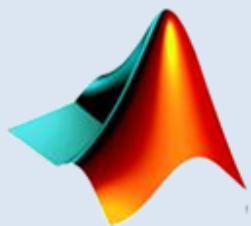


CREATING IMAGES

WITH



MATLAB[®]

Introduction

This guide was created as part of a **sigma**-funded project on promotional activities and resources for mathematics and statistics support centres.

The project was undertaken by staff and students of the Mathematics Resources Centre at the University of Bath. For more information, email mash@bath.ac.uk.

3D Plots

To create a 3D Plot in MATLAB, you must first decide what range you want on the x and y axes.

To do this we write

```
X=[-3:0.2:3];
```

```
Y=[-3:0.2:3];
```

where $-3 < X, Y < 3$. In this case, 0.2 determines the range of the mesh that you make on the plot, the smaller the number, the more intricate the grid, as in the picture. This grid is created using the command

```
[xx,yy]=meshgrid(x,y);
```

Now we must calculate the values of the function

```
zz=xx.^2+yy.^2;
```

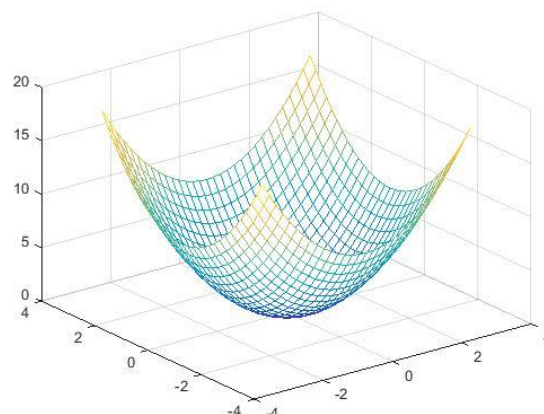
Here we are calculating the function $z=x^2+y^2$. The full stop in the expression calculates the values of x^2 and y^2 element by element as they are currently stored in a vector, so you cannot just square it as a whole.

Then we write

```
figure
```

```
surf(xx,yy,zz)
```

to plot the surface of the function that you have created.

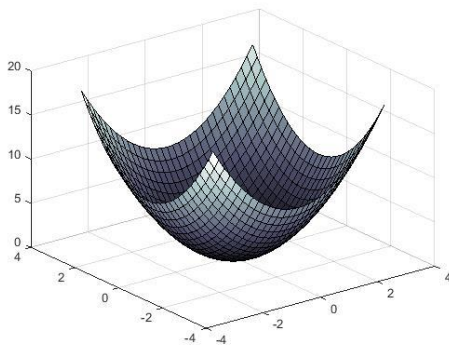


You can then personalise the plot to look how you would like:

shading interp – creates a smooth plot and removes the grid on the surface
mesh(xx,yy,zz) – creates a surface purely of the mesh grid such as in the first image

colormap bone – changes the colour of your plot, where **bone** is the name of the built in colour map. To see all the built in colour maps for MATLAB visit <http://www.mathworks.com/matlabcentral/mlc-downloads/downloads/submissions/30161/versions/4/screenshot.png>

These give you all the different options to colour any images you produce in MATLAB.



The complete code for this graph is

```
X=[-3:0.2:3];  
Y=[-3:0.2:3];  
[xx,yy]=meshgrid(x,y);  
zz=xx.^2+yy.^2  
figure  
surf(xx,yy,zz)
```

Once you've completed your plot, you can save it as a JPEG and then use it in other applications

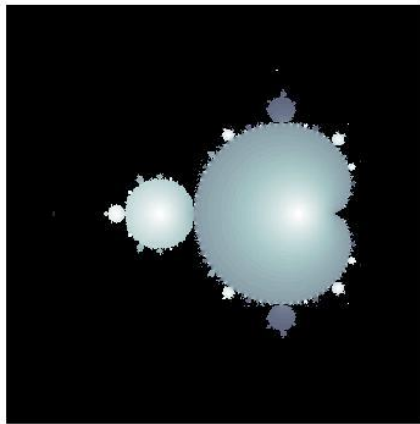
Some other interesting graphs are

- $zz = \sin(xx) + \sin(yy)$; for x, y between -5 and 5 .
- $zz = yy.^3 * xx - yy * xx.^3$;
- $zz = yy.^3 * xx + yy * xx.^3$;
- $R = \sqrt{xx.^2 + yy.^2} + \text{eps}$; $zz = \sin(R) ./ R$;
- $zz = (xx.^2) .* yy - 2 * yy$;

Fractals

This section includes examples on how to create fractal images in MATLAB. The images are shown with each section of code, plus a link to a downloadable version.

MATLAB_fractal1.jpg

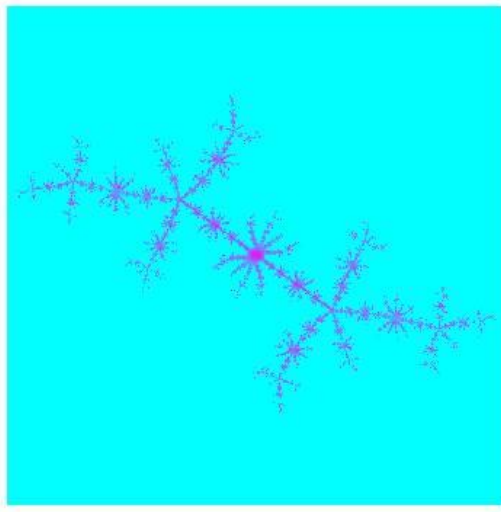


Link: <https://www.flickr.com/photos/152165451@N04/36388612513/in/album-72157688988119415/>

To change the colour of the Fractal select one of the above Colour Schemes and replace 'bone' with your desired colours.

```
col=100;
m=400;
cx=-.6;
cy=0;
l=1.5;
x=linspace(cx-l,cx+l,m);
y=linspace(cy-l,cy+l,m);
[X,Y]=meshgrid(x,y);
Z=zeros(m);
C=X+i*Y;
for k=1:col;
Z=Z.^2+C;
W=exp(-abs(Z));
end
colormap bone
pcolor(W);
shading flat;
axis('square','equal','off');
```

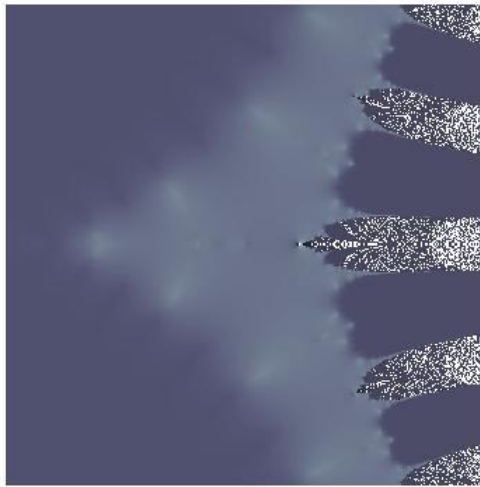
MATLAB_fractal2.jpg



Link: <https://www.flickr.com/photos/152165451@N04/37030712332/in/album-72157688988119415/>

```
col=30;
m=400;
cx=0;
cy=0;
l=1.5;
x=linspace(cx-l,cx+l,m);
y=linspace(cy-l,cy+l,m);
[X,Y]=meshgrid(x,y);
c= -0.561321+0.641000*i ;
Z=X+i*Y;
for k=1:col;
Z=Z.^2+c;
W=exp(-abs(Z));
end
colormap cool(256)
pcolor(W);
shading flat;
axis('square','equal','off');
```

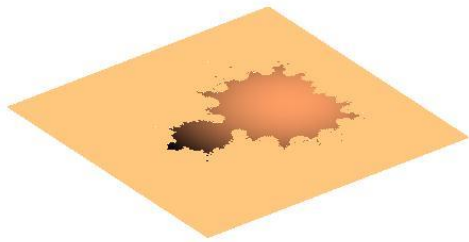
MATLAB_fractal3.jpg



Link: <https://www.flickr.com/photos/152165451@N04/36388612423/in/album-72157688988119415/>

```
col=20;
m=400;
cx=0;
cy=0;
l=5;
x=linspace(cx-l,cx+l,m);
y=linspace(cy-l,cy+l,m);
[X,Y]=meshgrid(x,y);
c=-0.01;
Z=X+i*Y+eps;
for k=1:col;
Z=Z.^Z+c;
W=exp(-abs(Z));
end
colormap bone(256)
pcolor(W);
shading flat;
axis('square','equal','off');
```

MATLAB_fractal4.jpg



Link: <https://www.flickr.com/photos/152165451@N04/37030712272/in/album-72157688988119415/>

```
col=20;
m=200;
cx=-.6;
cy=0;
l=1.5;
x=linspace(cx-l,cx+l,m);
y=linspace(cy-l,cy+l,m);
[X,Y]=meshgrid(x,y);
Z=zeros(m);
C=X+i*Y;
for k=1:col;
Z=Z.^2+C;
W=-abs(Z);
A = ( W <-.5);
B = 1-A;
V = abs(C.*C);
D = B.*sin(-0.2*V);
end
E = D-1;
colormap copper(256);
mesh(0.1*A+E);
shading flat;
axis([0 130 0 130 -2 0])
axis('square','equal','off');
```