1 Adding contour lines to a heat map

Here will will add contour lines to a heat map.

We'll use something a little more interesting for the array of values, we'll define a Mandlebrot fractal function. We have build a 1,000 and 1,000 array and calculate z as a Mandlebrot function of x and y.

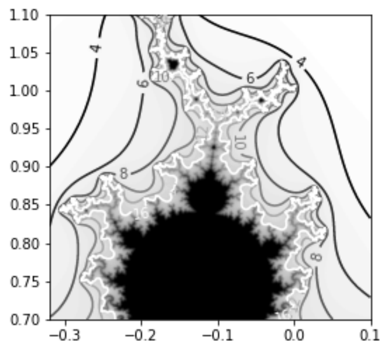
The heatmap is drawn with *plt.imshow*, and then contour lines are added with *plt.contour*.

See if you can follow how the arrays are built up, and the Mandlebrot function used to calculate Z, but the main purpose is to demonstrate adding contour lines to a heat map.

The Mandlebrot function may take up to 30 seconds to calculate (maybe longer on an old computer).

```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.cm as cm

%matplotlib inline

# Mandlebrot function - a fractal

def iter_count(c,max_iter):
    x=c
    for n in range(max_iter):
        if abs(x)>2:
            return (n)
        x=x**2+c
    return (max_iter)

# Build a 512 * 512 array of x, y

n=1000
max_iter=75
# xmin,xmax,ymin,ymax = -0.32,0,0.8,01.1
xmin,xmax,ymin,ymax = -0.32,0.1,0.7,1.1
x_series=np.linspace(xmin,xmax,n)
y_series=np.linspace(ymin,ymax,n)

# Create an empty array for z (which will calculated from all x and y)

z=np.empty((n,n))

# Calculate z based on the Mandlebrot function

for i,y in enumerate(y_series):
    for j,x in enumerate(x_series):
        z[i,j]=iter_count(complex(x,y),max_iter)

# THE CHART

# Show a grey scale heatmap with imshow

plt.imshow(z,
           cmap=cm.binary,
           interpolation='bicubic',
           origin='lower',
           extent=(xmin,xmax,ymin,ymax))
```

Figure 1: Adding contour lines to a heatmap



```
# Extent (above) defines the axes values which are not held in the
# results array (z) itself

# Add contours

levels=[2, 4, 6, 8, 10, 12, 14, 16] # Define levels

ct=plt.contour(x_series,y_series,z,levels,cmap=cm.gray)

# Add contour labels

plt.clabel(ct,fmt='%d')

plt.show()
```