

The Mandelbrot Set

- the “Mandelbrot set” is the set of points C in the complex plane for which the series

$$Z_{n+1} = Z_n^2 + C$$

with $Z_0=0$ remains bound (i.e. does not diverge).

- for the Mandelbrot set, divergence is given once $|Z_n| > 2$

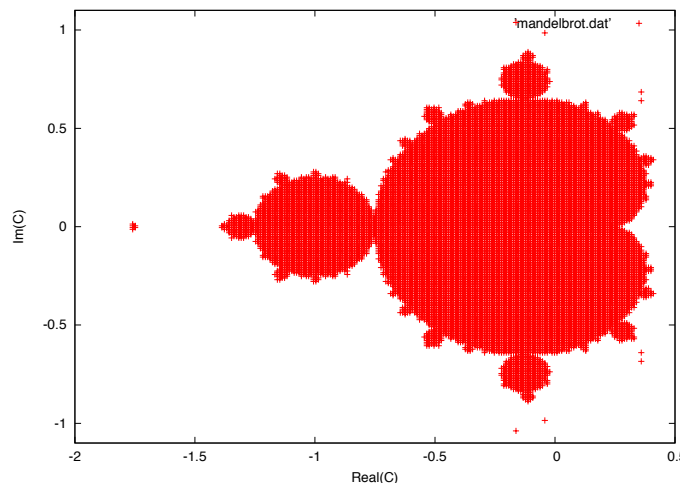
➤ **exercise:**

- write an OpenMP parallel code covering the complex plane in the range

$$C_{\min} = (-2, -1.1), \quad C_{\max} = (+0.5, +1.1)$$

determining the divergence of each point.

- write the non-divergent points into a file, e.g. ‘mandelbrot.dat’
- use, for instance, `gnuplot` to generate a plot marking each point C for which the series has not diverged with a cross:



▪ **tips:**

- let the number of points in each dimension `Real(C)` and `Im(C)` be a parameter, e.g.

```
NPOINTS_PER_DIMENSION
```

- use dynamically allocated arrays, e.g.

```
double *c_real, *c_img;
int *notdiverged;
```

- `notdiverged []` should be accessed like a 2-dimensional array storing either 0 or 1
- if the series has not diverged after `NMAXITERATIONS=1000` consider it non-divergent
- fill the arrays `c_real[]`, and `c_img[]` before a double nested loop checking for divergence
- use a subroutine to check for the divergence of a given point `c_real[i]`, `c_img[j]`
- use a subroutine that takes the arrays `c_real[]`, `c_img[]`, `notdiverged[]` to write the output file