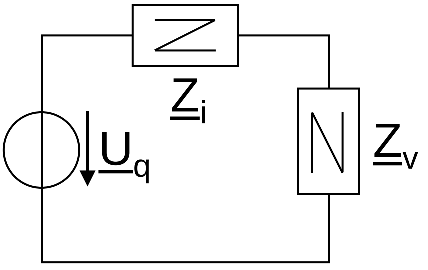
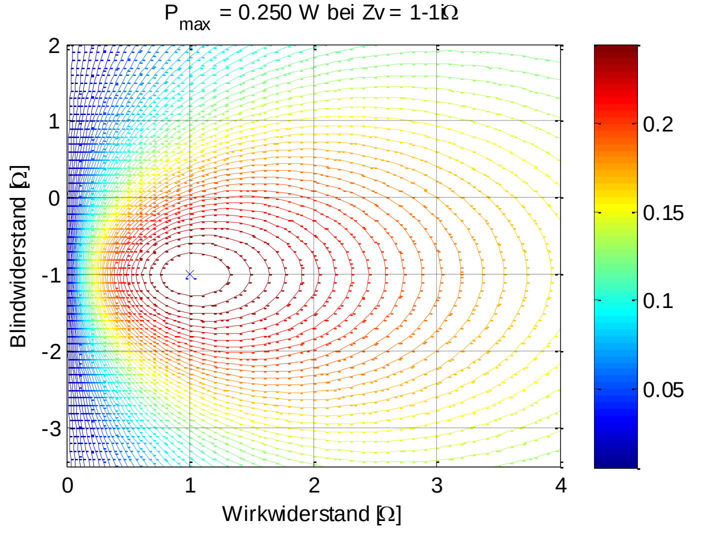
Homework 5 (sim10_arithmetics2)

1) impedance matching



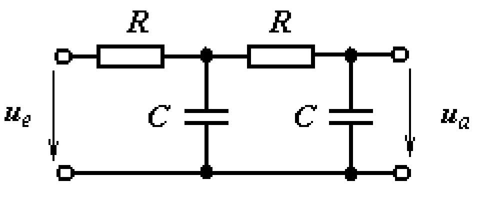


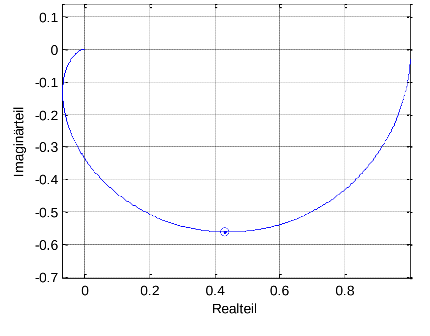
$\underline{U}_q$=1V, $\underline{Z}_i$ = (1+j) Ω.

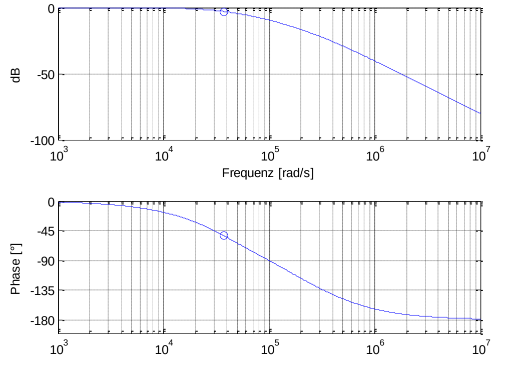
a) Calculate the real power at $\underline{Z}_v$ as a function of the active and reactive components of $\underline{Z}_v$ and plot the result as a contour plot.

b) Find load impedance $\underline{Z}_v$ with maximum real power.

2) Low pass filter



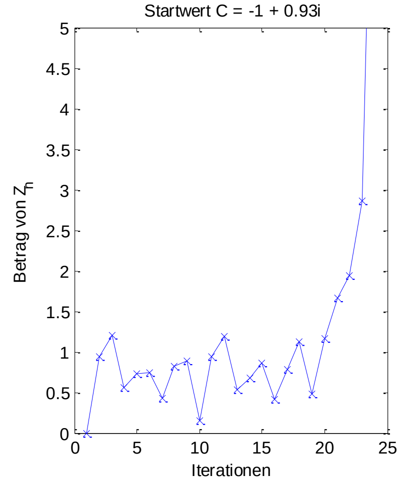




C=1µF, R = 10 Ω.

Draw the Nyquist- and Bodeplot of the voltage transfer function $\underline{U}_a/\underline{U}_e$ and mark the cut-off frequency where the amplitude drops to 1/√2.

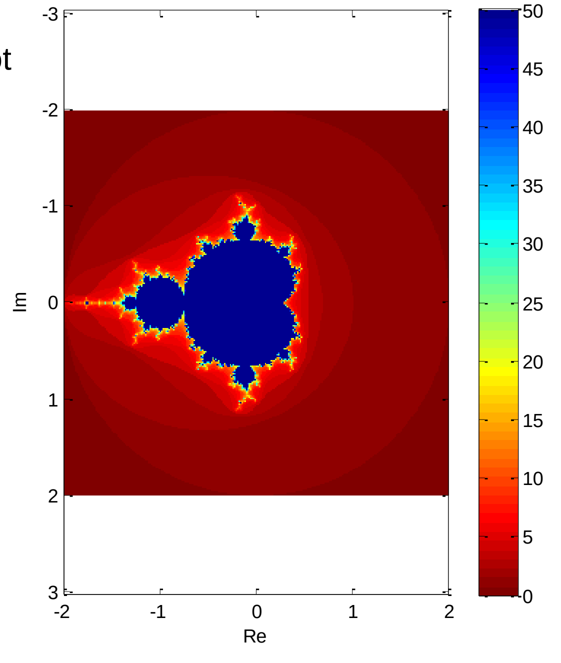
Aufgabe 3: Mandelbrot set



For this purpose the sequence $Z_{n+1} = Z_n^2 + C$ with $Z_0=0$ will be calculated.

a) For C= - 0.1 + 0.93i the sequence is plotted on the right.
As soon as the magnitude of Z becomes larger than 2, it diverges towards infinity. Calculate 30 elements of the sequence and determine when the sequence diverges. Do not use *if-end* in your code!

b) The first 50 elements of the sequence are now to be calculated not only for a single number C, but for all numbers of the complex number plane, whose real and imaginary part is smaller than 2. We are not interested in the final value of the sequence, but after how many iterations the sequence diverges.

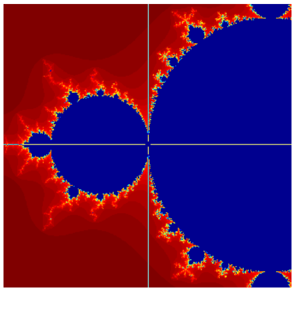


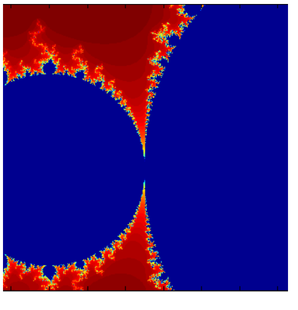
Generate the starting values of the sequence

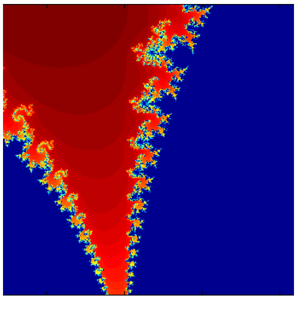
```
re=linspace(-2,2,div);
im=re;
[RE,IM] = meshgrid(re,im);
% matrix of complex plane
C = RE + 1i*IM;
```

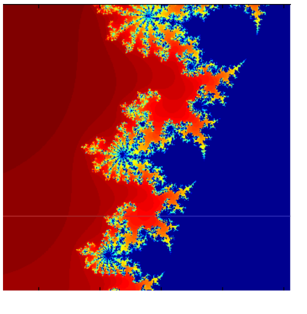
and calculate the number of iterations for each start value and plot them with *imagesc* in the colormap "jet".

c) Extend the program with a loop and the ginput() function to zoom into the images interactively.









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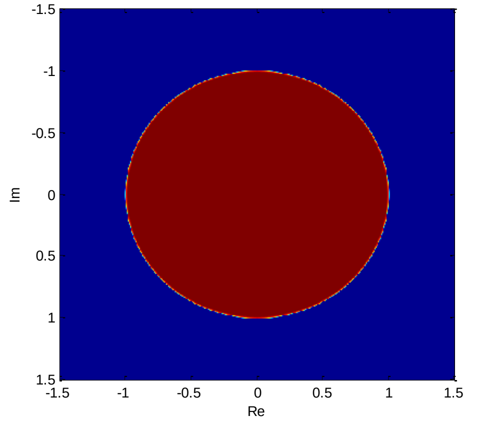
Optional

Aufgabe 4: Julia set

The mapping rule is: $Z_n = Z_{n-1}^2 + c$

Here Z_0 are the points of the complex number plane and c is a (complex) constant. If this mapping rule is executed iteratively, three possibilities result for each point Z.

$Z \rightarrow \infty$	(set of fugitives)
$Z \rightarrow 0$	(set of prisoners)
Z finite	(Julia set)

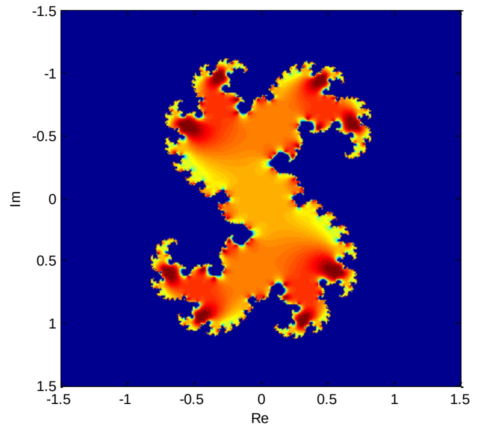


after 10 iterations for c = 0

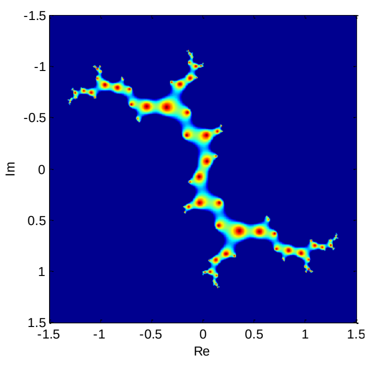
Example: for c=0, the Julia set in the complex plane is a circle with radius 1. All points outside belong to the fugitives, all points inside to the prisoners.

Write a program that, depending on c and the number of iterations, colors the magnitude of Z in the range of values from 0 to 2.

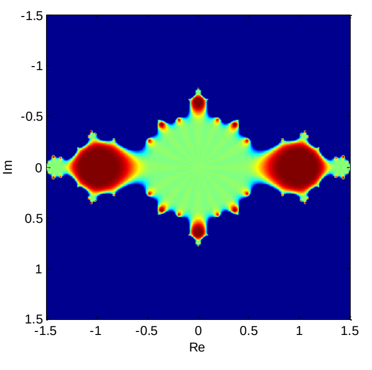
Use the colormap jet, where the fugitives (Z>=2) should be displayed in blue and the prisoners (Z=0) in red.



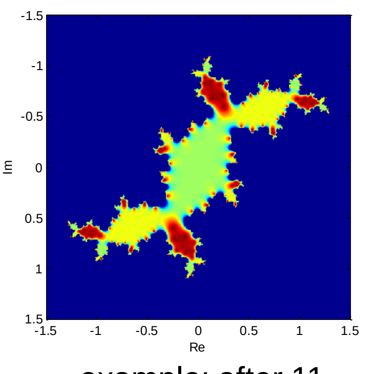
after 19 iterations for c = 0,36 + 0,1i



example: after 7 iterations for c = -i



example: after 7 iterations for c = -1



example: after 11 iterations for c = -0.1 + 0.8i