How to Draw Fractals with C

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Contents

This set of notes assume no maths higher than GCSE level and absolutely no programming experience.

1 Elementary Math

1.1 Sets

sets can be defined by listing its elements separated by commas in curly braces ie $S = \{1, 2, 3, 4\}$

Two sets A and B are equal iff every element of A is in B, and every element of B is in A. ie if $A = \{1, 2, 3, 4\}$ and $B = \{1, 2, 3, 4, 4\}$ then $A = B$ (repeats aren't counted in a set)

1.2 Some useful sets

$\mathbb{N}$ the set of natural numbers $\mathbb{N} = \{0, 1, 2, 3, \ldots\}$

$\mathbb{Z}$ the set of of all integers $\mathbb{Z} = \{\ldots, -2 - 1, 0, 1, 2, 3, \ldots\}$

$\mathbb{Q}$ the set of rational numbers $\mathbb{Q} = \{\frac{a}{b} : a, b \in \mathbb{Z}, b \neq 0\}$

$\mathbb{R}$ the set of real numbers

$\mathbb{C}$ the set of complex numbers $\mathbb{C} = \{a + bi : a, b \in \mathbb{R}\}$

1.3 Functions

functions map every element from one set of elements(domain) to an element of another set(codomain). for example the function $f(x) = x^2$ maps the number 2 to 4 and -3 to 9. here the domain is $\mathbb{R}$ and the codmain is $\mathbb{R}^+$

1.4 Induction

2 C and the Shell

In this course we will be using the C programing language because C is the bestest!

2.1 Hello World

Type the code in the following box into your favorite text editor

```c
#include <stdio.h>

int main() {
        printf("Hello, World!\n");
}
```

save as hello.c

at the command line type

`gcc hello.c && ./a.out`

this is really two commands, the first `gcc hello.c` compiles our source code into machine language. this outputs the file `a.out` in the same directory as the source code.

2.2 defining functions

In C functions are defined by writing the return type, the function name, and have the variables separated by commas in parentheses.

MAJOR DIFFERENCE between C functions and maths functions, C functions have SIDE EFFECTS!!!.

2.3 predicate logic

A	B	A∩B	A∪B
F	F	F	F
F	T	F	T
T	F	F	T
T	T	T	T

3 Drawing Geometry

3.1 Cartesian Geometry

2D Cartesian geometry is used to encode and manipulate points in 2D space to do this we choose some point as the origin and mark in O, choose a unit vector in some direction

Now in computer graphics the origin is the top left pixel of the monitor and

3.2 Drawing dots

The bare minium code necessary to draw a window and draw a dot to it.

```cpp
//  g++ draw_dot.c -lSDL2 && ./a.out
#include <SDL2/SDL.h>

int main() {
    SDL_Init(SDL_INIT_VIDEO);
    SDL_Window* window = SDL_CreateWindow(
                    "draw dot", SDL_WINDOWPOS_UNDEFINED,
                    SDL_WINDOWPOS_UNDEFINED, 1000, 1000, 0);
    SDL_Renderer* renderer = SDL_CreateRenderer(
                        window, -1, SDL_RENDERER_ACCELERATED);

    SDL_Event event;

    while(event.type != SDL_QUIT) {
        SDL_PollEvent(&event);
        SDL_SetRenderDrawColor(renderer, 0, 0, 0, 0);
        SDL_RenderClear(renderer);


        SDL_RenderPresent(renderer);
    }


    // clean up
    SDL_DestroyRenderer(renderer);
    SDL_DestroyWindow(window);
}
```

Appendices

A Useful code

```cpp
class Complex { public:
    double a, b;
    Complex(double a_, double b_) :a{a_}, b{b_} {}

    Complex operator + (Complex const& obj) {
        return Complex(a+obj.a, b+obj.b);
    }
};
```