Simple Perl 6 Fractals and Concurrency

Steve Mynott

https://github.com/stmuk/contalk

Why?

- Fractals are nice and easy to calculate and look pretty
- But time consuming to run
- Supposed to run well in parallel
- Perl 6 has great support for concurrency
- Use those extra core(s)

Which Fractal?

- The Obvious One!
- Benoit B. Mandelbrot (20 November 1924 – 14 October 2010)

How?

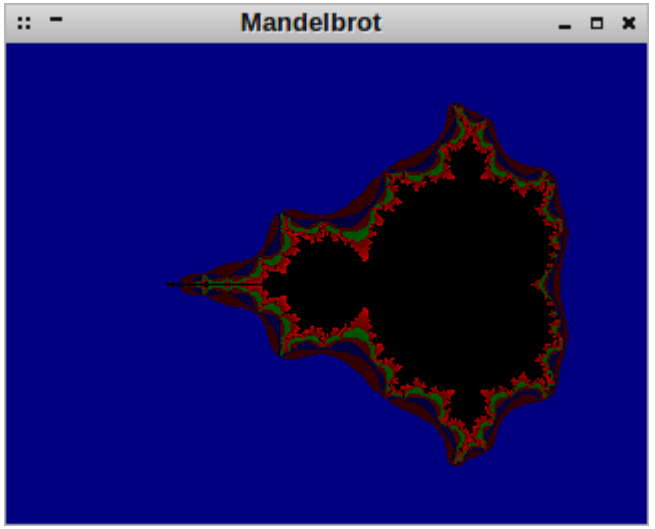
- Perl 6 in “performance enhancement phase”
- So very small size 320x240 (80s retro!)
- On Celeron N2840 (~2.16GHz) took 100 secs
- Plot with SDL (Simple DirectMedia Layer)
- Code tested on Linux and Mac

Code Overview 1 of 2

```
loop (my $y = 1; $y >= -1; $y -= 0.01) { # rows
    loop (my $x = -2; $x <= 1; $x += 0.01) { # cols

            my ($res, $i) = mandelbrot($x + $y * i);
            my $color=128;
            $color=10*$i if $i;

            if !$res.defined {
                $color=0;
                SDL_SetRenderDrawColor($render, $color, $color, $color, 0);
                SDL_RenderDrawPoint($render, ($x*($width/4)).Int+200, ($y*($height/4)).Int+120);
            } else {
                if $i < 5 {
                    SDL_SetRenderDrawColor($render, 0, 0,128, 0);
                } elsif $i > 5 and $i < 7 {
                    SDL_SetRenderDrawColor($render, 0, 0, $color, 0);
                }

                ...

                SDL_RenderDrawPoint($render, ($x*($width/4)).Int+200, ($y*($height/4)).Int+120);
                SDL_RenderPresent($render);
            }

        }

}
```

Code Overview 2 of 2

```
sub mandelbrot(Complex $c) {
    my $z = $c;
    for (1 .. 20) -> $i {
        $z = $z * $z + $c;
        return ($z,$i) if $z.abs> 2;
    }
}
```



Perl 6 Promises

```
my $p = start { say "hi" }

await $p;
```

Simple Loop

```
for ('a'..'c') -> $l {
    print "$l";
    for (1..3) -> $i {
        print $i
    }
}
```

```
a123b123c123
```

Async Loop

```
await do for ('a'..'c') -> $l {
    print "$l";
    start do for (1..3) -> $i {
        print $i
    }
}
```

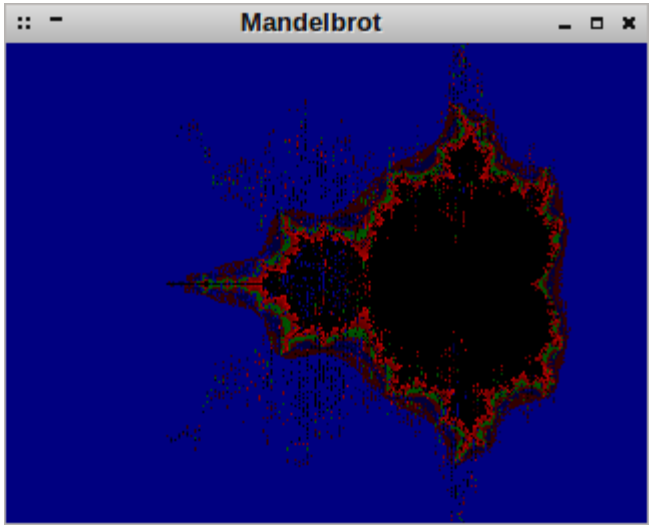
```
ab123c123123
```

mbrot2.p6

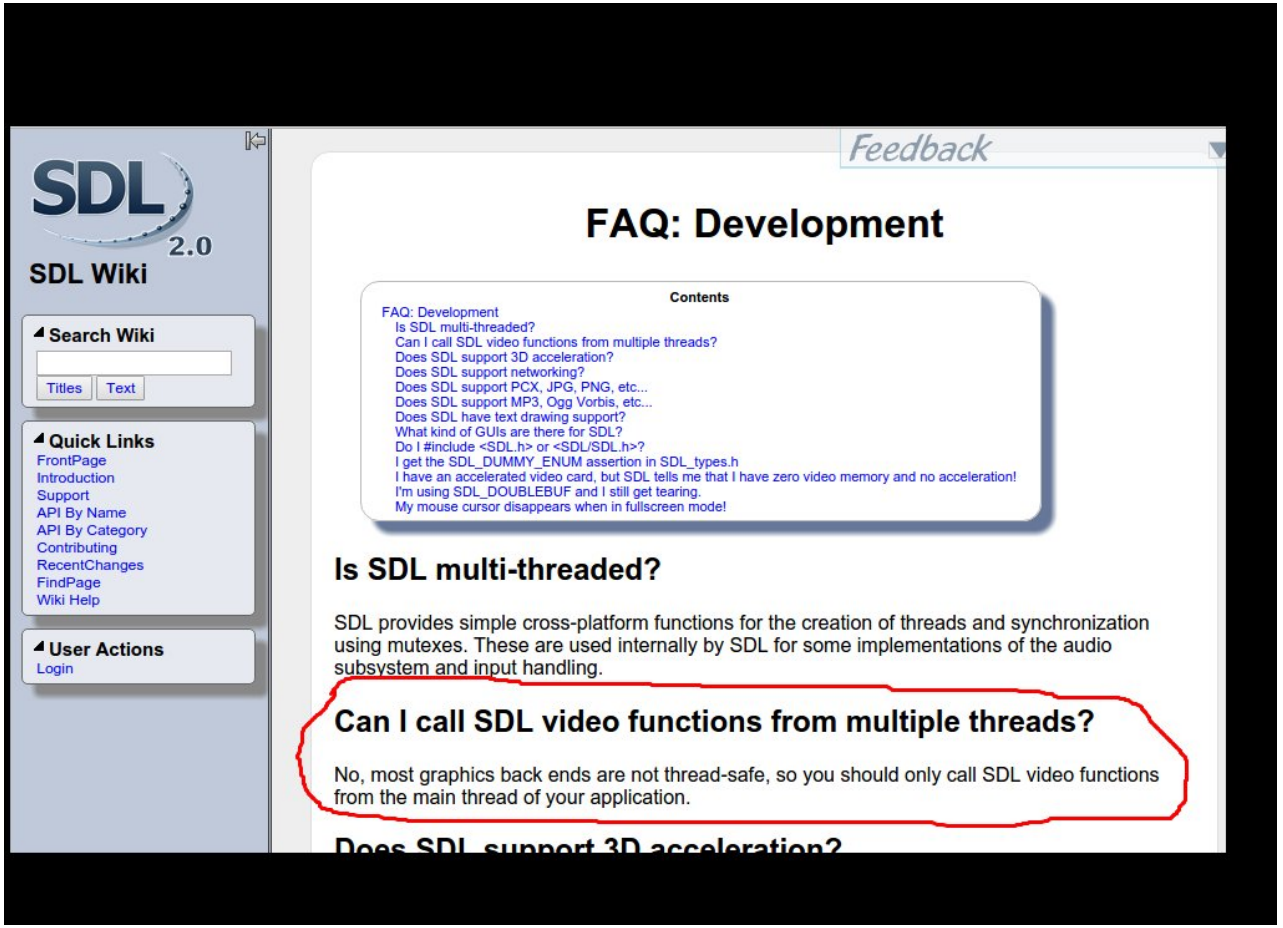
```
await do for ( 0..$width) -> int $xcoord {
    start {
        for ( 0..$height-1) -> int $ycoord {
```

Oh dear

- Took 80% of time (better) but

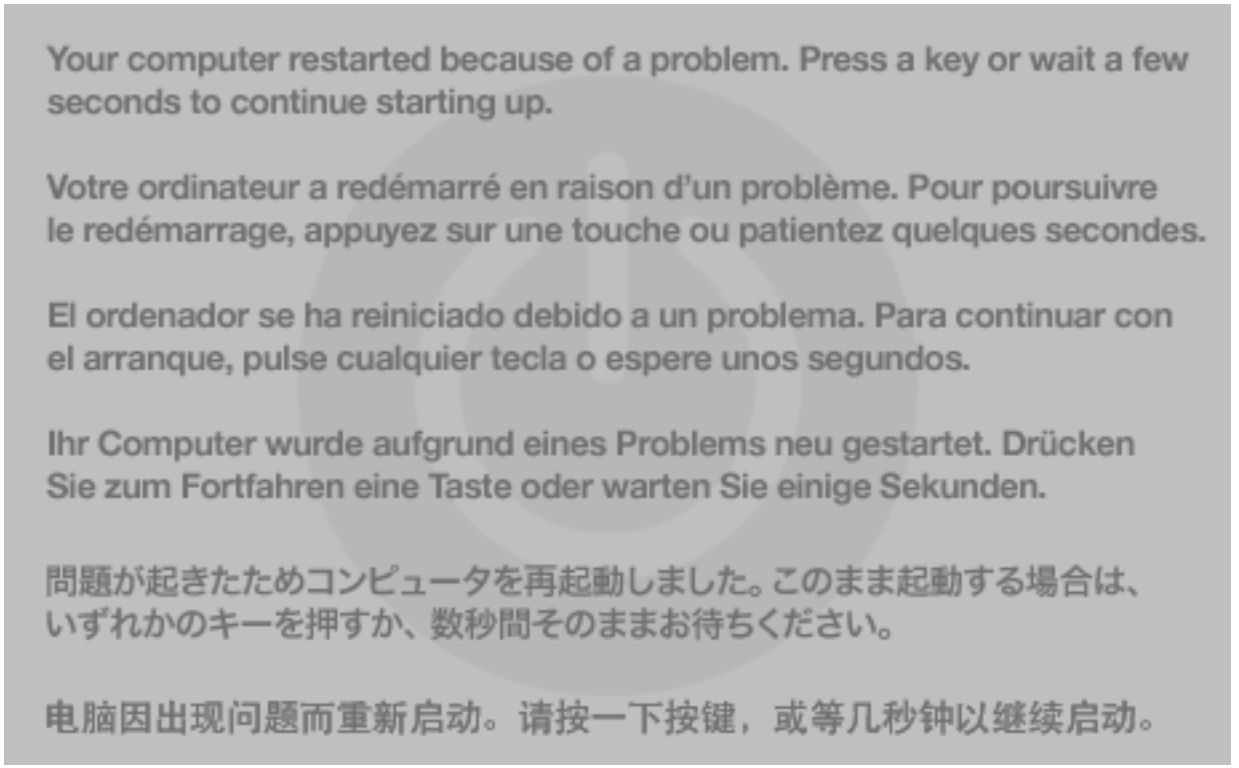


SDL2 didn't work with threads



Mac didn't like it

- Reproducible Kernel panic
- Apple's problem not the Perl 6 Team!



What's A Solution?

- http://doc.perl6.org/language/concurrency
- Locking!

mbrot3.p6

```
    my $l = Lock.new;

    await do for ( 0..$width) -> int $xcoord {
        start {
            for ( 0..$height-1) -> int $ycoord {
                …
                $l.protect(sub{plot($render, $xcoord, $ycoord
$color)});
```

Visible Threading

Locking Works But...

- Image looks fine and its only costs a little more time than not locking
- Not really supposed to use lock due to risk of deadlocks
- Better, more high level solutions in Perl6
- “Channel” – thread safe queue (multiple writers to single reader)

mbrot4.p6 (reader)

```
my $c = Channel.new;

my $plotting = start {
    my $closed = $c.closed;
    loop {
        if $c.poll -> $item {
            my ($xcoord, $ycoord, $color) = $item;
            plot($render, $xcoord, $ycoord, $color);
        }
        elsif $closed {
            last;
        }
    }
}
```

mbrot4.p6 (writers)

```
await do for ( 0..$width) -> int $xcoord {

    start {
            ...
            my $item = ($xcoord, $ycoord, $color);
            $c.send($item);
        }
    }

}

$c.close;

await $plotting;
```

Cheating a little

- Messing with thread scheduler

```
$PROCESS::SCHEDULER=ThreadPoolScheduler.new(initial_threads => 0, max_threads => 2,
uncaught_handler => Callable);
```

Benchmarks

benchmarking will run 3 iteration(s)

- mbrot1.p6 – non-concurrent 100s
- mbrot2.p6 - broken concurrent 74s
- mbrot3.p6 - concurrent with lock 80s
- mbrot4.p6 - concurrent with channel 112s

Threading is slower!

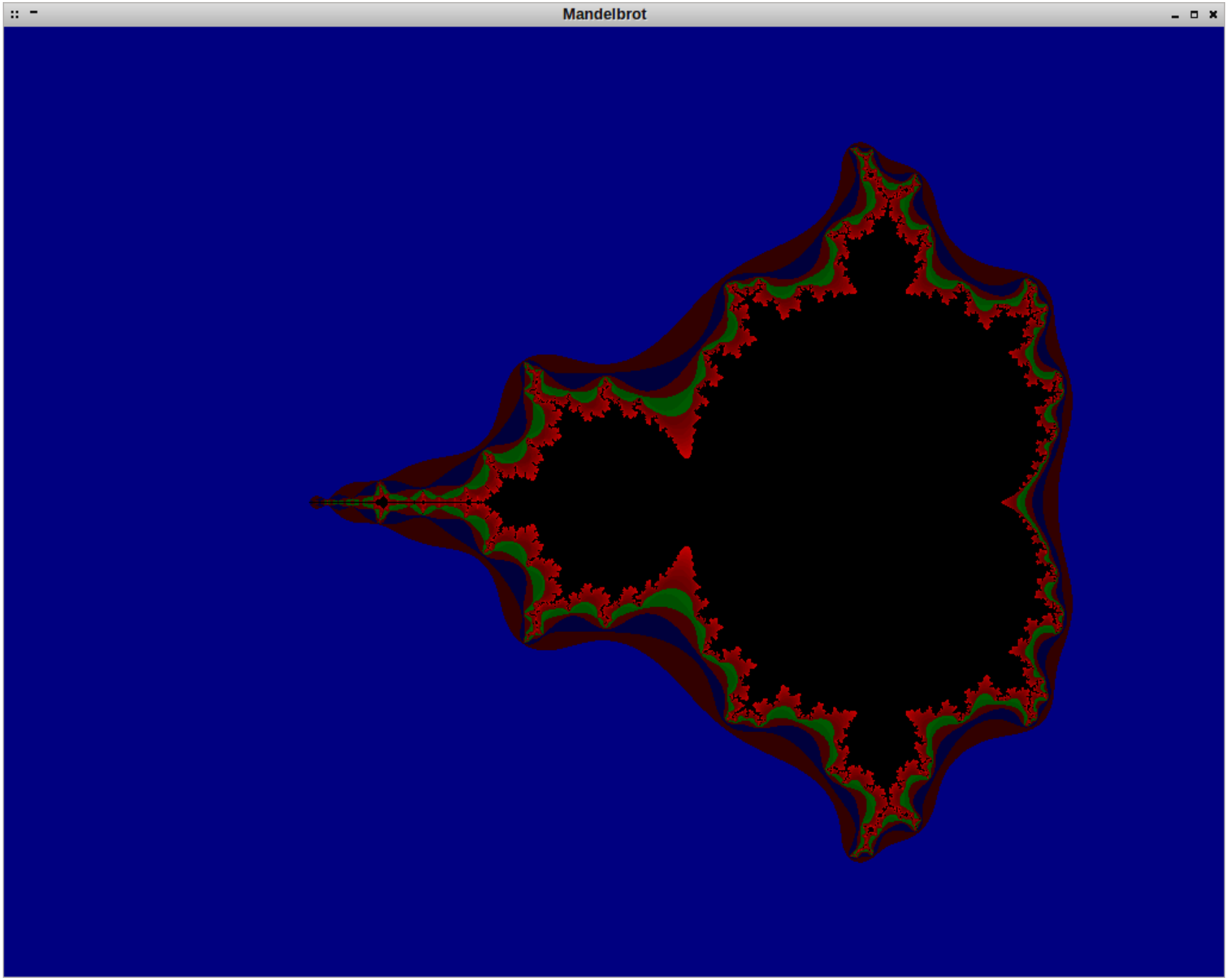
- What to do?
- Freenode/#perl6
- “Threading has a lot of overheads only improves performance with 1000-10,000s of calculation / promise” – moritz
- Increase number of pixels and wait longer

Bigger Mandelbrot!

- 1024x768 (90s retro)
- Use faster computer (2nd Gen i5 2.5Ghz)
- Wait longer

Results

- Standard Mandelbrot – 67 minutes
- Mandelbrot with channel – 62 minutes
- Not hugely different but at least faster!
- Research continuing – watch this space!


Mandelbrot

Conclusions

- Concurrency in Perl 6 is fairly easy
- It is a good selling point
- Not a “silver bullet”
- Releases this year set to improve performance

https://github.com/stmuk/contalk