More OpenMP

- `schedule` clause
- `collapse` clause (OpenMP 3.0)
- Matrix power example

Specifying Data Distributions

Using just

```
#pragma omp for
```

leaves the decision of data allocation up to the compiler

When you want to specify it yourself, use **`schedule`**:

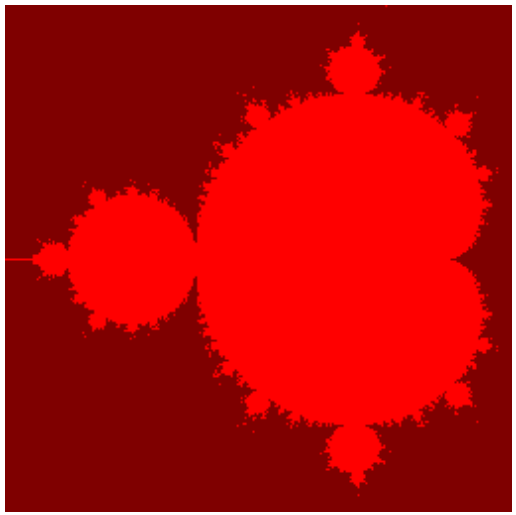
```
#pragma omp for schedule(....)
```

See color Mandelbrot example...

Mandelbrot: Speed-up with 4 Processors

Sequential performance:

4000 pixels: 2.59 seconds, 99% CPU

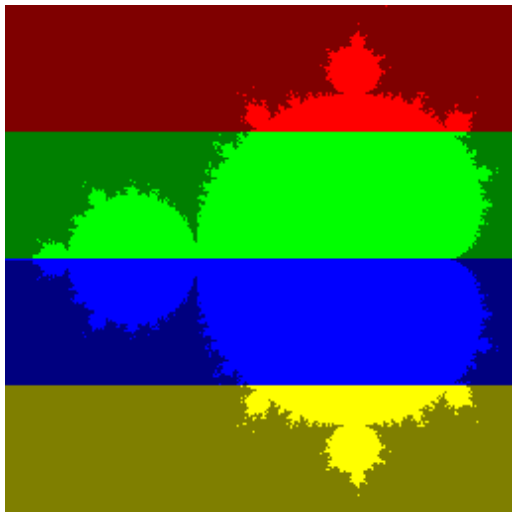


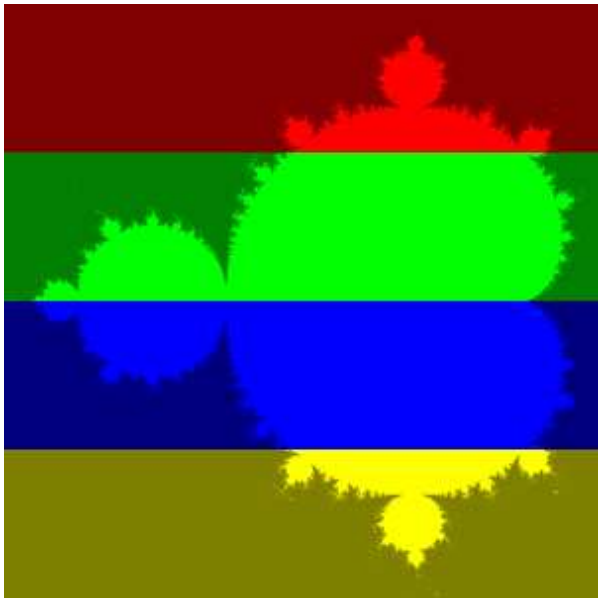
Measurements use a Xeon 4-CPU machine, gcc 4.1.2, and Linux 2.6.23

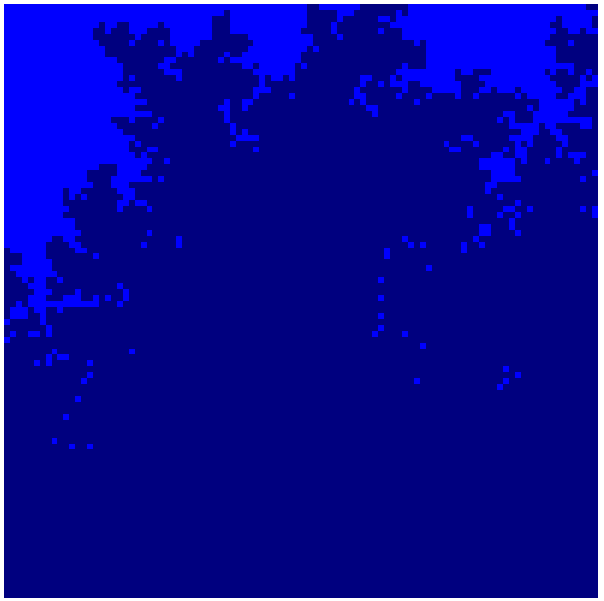
Mandelbrot: Speed-up with 4 Processors

4 processors, `schedule(auto)`

01.04 seconds, 239% CPU







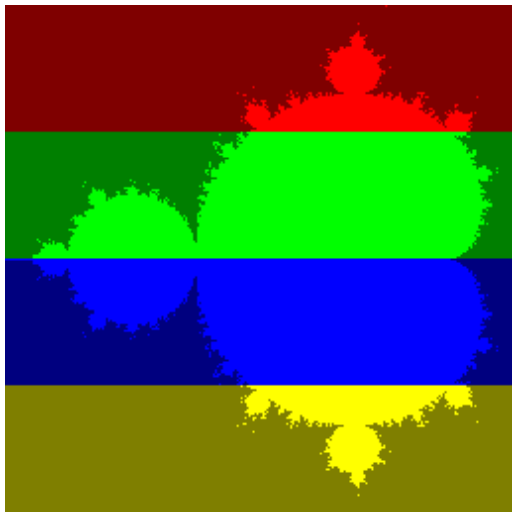
256 pixels

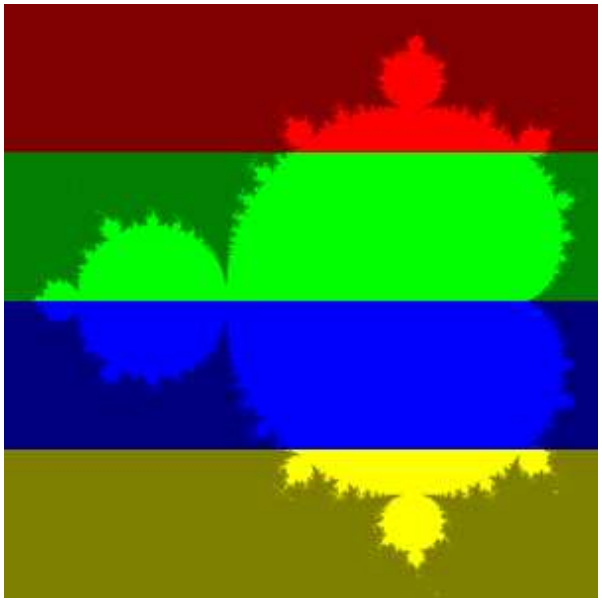
2000 pixels

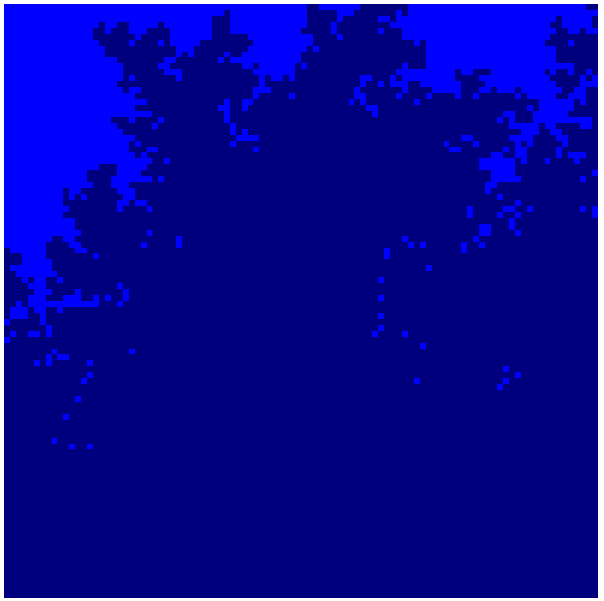
Mandelbrot: Speed-up with 4 Processors

4 processors, `schedule(static)`

00.93 seconds, 267% CPU







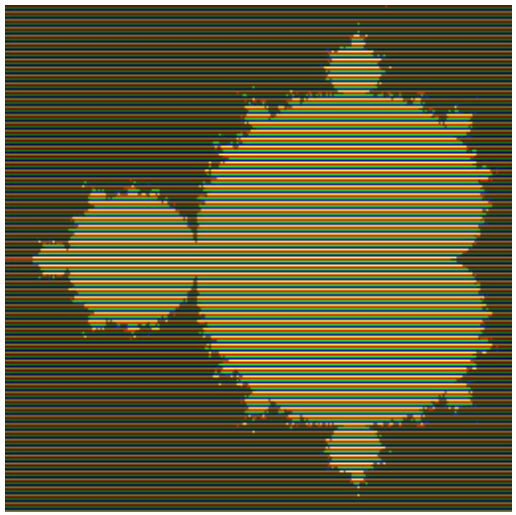
256 pixels

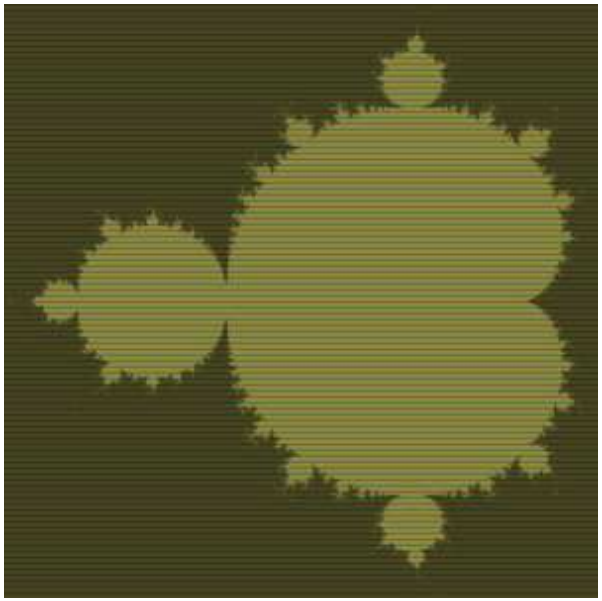
2000 pixels

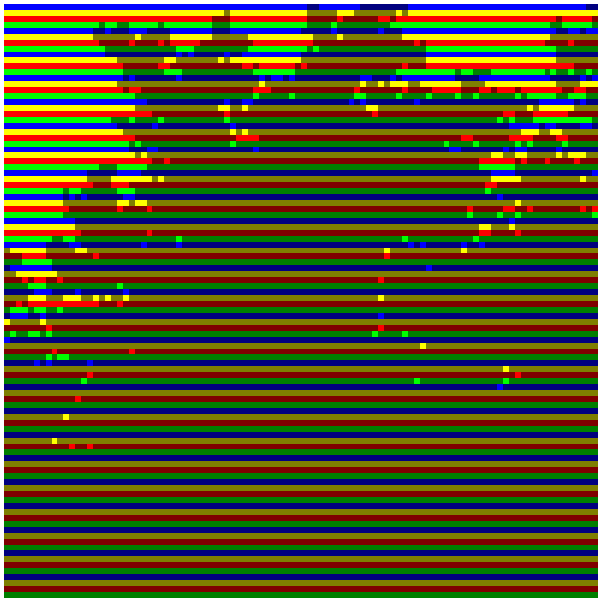
Mandelbrot: Speed-up with 4 Processors

4 processors, `schedule(static, 1)`

00.86 seconds, 289% CPU







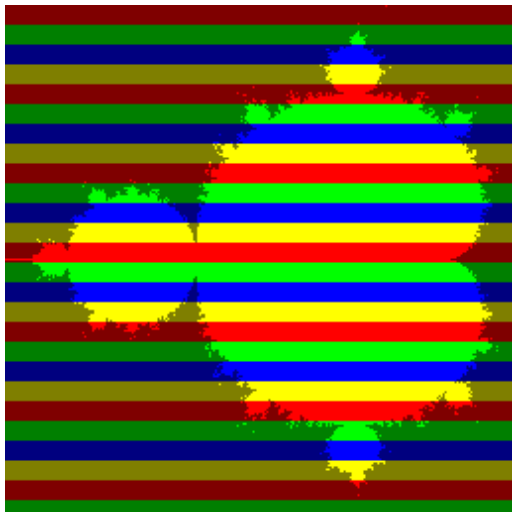
256 pixels

2000 pixels

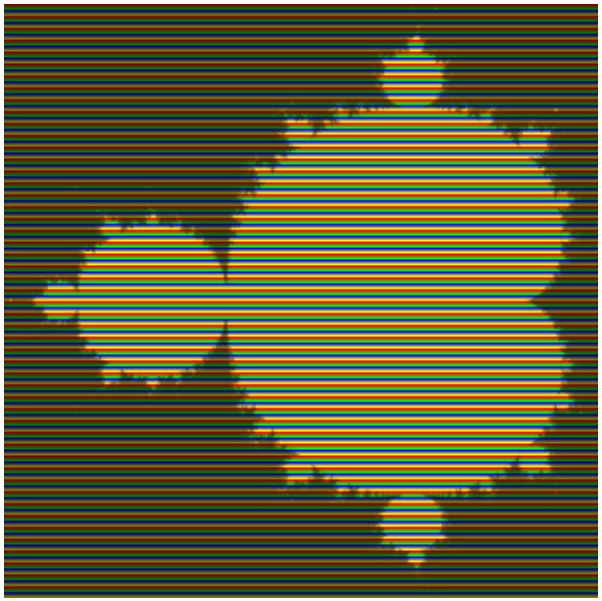
Mandelbrot: Speed-up with 4 Processors

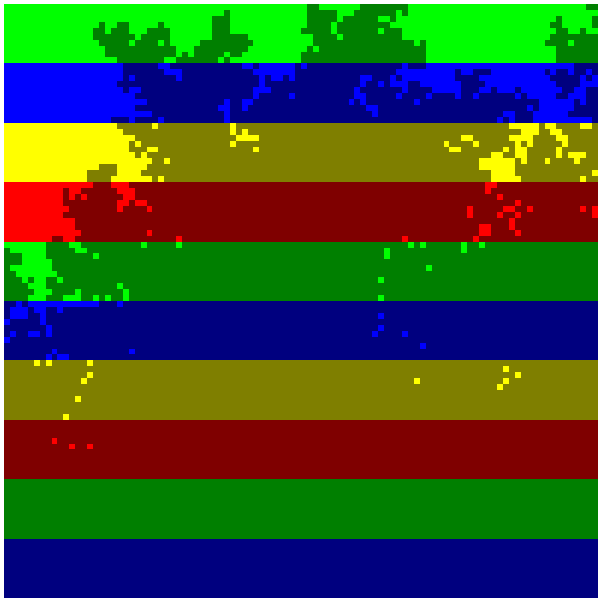
4 processors, `schedule(static, 10)`

00.85 seconds, 294% CPU



256 pixels



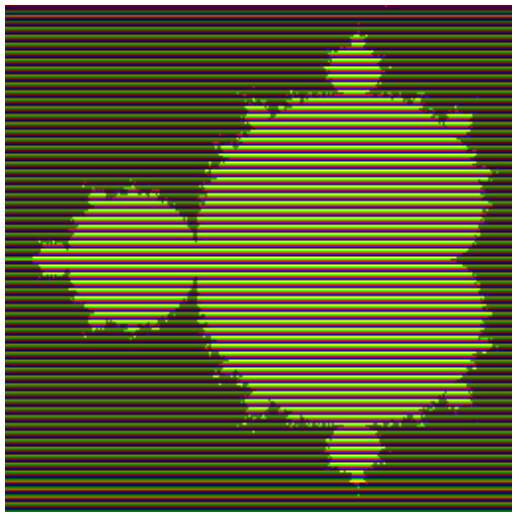


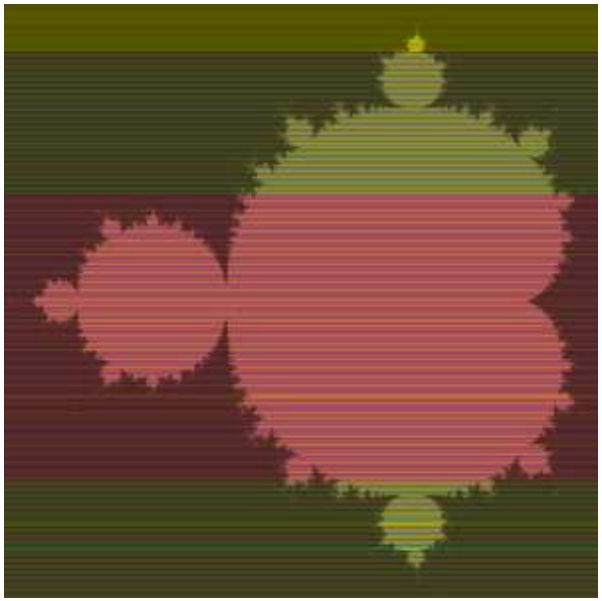
2000 pixels

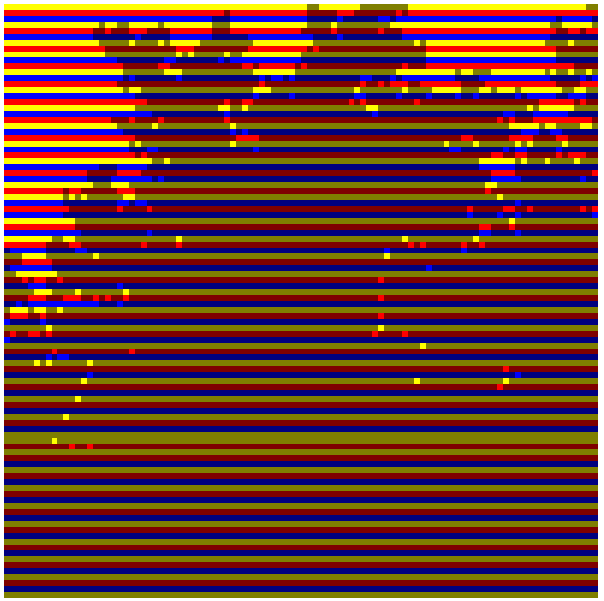
Mandelbrot: Speed-up with 4 Processors

4 processors, `schedule(dynamic)`

00.72 seconds, 350% CPU







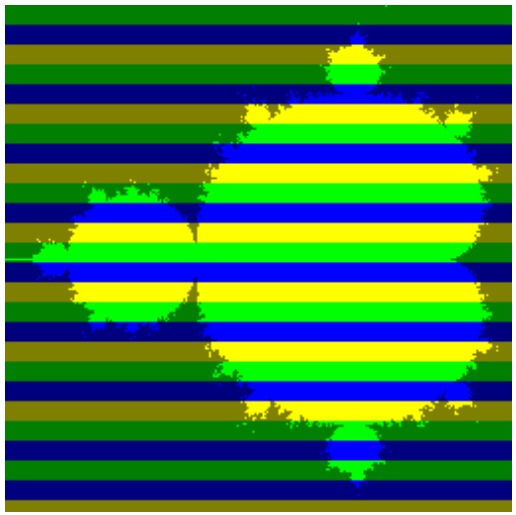
256 pixels

2000 pixels

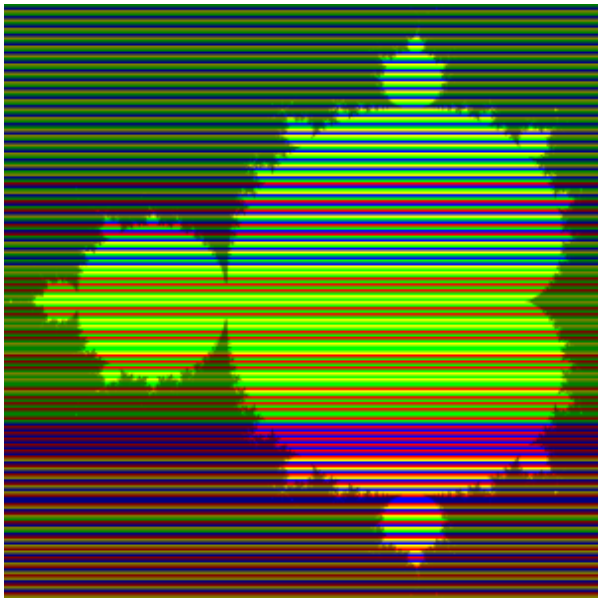
Mandelbrot: Speed-up with 4 Processors

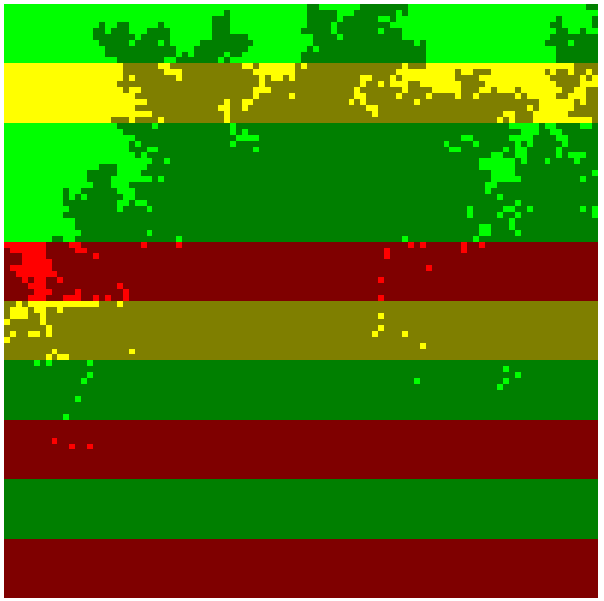
4 processors, `schedule(dynamic, 10)`

00.66 seconds, 381% CPU



256 pixels



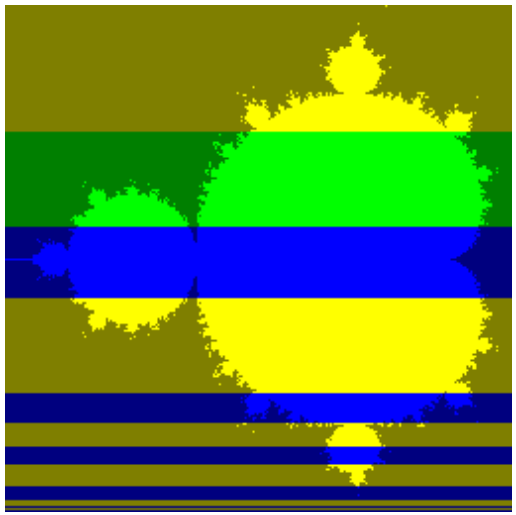


2000 pixels

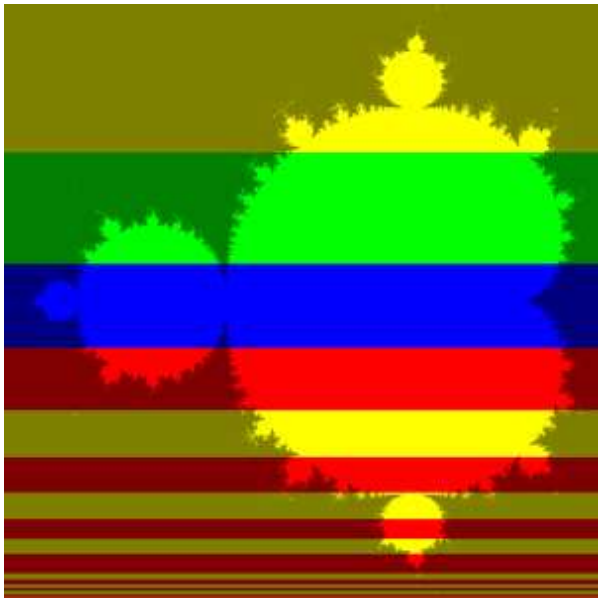
Mandelbrot: Speed-up with 4 Processors

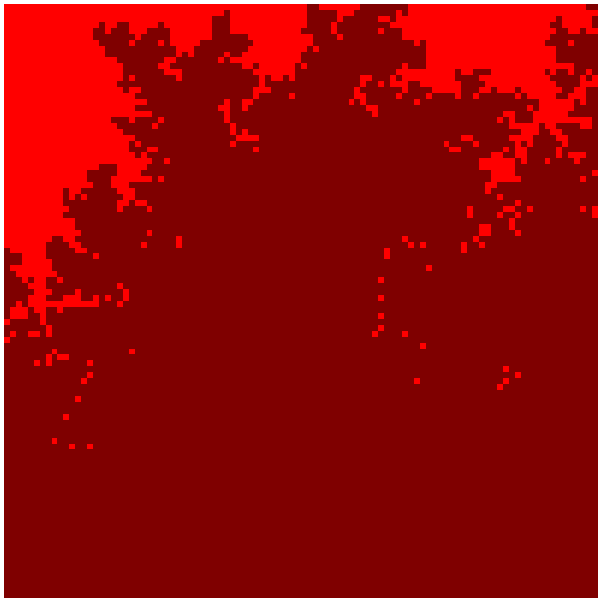
4 processors, `schedule(guided)`

00.83 seconds, 302% CPU



256 pixels



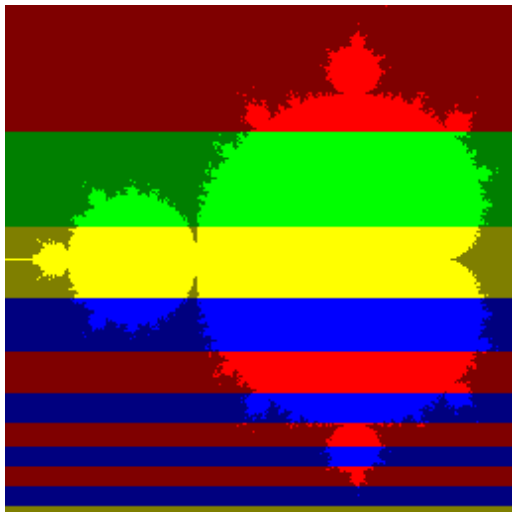


2000 pixels

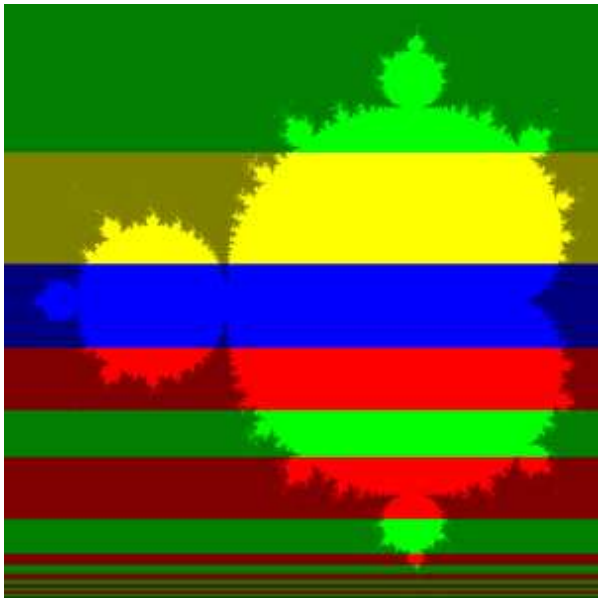
Mandelbrot: Speed-up with 4 Processors

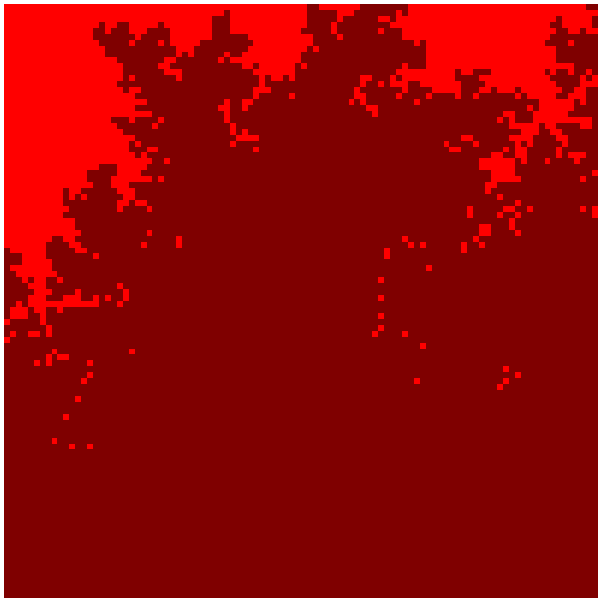
4 processors, `schedule(guided, 10)`

00.78 seconds, 318% CPU



256 pixels





2000 pixels

Collapsing Loops

Suppose that we want to break up the Mandelbot image in finer granularities than a line:

```
int y; ...
#pragma omp parallel for
for (y = 0; y < h; ++y) {
  int x; ...
  for (x = 0; x < w; ++x) { ... }
}
```

With OpenMP 3.0 (not supported on CADE installation), you could use the **`collapse`** clause

```
int x, y; ...
#pragma omp parallel for collapse(2)
for (y = 0; y < h; ++y)
  for (x = 0; x < w; ++x) { ... }
```