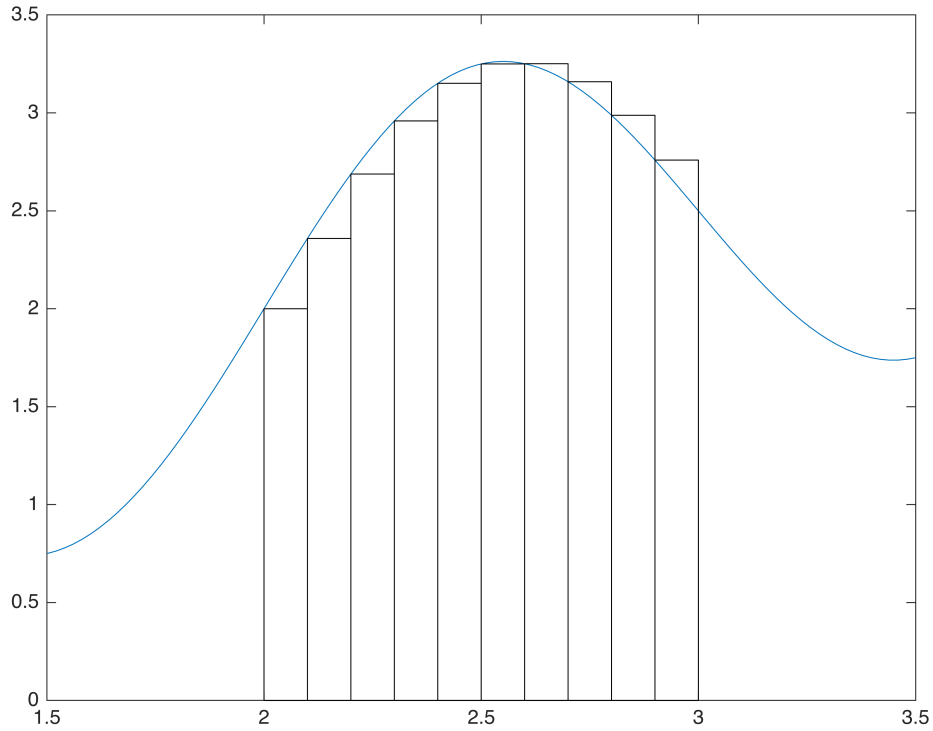
Michael Foster HW 6

1.

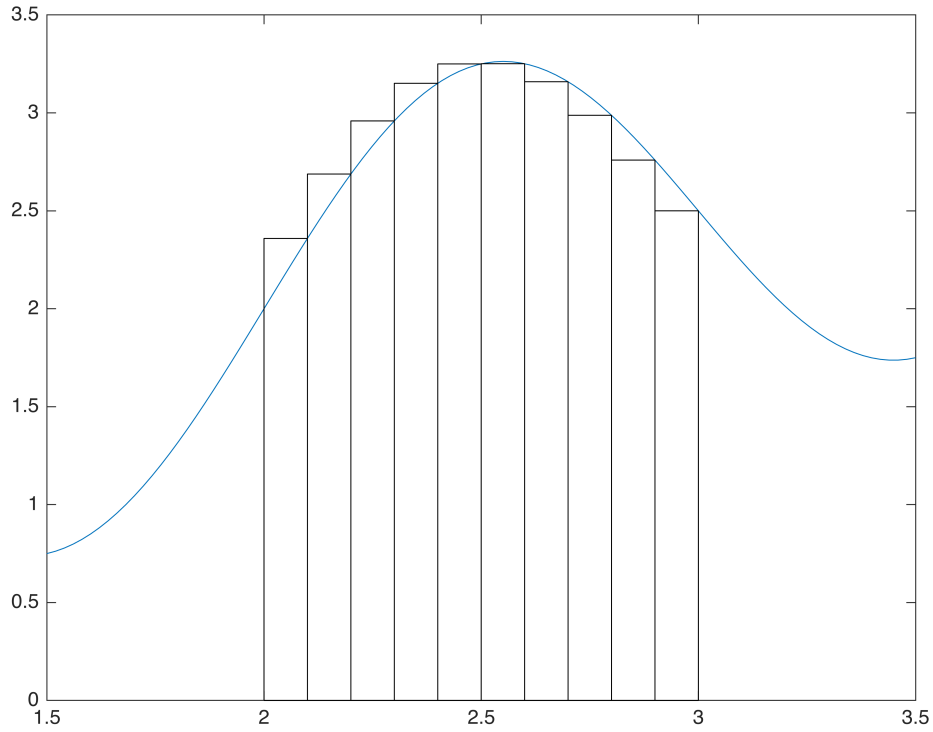
a.

```
f = @(x) sin(pi*x)+0.5*x+1;
x = linspace(1.5,3.5);
plot (x,f(x))
hold on
I =[2,3];
[x,y ]= lhrect (f,I,10);
plot (x,y,'k')
hold off
```



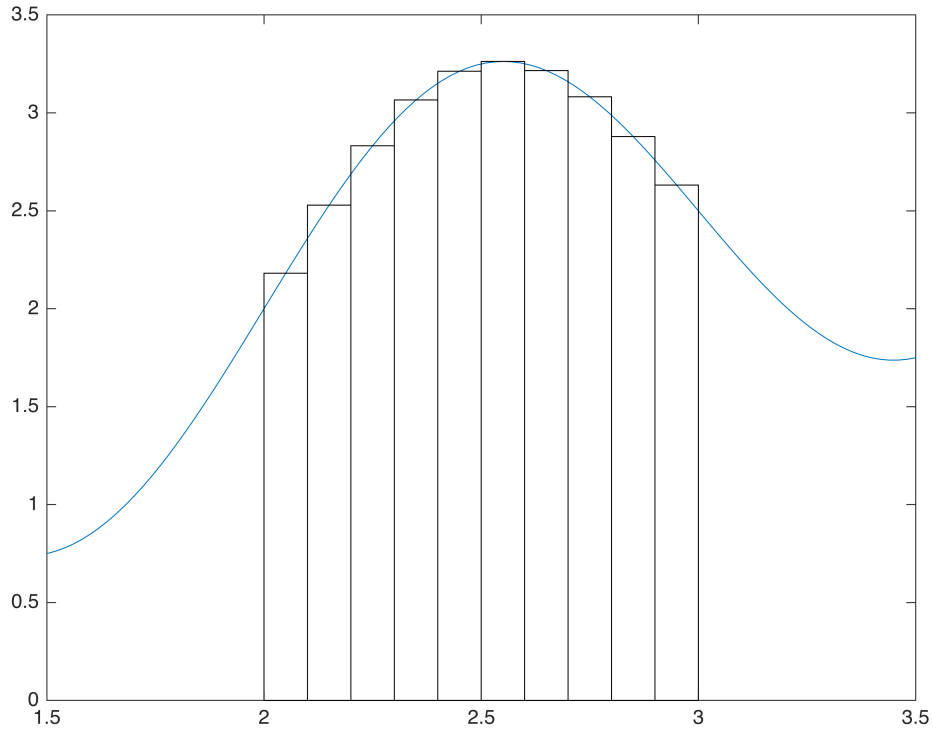
b.

```
f = @(x) sin(pi*x)+0.5*x+1;
x = linspace(1.5,3.5);
plot (x,f(x))
hold on
I =[2,3];
[x,y ]= rhrect (f,I,10);
plot (x,y,'k')
hold off
```



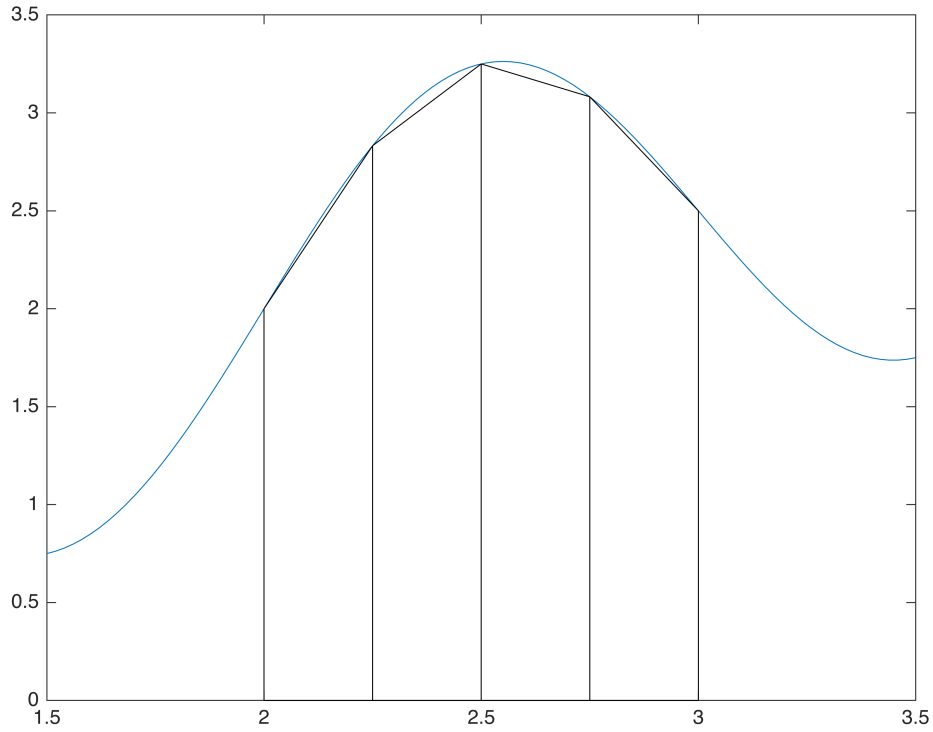
c.

```
f = @(x) sin(pi*x)+0.5*x+1;
x = linspace(1.5,3.5);
plot (x,f(x))
hold on
I =[2,3];
[x,y ]= mprect (f,I,10);
plot (x,y,'k')
hold off
```



d.

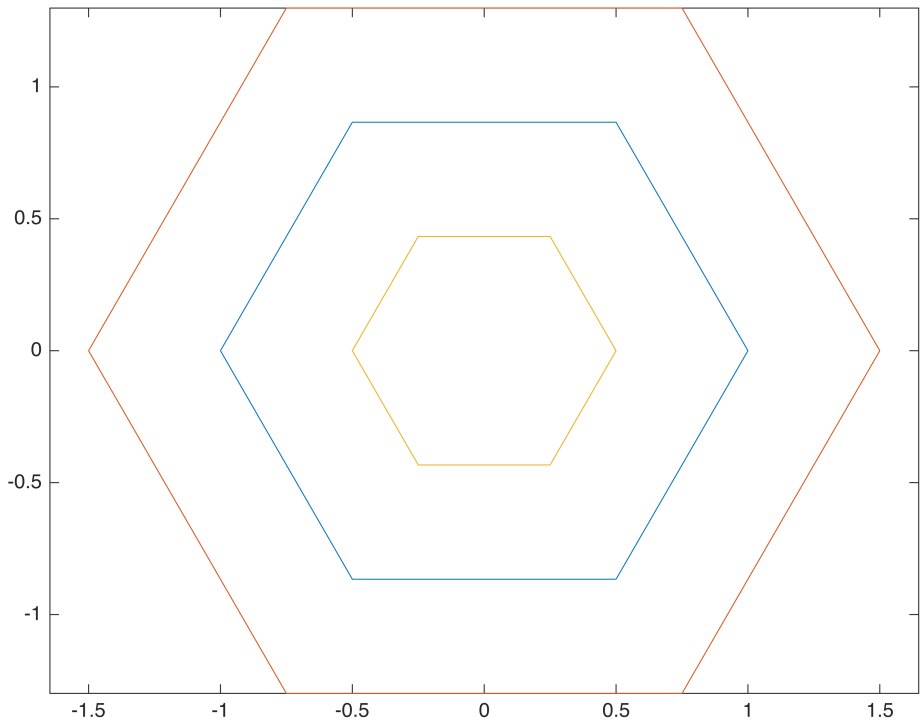
```
f = @(x) sin(pi*x)+0.5*x+1;
x = linspace(1.5,3.5);
plot (x,f(x))
hold on
I =[2,3];
[x,y ]= trrect (f,I,4);
plot (x,y,'k')
hold off
```



2.

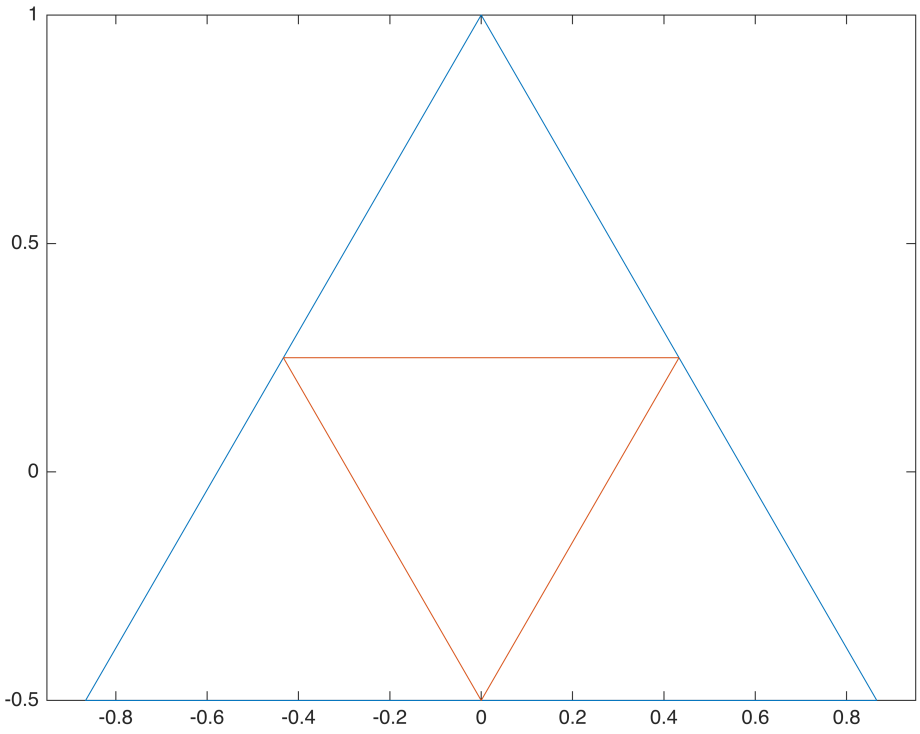
a.

```
[x,y]=ngon(6);
V=[x;y];
A = eye(2)*1.5;
B = eye(2)*.5;
AV = A*V;
BV = B*V;
plot(V(1,:),V(2,:),AV(1,:),AV(2,:),BV(1,:),BV(2,:))
axis equal
```



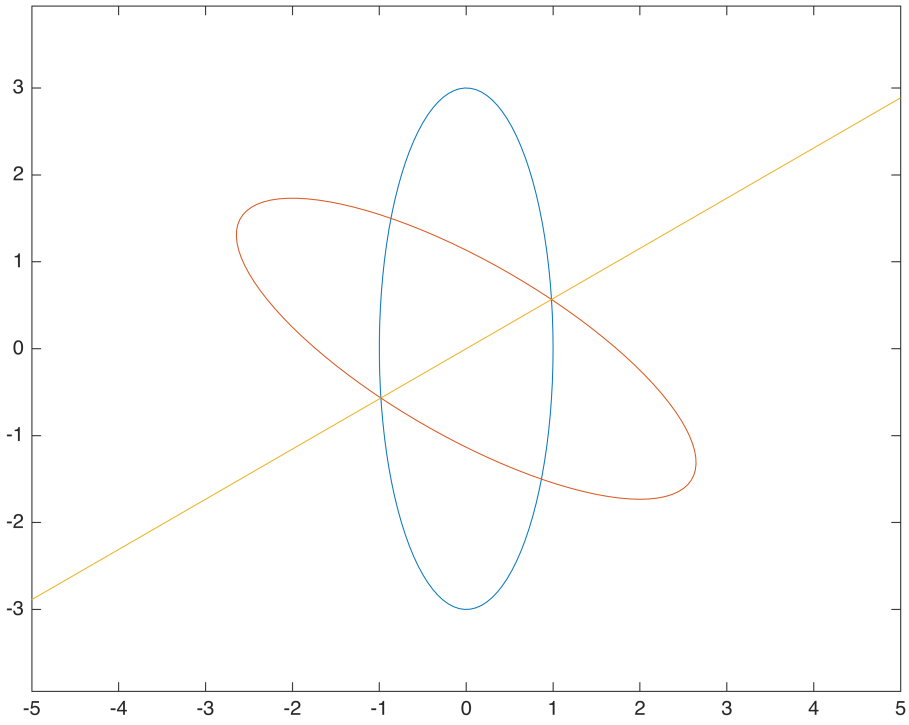
b.

```
clear A
clear B
clear [x,y]
clear V
[x,y]=ngon(3);
V=[x;y];
theta = pi/3;
A = [cos(theta) -sin(theta); sin(theta) cos(theta)];
B = eye(2)*.5;
ABV = A*B*V;
plot(V(1,:),V(2,:),ABV(1,:),ABV(2,:))
axis equal
```



c.

```
clear A
clear B
clear [x,y]
clear V
clear theta
t = linspace(0,2*pi,100);
x = cos(t);
y = 3*sin(t);
V = [x;y];
theta = pi/6;
A = [cos(2*theta) sin(2*theta); sin(2*theta) -cos(2*theta)];
AV = A*V;
xl = linspace(-5,5);
yl = tan(theta)*xl;
plot(V(1,:),V(2,:),AV(1,:),AV(2,:),xl,yl)
axis equal
```



4.

a.

Equations:

a0 = 5

a0 + 2a1 + 4a2 + 8a3 + 16a4 = -101

a0 + 7a1 + 49a2 + 343a3 + 2401a4 = -7.25

a0 + 9a1 + 81a2 + 729a3 + 6561a4 = -15.25

a0 + 10a1 + 100a2 + 1000a3 + 10000a4 = -5

b.

```
M = [1 0 0 0 0; 1 2 4 8 16; 1 7 49 343 2401; 1 9 81 729 6561; 1 10 100 1000
10000];
b = [5 −101 −7.25 −15.25 −5];
b = b';
```

c.

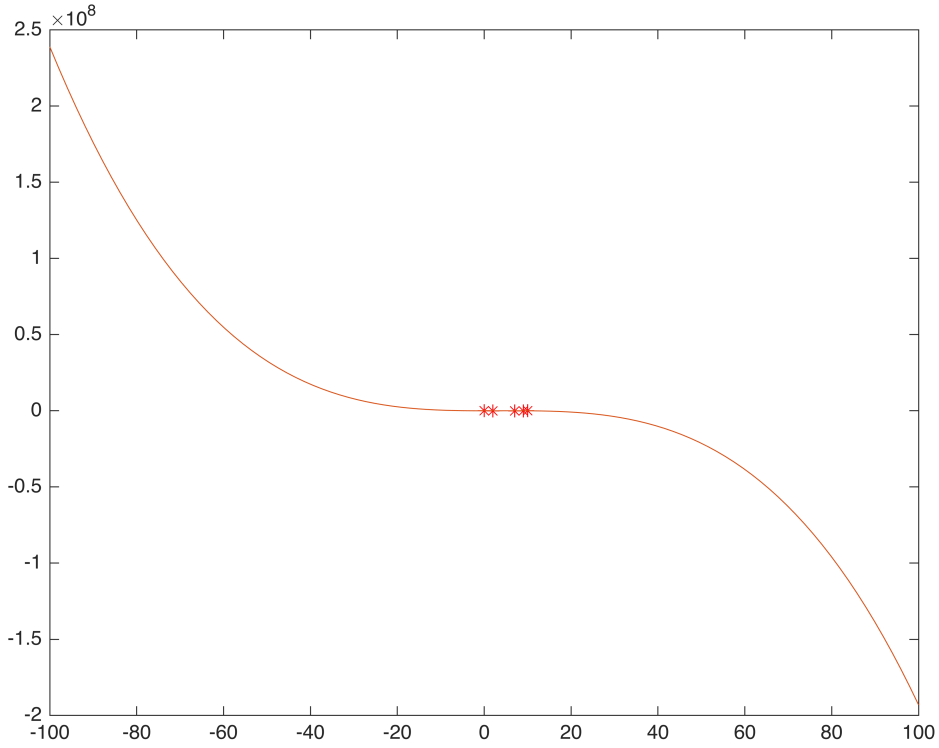
```
a = M\b
```

```
a = 5×1
    5
```

```
  -126
  47.5
    -6
  0.25
```

d.

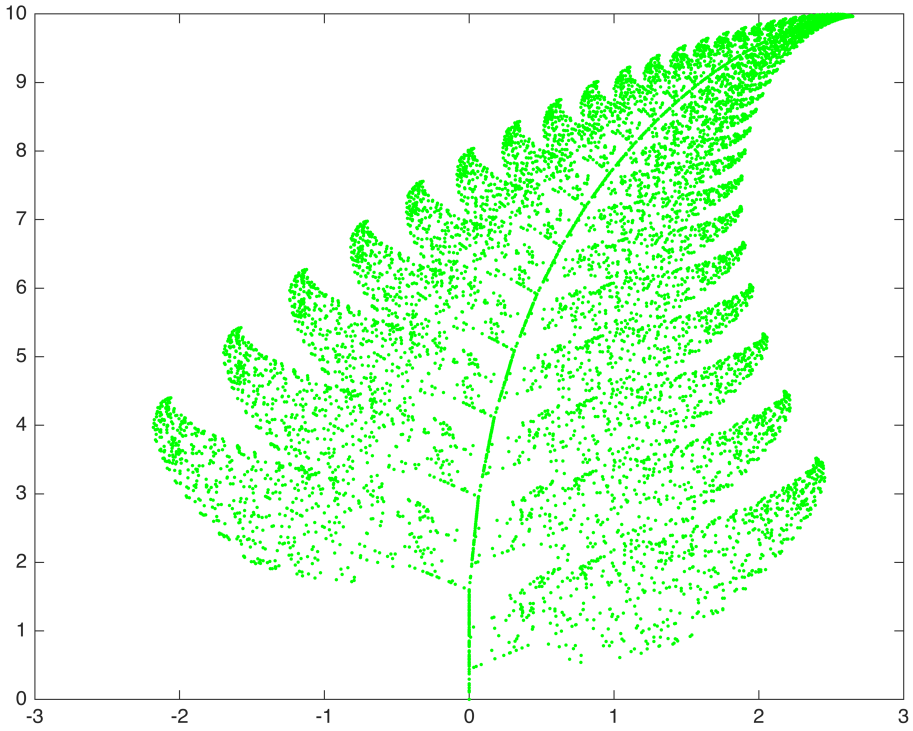
```
xpoints = [0,2,7,9,10];
ypoints = [5,-101,-7.25,-15.25,-5];
plot(xpoints, ypoints, '*r')
hold on
x = linspace(-100,100);
y = (.00390625*(x.^4)) + (-216*(x.^3)) + (2256.25*(x.^2) )+ (-126*x) + 5;
plot(x,y)
hold off
```



4.

```
A1 = [0.85 0.04;-0.04 0.85];
b1 = [0;1.6];
A2 = [0.2 -0.26;0.23 0.22];
b2 = [0;1.6];
A3 = [-0.15 0.28;0.26 0.24];
b3 = [0;0.44];
A4 = [0 0;0 0.16];
b4 = [0;0];
numpoints = 10000;
```

```
V = zeros(2,numpoints);
for n= 2:numpoints
    roll = randi(100,1);
    if roll <= 85
        V(:,n) = A1*V(:,n-1)+b1;
    elseif roll <= 92
        V(:,n) = A2*V(:,n-1)+b2;
    elseif roll <= 99
        V(:,n) = A3*V(:,n-1)+b3;
    else
        V(:,n) = A4*V(:,n-1)+b4;
    end
end
plot(V(1,:),V(2,:),'.g')
```



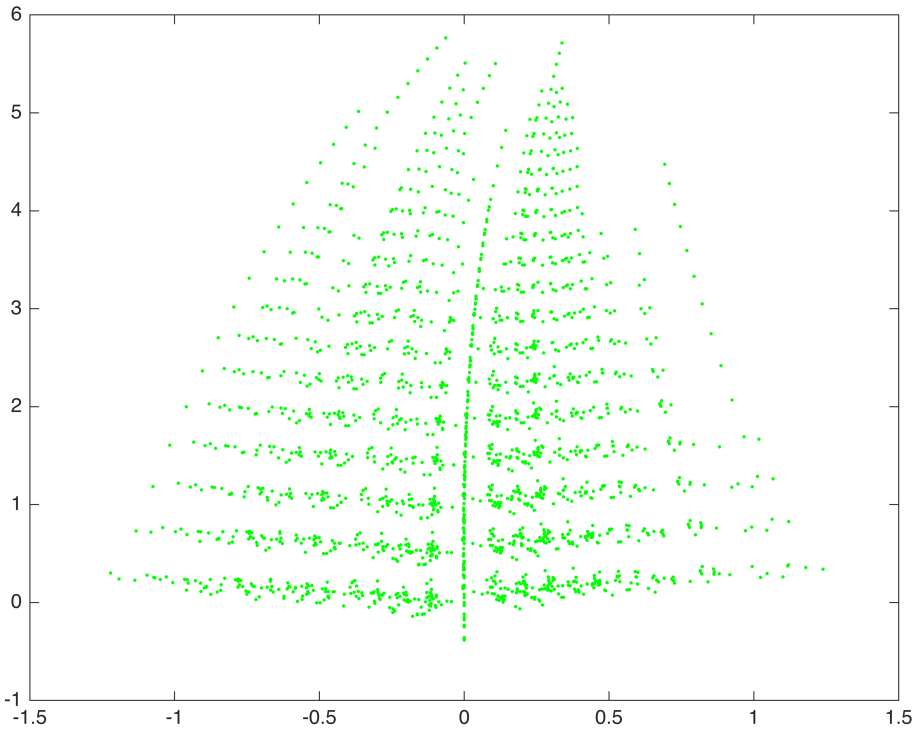
Not sure how to color the stem, bottom left leaf and bottom right leaf. Below is code that has some gaps but is an attempt at coloring each part.

```
% stem = V(:,n) <= ?
% plot(V(1,stem),V(2,stem), '.k')
% hold on
% bottomleft = V(:,n) <= ? & >= ?
% plot(V(1,bottomleft),V(2,bottomleft),'.r')
% bottomright = V(:,n) <= ? & >= ?
% plot(V(1,bottomright),V(2,bottomright), '.b.')
% hold off
```

```
% axis equal
```

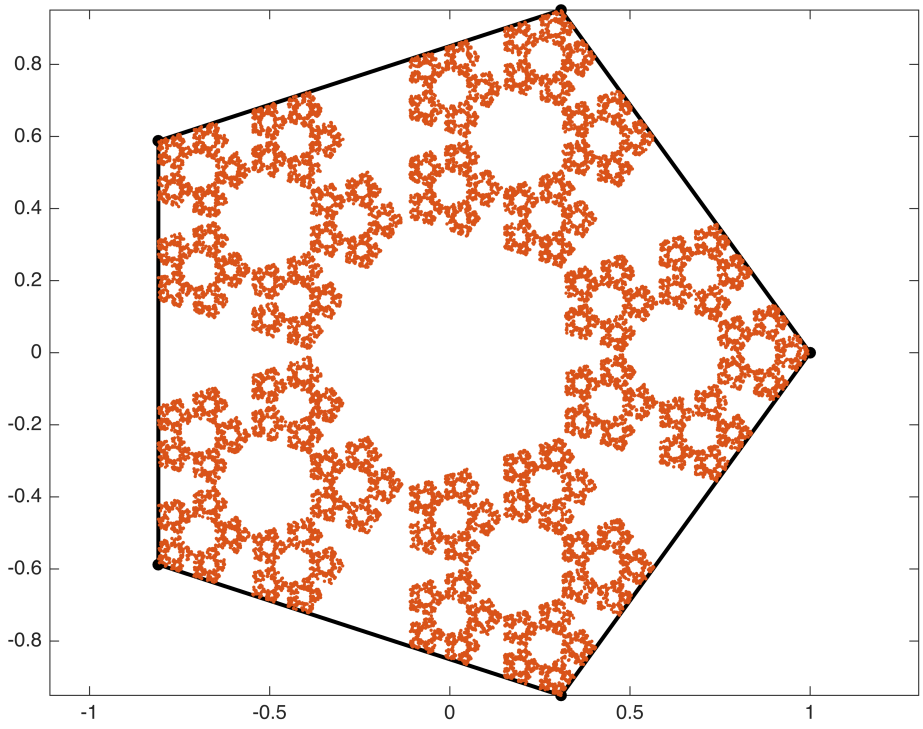
5.

```
A1 = [0 0; 0 .25];
b1 = [0;-.4];
A2 = [0.95 .005;-.005 .93];
b2 = [-.002;.5];
A3 = [.035 -.2;.16 .04];
b3 = [-.09;.02];
A4 = [-.04 .2;.16 .04];
b4 = [.083;.12];
numpoints = 2000;
V = zeros(2,numpoints);
for n= 2:numpoints
    roll = randi(100,1);
    if roll <= 2
        V(:,n) = A1*V(:,n-1)+b1;
    elseif roll <= 86
        V(:,n) = A2*V(:,n-1)+b2;
    elseif roll <= 93
        V(:,n) = A3*V(:,n-1)+b3;
    else
        V(:,n) = A4*V(:,n-1)+b4;
    end
end
plot(V(1,:),V(2,:),'.g')
```

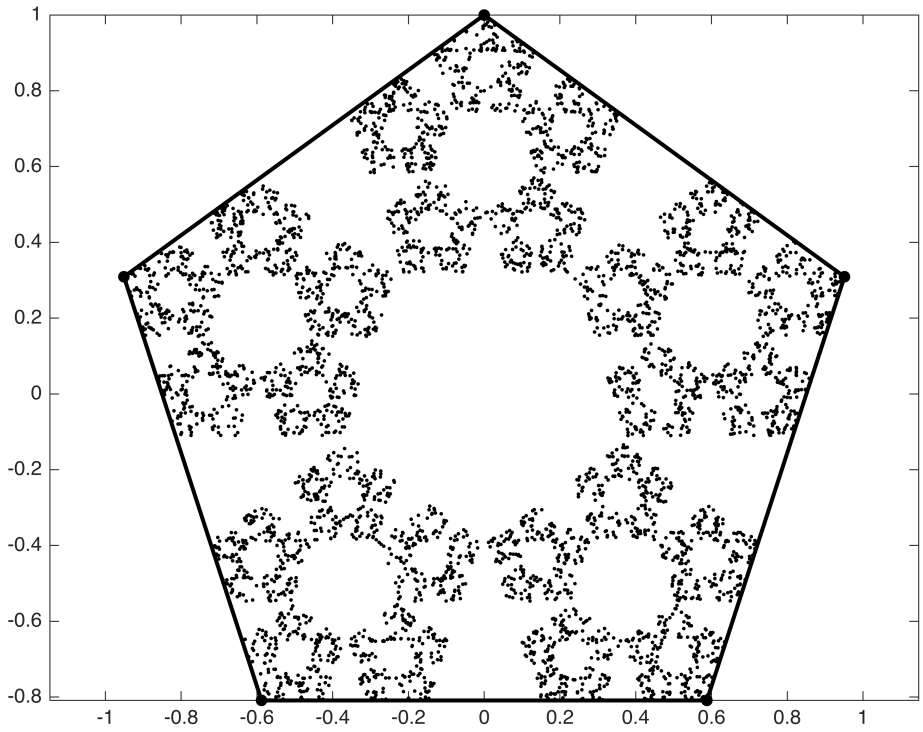


6.

```
theta = 2*pi/5;
v=exp(sym([1:5]*theta*1i));
v = double(v);
plot([v v(1)],'.-k','LineWidth',2,'MarkerSize',20);
axis equal
numpoints = 25000;
z=complex(zeros(numpoints,1));
z(1) = complex(0.8,0);
hold on
for n=2:numpoints
    z(n) = 0.375*z(n-1)+0.625*v(randi([1,5]));
end
plot(z,'.');
hold off
```




```
theta = 2*pi/5;
v=exp(sym([1:5]*theta*1i));
plot(exp(pi/2*1i)*[v v(1)],'.-k','LineWidth',2,'MarkerSize',20);
axis equal
numpoints = 5000;
z=complex(zeros(numpoints,1));
z(1) = complex(0.8,0);
hold on
for n=2:numpoints
    z(n) = 0.375*z(n-1)+0.625*v(randi([1,5]));
end
plot(exp(pi/2*1i)*z,'k.',"MarkerSize",5)
hold off
```



Chose to do 5000 because 25000 was taking too long to run.

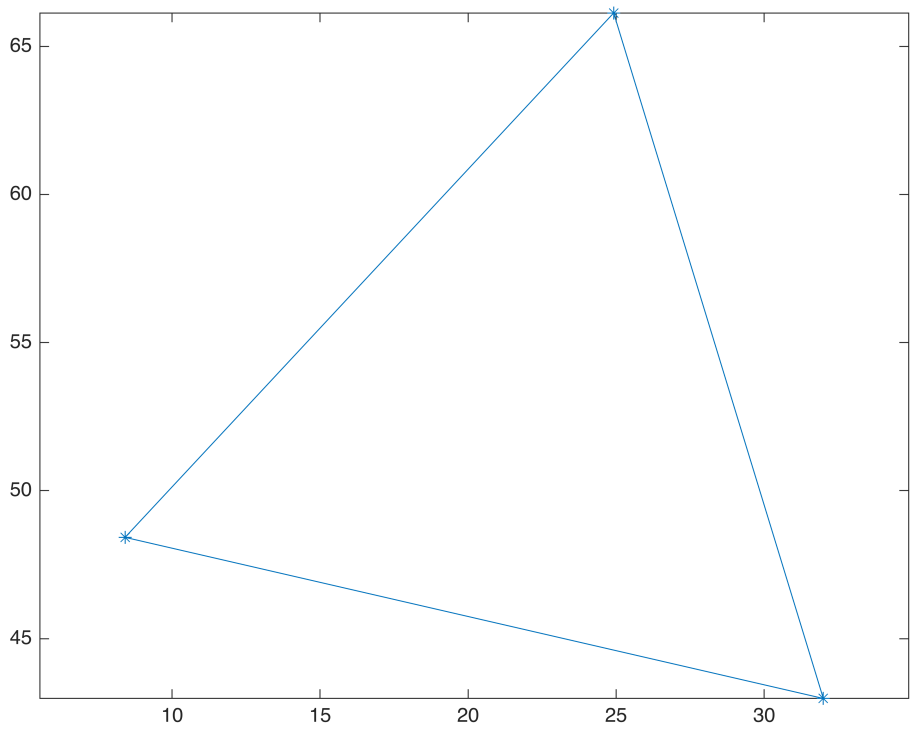
7.

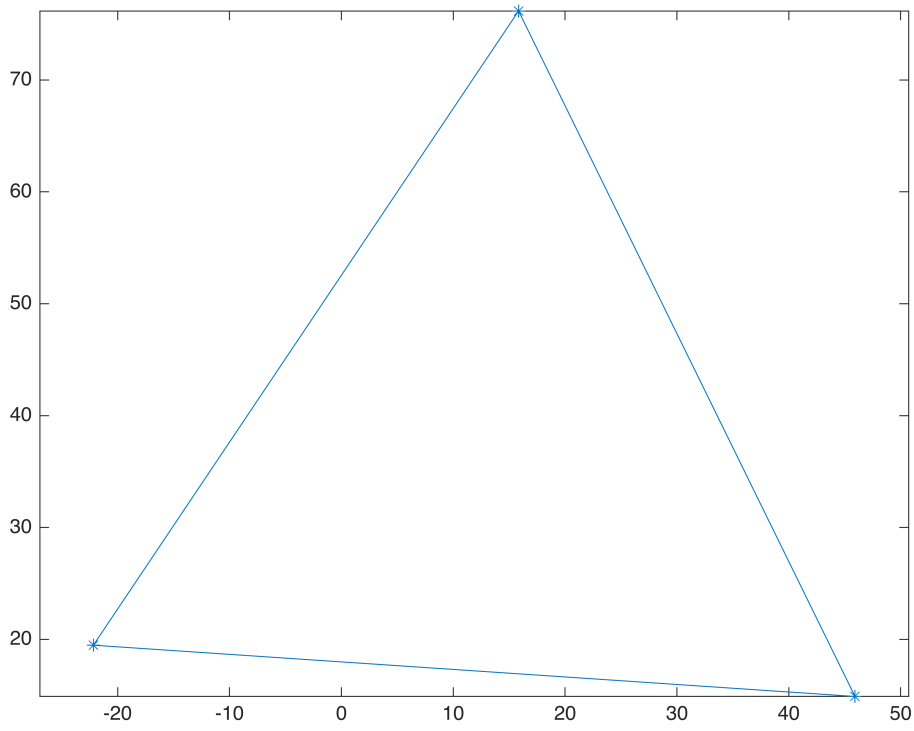
a.

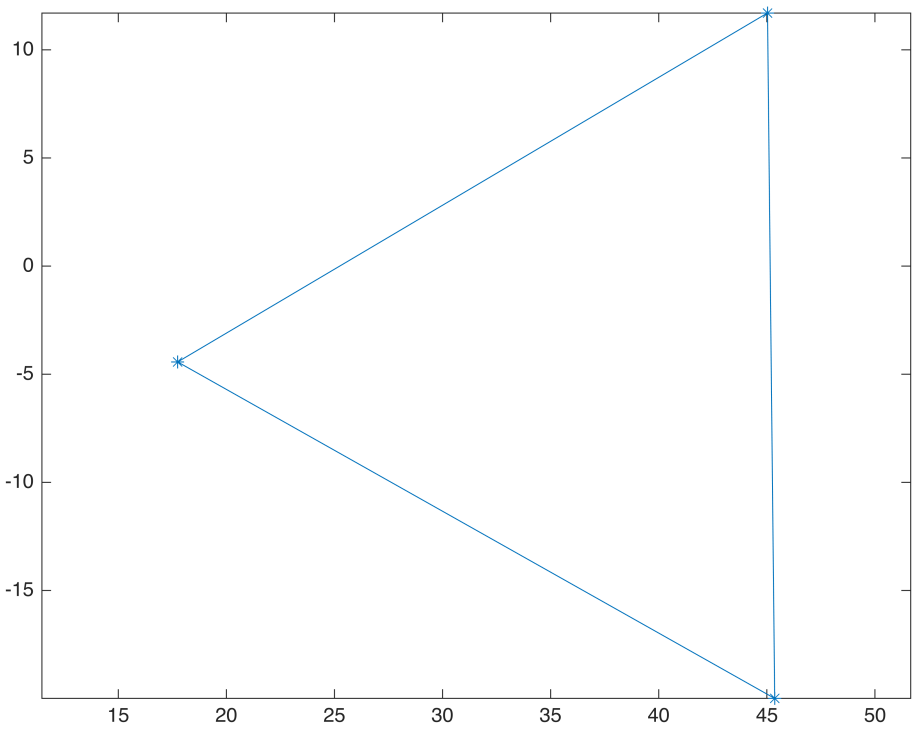
Theorem 2 is true because pi/3 radians in degrees is 60 degrees. Therefore e^-pi/3i will create an angle of 60 degrees between all of the sides of the triangle. For the length of each side, | e^-pi/3 | has length 1 and so scaling each side with this will produce sides of the same length. Therefore the triangle is equilateral.

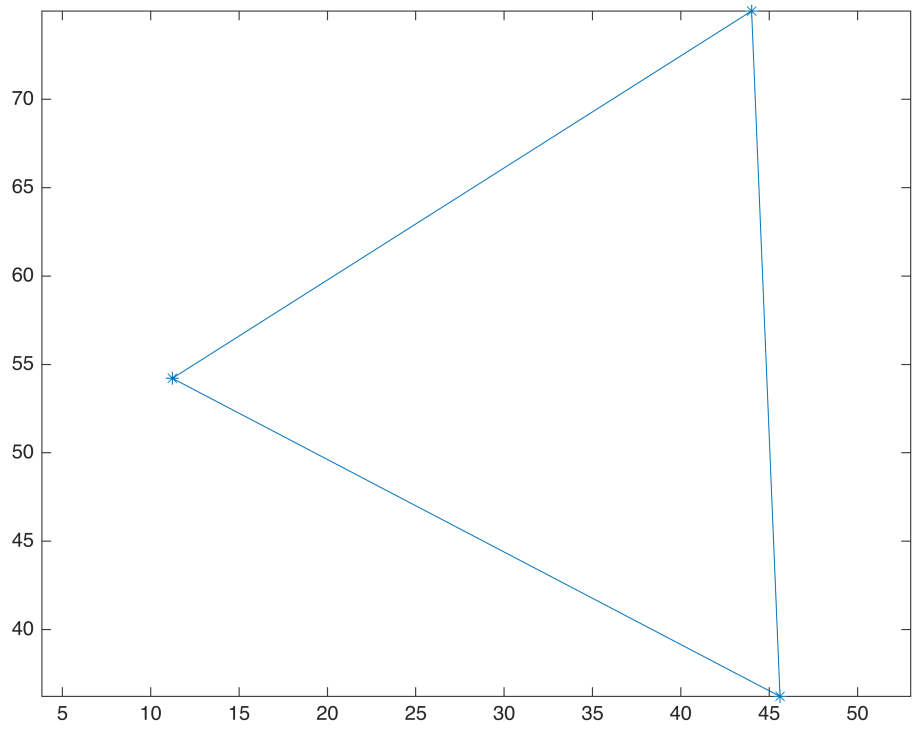
c.

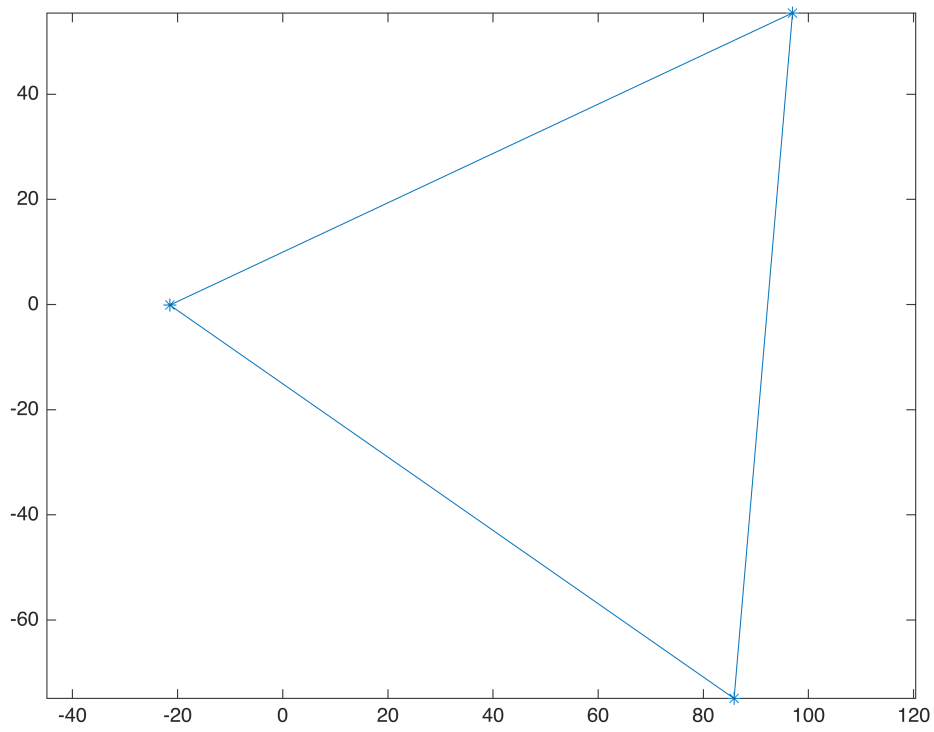
```
for n = 1:5
z1 = complex(100*rand(1)-50,100*rand(1)-50);
z2 = complex(100*rand(1),100*rand(1));
z3 = euclidI(z1,z2);
plot ([z1 z2 z3 z1],' -*')
axis equal
figure
end
```


65
60
55
50
45
10
15
20
25
30


70
60
50
40
30
20
-20
-10
0
10
20
30
40
50


10
5
0
-5
-10
-15
15
20
25
30
35
40
45
50


70
65
60
55
50
45
40
5
10
15
20
25
30
35
40
45
50



Functions

1.

a.

```
function [X,Y]= lhrect(f,I,n)
a = I(1);
b = I(2);
x = linspace(a, b, n+1);
X = [x(1:n) % x- coord of Lower Left Corner of rectangle
    x(1:n) % x- coord of Upper Left Corner of rectangle
    x(2:n+1) % x- coord of Upper Right Corner of rectangle
    x(2:n+1) % x- coord of Lower Right Corner of rectangle
    x(1:n)]; % repeat x- coord of Lower Left Corner of rectangle
Y = [zeros(1,n) % y- coord of Lower Left Corner of rectangle
    f(x(1:n)) % y- coord of Upper Left Corner of rectangle
    f(x(1:n)) % y- coord of Upper Right Corner of rectangle
    zeros(1,n) % y- coord of Lower Right Corner of rectangle
    zeros(1,n)]; % repeat y- coord of Lower Left Corner of rectangle
end
```

b.

```
function [X,Y]= rhrect(f,I,n)
a = I(1);
```

```
b = I(2);
x = linspace(a, b, n+1);
X = [x(1:n) % x- coord of Lower Left Corner of rectangle
    x(1:n) % x- coord of Upper Left Corner of rectangle
    x(2:n+1) % x- coord of Upper Right Corner of rectangle
    x(2:n+1) % x- coord of Lower Right Corner of rectangle
    x(1:n)]; % repeat x- coord of Lower Left Corner of rectangle
Y = [zeros(1,n) % y- coord of Lower Left Corner of rectangle
    f(x(2:n+1)) % y- coord of Upper Left Corner of rectangle
    f(x(2:n+1)) % y- coord of Upper Right Corner of rectangle
    zeros(1,n) % y- coord of Lower Right Corner of rectangle
    zeros(1,n)]; % repeat y- coord of Lower Left Corner of rectangle
end
```

c.

```
function [X,Y]= mprect(f,I,n)
a = I(1);
b = I(2);
x = linspace(a, b, n+1);
deltax = (b-a)/n;
X = [x(1:n) % x- coord of Lower Left Corner of rectangle
    x(1:n) % x- coord of Upper Left Corner of rectangle
    x(2:n+1) % x- coord of Upper Right Corner of rectangle
    x(2:n+1) % x- coord of Lower Right Corner of rectangle
    x(1:n)]; % repeat x- coord of Lower Left Corner of rectangle
Y = [zeros(1,n) % y- coord of Lower Left Corner of rectangle
    f(x(1:n)+ deltax/2) % y- coord of Upper Left Corner of rectangle
    f(x(1:n)+ deltax/2) % y- coord of Upper Right Corner of rectangle
    zeros(1,n) % y- coord of Lower Right Corner of rectangle
    zeros(1,n)]; % repeat y- coord of Lower Left Corner of rectangle
end
```

d.

```
function [X,Y]= trrect(f,I,n)
a = I(1);
b = I(2);
x = linspace(a, b, n+1);
X = [x(1:n) % x- coord of Lower Left Corner of rectangle
    x(1:n) % x- coord of Upper Left Corner of rectangle
    x(2:n+1) % x- coord of Upper Right Corner of rectangle
    x(2:n+1) % x- coord of Lower Right Corner of rectangle
    x(1:n)]; % repeat x- coord of Lower Left Corner of rectangle
Y = [zeros(1,n) % y- coord of Lower Left Corner of rectangle
    f(x(1:n)) % y- coord of Upper Left Corner of rectangle
    f(x(2:n+1)) % y- coord of Upper Right Corner of rectangle
    zeros(1,n) % y- coord of Lower Right Corner of rectangle
    zeros(1,n)]; % repeat y- coord of Lower Left Corner of rectangle
end
```

2.

```
function [x,y]= ngon(n)
t = linspace(0 ,2*pi ,n+1) - pi/2+ pi/n ;
x = cos(t);
y = sin(t);
end
```

7.

b.

```
function z3 = euclidI(z1,z2)
    z3 = z1+(z2 - z1)*exp((-pi/3)*1i);
end
```