Mandelbrot Area Challenge

Fast & Efficient Python School
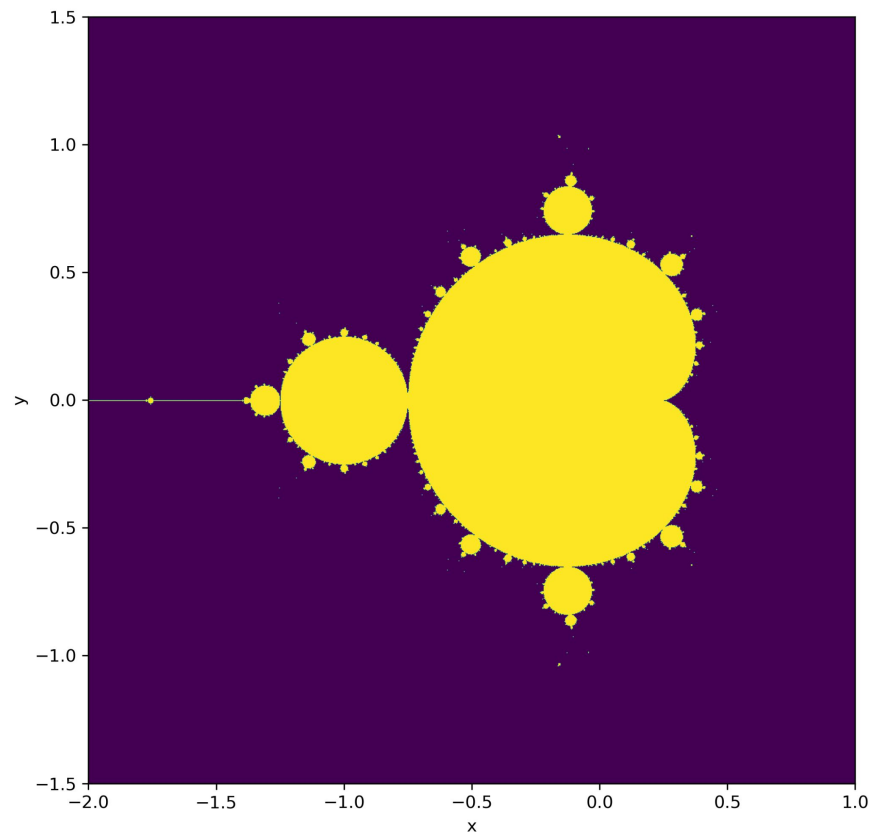
Thanks to Jim Pivarski

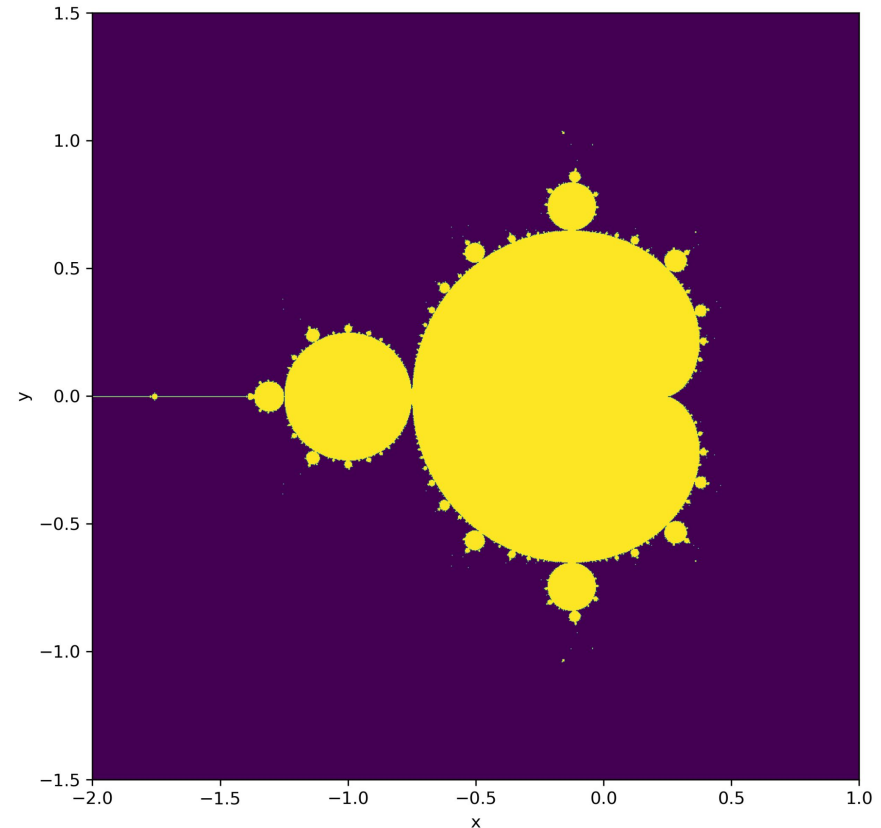# Mandelbrot Set

- Set of complex numbers **c**

$$z_{i+1} = |z_i|^2 + c \text{ with } z_0 = 0$$

$$|z_i| \to \infty \text{ as } i \to \infty$$

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Goal: Calculate the area of the Mandelbrot set and the uncertainty on the area
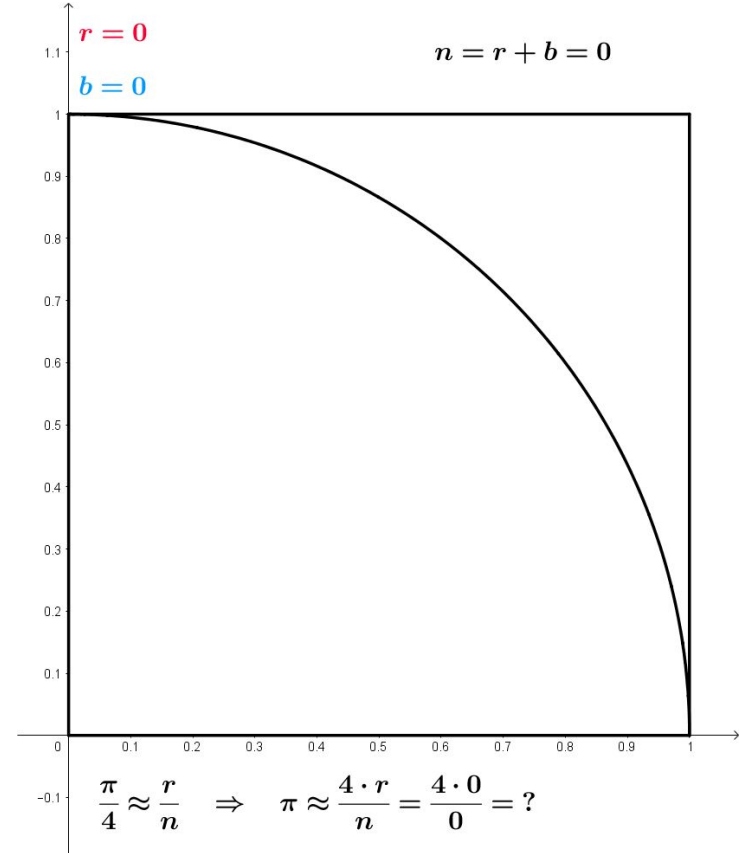
The Task

Task

- Area can be calculated recursively, but lot of terms need to be computed
  - 10^{1181} for three digits
- Faster: Use sampling to calculate area

A = (points in set) / (total points sampled) * (area of sampling region)

$r = 0$

$b = 0$

$n = r + b = 0$

$$\frac{\pi}{4} \approx \frac{r}{n} \quad \Rightarrow \quad \pi \approx \frac{4 \cdot r}{n} = \frac{4 \cdot 0}{0} = ?$$
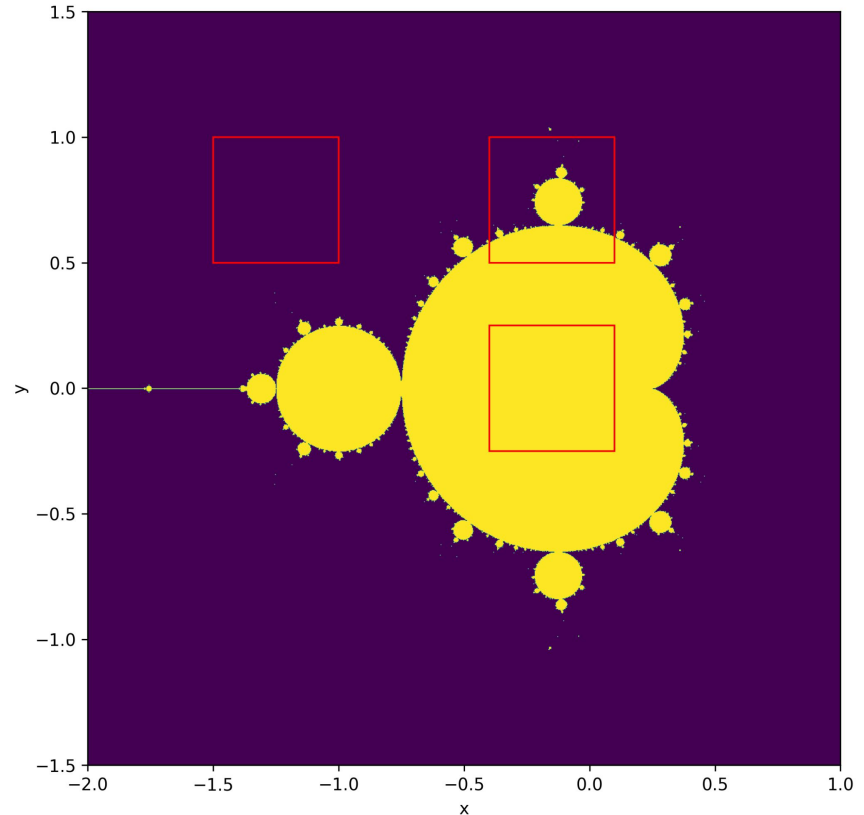
Task

But: Area estimate will be uncertain in some regions (Edge region)

Idea: Subdivide the plane into equal-sized tiles and sample different number of points in each tile

->Uncertainty on area in tile has to reach specific threshold

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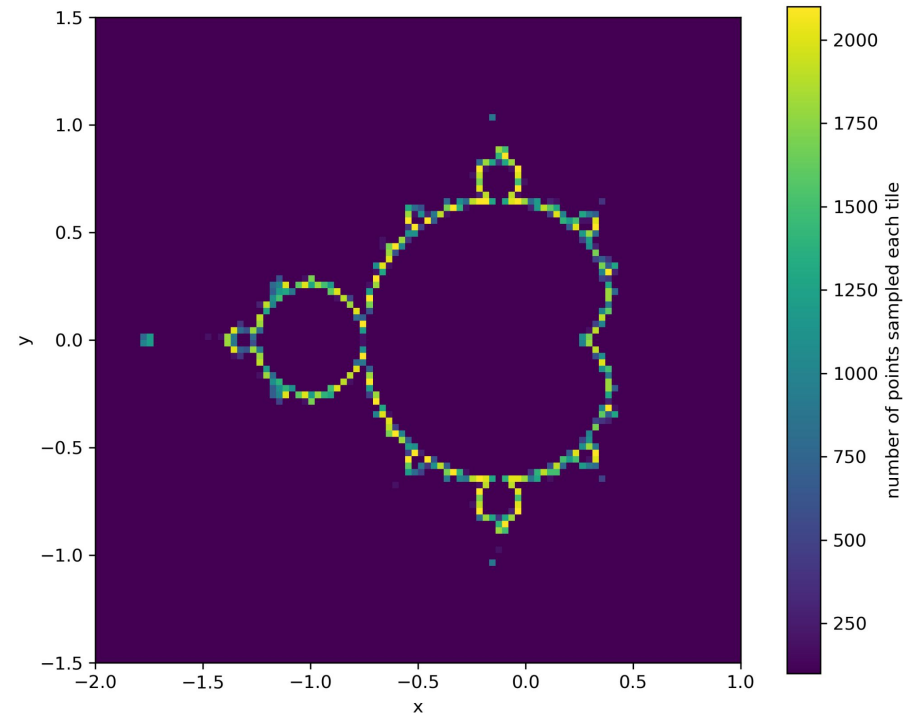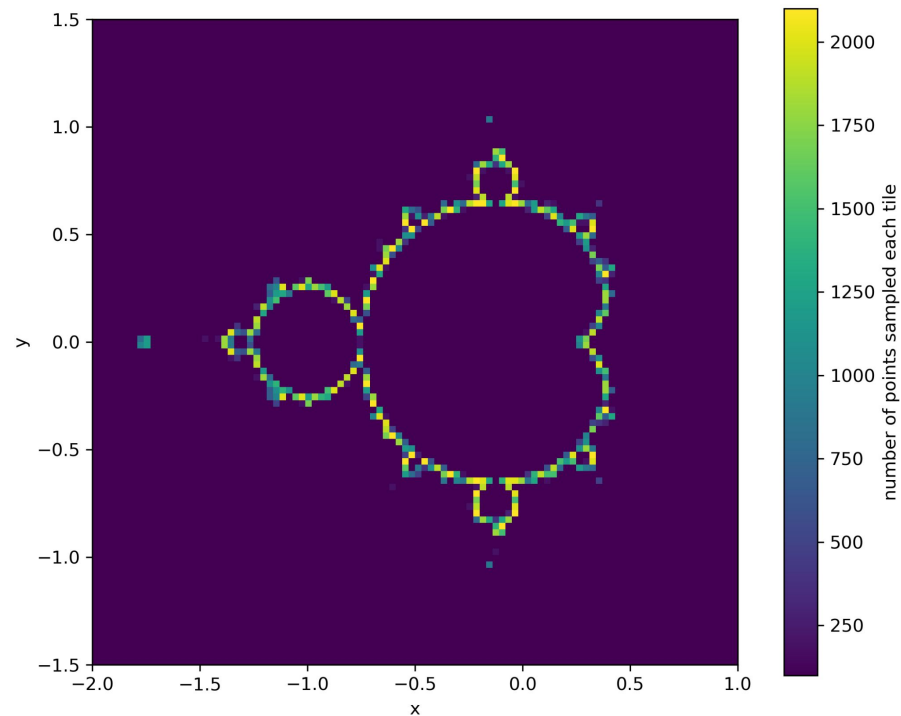->Uncertainty on area in tile has to reach specific threshold

Task: Implement the calculation on GPUs and break the current world record!

The Rules

Rules

- Limitations: **NONE**, use anything you want
- Starting point with detailed explanations: Vispa Example
- http://vispa.physik.rwth-aachen.de

- Teams:
  - 3 teams with 6 people
  - 4 teams with 7 people
  - Teams will be assigned
  - After you have been assigned, please put your name accordingly into this spread sheet
- Team names:
  - Red (No. 1)
  - Yellow (No. 2)
  - Pink (No. 3)
  - Green (No. 4)
  - Orange (No. 5)
  - Blue (No. 6)
  - White (No. 7)

The presentation

Presentation

- Slides for 7(+3)min presentation
- Please mail your slides to info@erumdatahub.de until 11:00 on Thursday

Use the presentation template on google slides

Rooms: Here, Rooms next to the buffet

Jury (Lecturers & Tutors) will announce a winner based on:
- Teamwork
- Problem investigation
- Ansatz
- Results
- Outlook
- Bonus points: Creativity