Lab2
Computational Physics I - Phys381

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1 Fractals

1.1 Question a:

1.1.1 Question a-i:

A complex number will produce a fractal if, when starting at zero and applying a law(interaction), keeps bounded until the number of interactions break. The interaction is going to keep bounded if you set a specific value for the complex number. On this interaction law the values for the complex number that keeps the value bounded are $-1 < x \leq 1$.

Data points obtained from [1.3.1]:

n_c	complex z	$\|complexz\|^2$
1	(0.300, 0.300)	0.424
2	(0.300, 0.483)	0.566
3	(0.159, 0.587)	0.609
4	(-2.0E-02, 0.48)	0.488

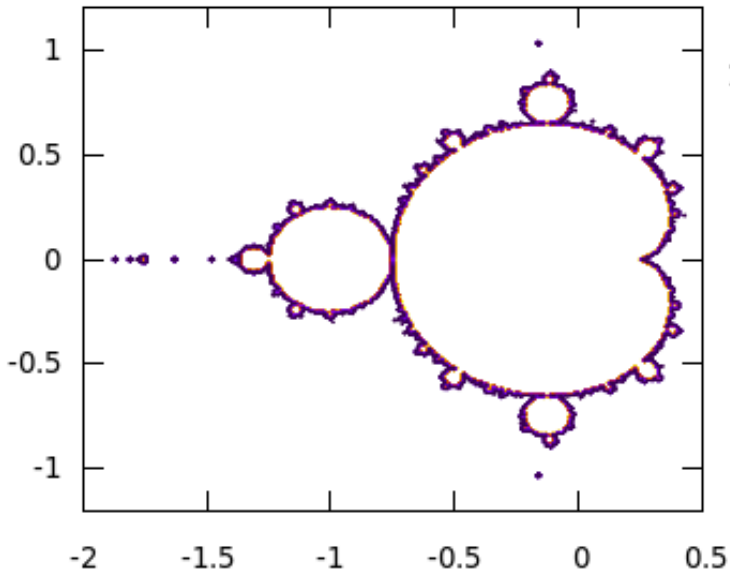
1.1.2 Question a-ii:

Data points obtained from [1.3.2]:

n_c	complex z	$\|complexz\|^2$
1	(0.500, 1.000)	1.118
2	(-0.250, 2.000)	2.015
3	(-3.437, 0.000)	3.437
4	(12.31, 1.000)	12.35
5	(151.1, 25.63)	153.3

1.2 Question B:

Figure obtained through the [1.3.3] and plotted using [1.3.4]:



1.3 Codes:

1.3.1 Question a-i:

```
 program main
complex :: complex_c, complex_z
integer :: i
complex_z = cmplx(0, 0)
complex_c = cmplx(.3, .3)
doi = 1, 4
complex_z = complex_z * complex_z + complex_c
print*, i, complex_z, abs(complex_z)
enddo
end
```

1.3.2 Question a-ii:

```
 program main
complex :: complex_c, complex_z
integer :: i
complex_z = cmplx(0, 0)
complex_c = cmplx(.5, 1)
doi = 0, 10
complex_z = complex_z * complex_z + complex_c
print*, i, complex_z, abs(complex_z)
enddo
end
```

1.3.3 main-program

```
 program main
! beginning of the code

complex :: complex_c, complex_z
! declaration of complex statements
integer :: i, j, k
! declaration of integer statements
real :: x, y
! declaration of real statements

open(12, file = "lab2.dat")
! open a file for writing the data points

x = -2.0
! initial value for x
k = -1000
! maximum value for iterations
do j = -200, 200
! first loop for the position x
y = -2.0
! initial value for y
do i = -200, 200
! second loop for the position y
complex_c = cmplx(x, y)
! value for complex C
complex_z = cmplx(.0, .0)
! value for complex Z
do
! Third loop

complex_z = (complex_z * complex_z) + complex_c
! Equation for the Mandelbrot

if abs(complex_z) >= 2.0) then
! first condition for breaking the loop
exit
! break the loop
end if
! end of the condition
if k == 1000) then
! second condition for
exit
! break the loop
end if
! end of the condition
k = k + 1
! increments for the number of iterations
end do
! end of the third loop
write(12, *), real(complex_c), aimag(complex_c), k
! writing the data on the open file
k = -1000
! restatement for k
y = y + 0.01
```

```
! increments for position y
end do
! end of the second loop
x = x + 0.01
! increments for position x
end do
! end of the first loop

close(12)
! close the open file

end program main
! end of the program
```

1.3.4 gnuplot-script

```
 reset
set xrange[-2.0:0.5]
set yrange[-1.2:1.2]
set key outside top right
set cntrparam levels auto 25
unset ztics
set key outside top right
unset surface
set isosamples 50
set view map
set palette rgbformulae 33,13,10
set contour
set ticslevel 0.8
set view map splot 'lab2.dat' u 1:2:3 w lines no title
pause -1
```