An Investigation of Chaos Theory Using Supercomputer Techniques

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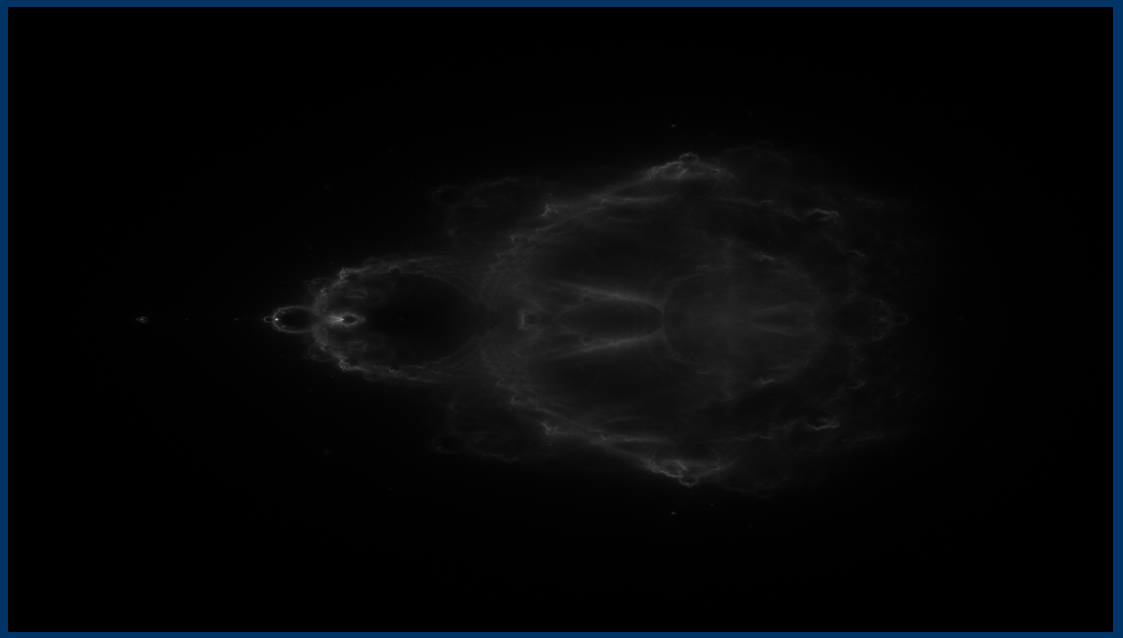
Chaos Theory

- The theory of non-linear functions, such that small differences in the input of the function can result in large and unpredictable differences in the output.
- Seen all over the world:
  - Weather
  - Stock Market
  - Physics

Fractals

- A mathematically generated pattern that is reproducible at any magnification or reduction.
- An example mathematical chaotic system

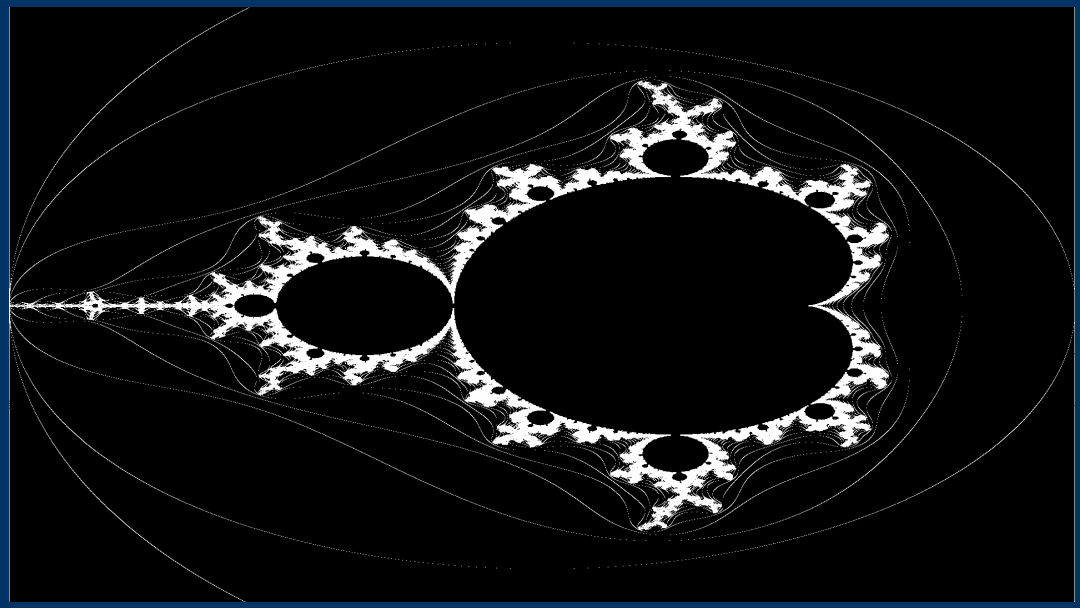


Julia Set

- Complex recursive equation
- z(n+1) = z(n)^2 + C
- C constant, z(0) based on point

Mandelbrot Set

- Complex recursive equation
- z(n+1) = z(n)^2 + C
- z(0) = 0, C based on point
- Set of all Julia set fractals



Supercomputing

- Fractal images are “Embarrassingly parallel” and thus lend themselves to supercomputing and the Message Passing Interface (MPI)
- In the case of the Julia set video, processors can share the load by generating different frames
- Each pixel can be calculated independently, processors split the image and calculate portions.

Progress

- Gained access to MPI on school server bottom
- Cray supercomputer fixed (thanks to Mr. Latimer and the people at Cray)
- Rewrote much of my second quarter code to utilize multiple processors
- Wrote a different rendering algorithm known as the buddhabrot

Results

- Performance is increased with more processors.
- Speed is not the original time divided by number of processors
- This is due to time for messages to pass between different processors.
- More message passing time for more processors.