Mandelbrot Set Experiments

Study of processing time using various computation methods

Experiments conducted on Tuesday, the 10th of August 2021, at 22:22:50

19 experiments were conducted by using the following computation methods:

→ Naïve implementation

→ Numba just-in-time compiling

→ Numba just-in-time compiling with parallel processing

→ Multiprocessing

→ Multiprocessing with Numba just-in-time compiling

Experiments conducted using a computer with:

Python version: 3.8.5

Python build: Sep 3 2020 21:29:08

Operating system: Windows

Operating platform: Windows-10-10.0.19041-SP0

Processor: Intel64 Family 6 Model 78 Stepping 3, GenuineIntel

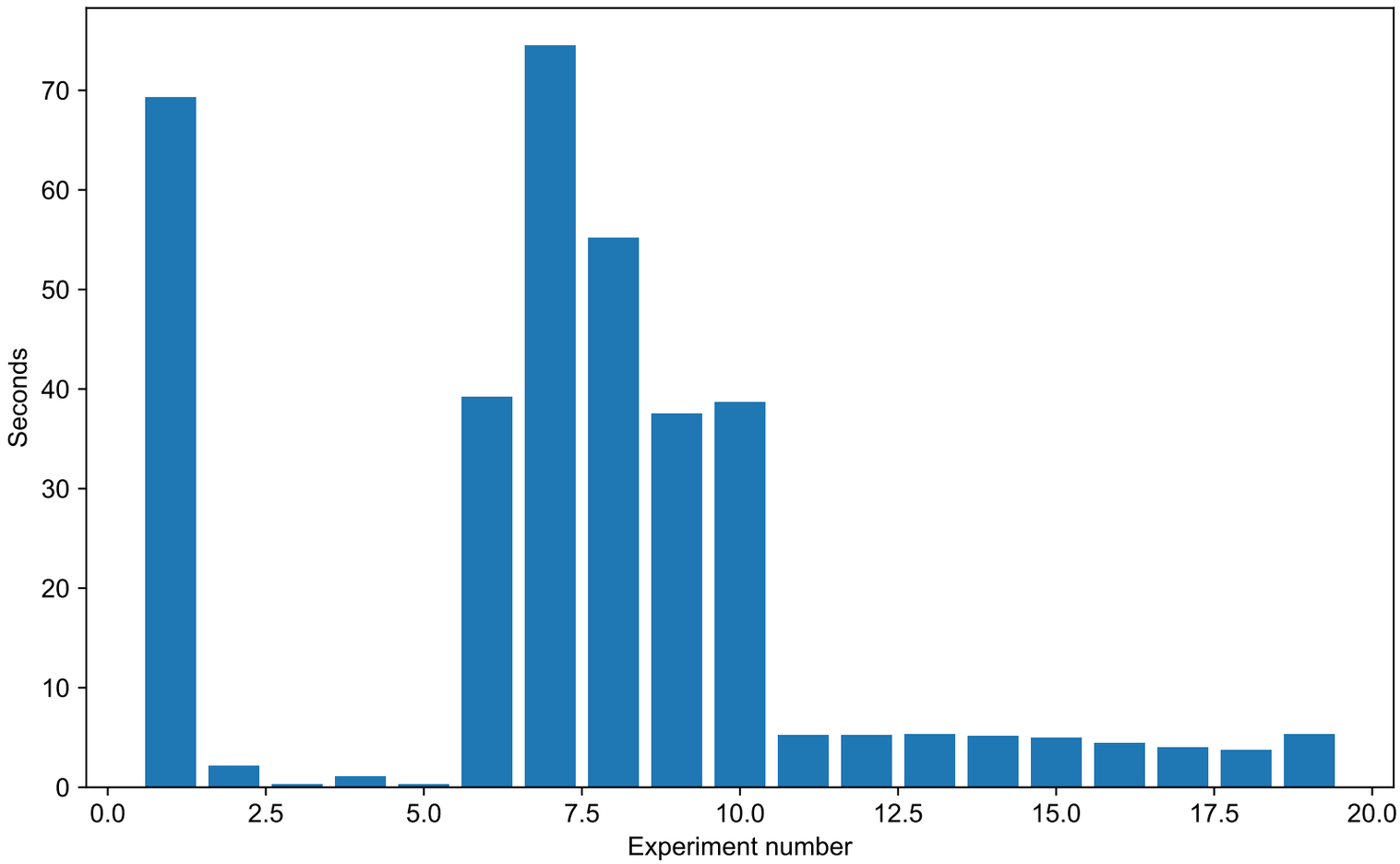
RAM installed: 8.43 GB

In the pages below, time statistics are presented for all the experiments, together with Mandelbrot set plots for each experiment:

Mandelbrot experiments time statistics

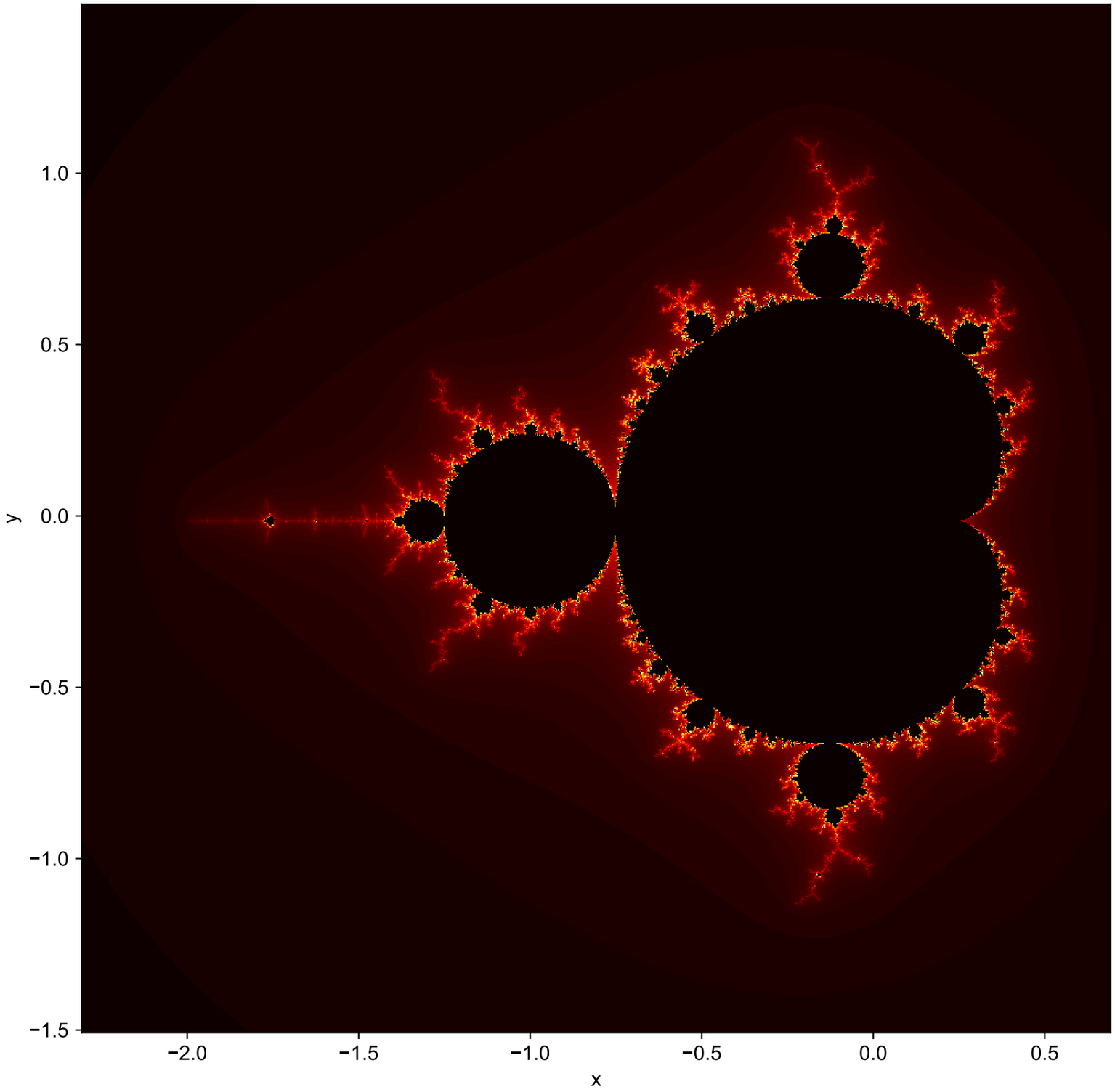
Experiments:

1: Naïve, Default cores, 927 points per axis, ET: 69.294839 seconds
2: JIT, Default cores, 927 points per axis, ET: 2.176718 seconds
3: JIT, Default cores, 927 points per axis, ET: 0.351612 seconds
4: JIT Parallel, Default cores, 927 points per axis, ET: 1.127372 seconds
5: JIT Parallel, Default cores, 927 points per axis, ET: 0.313816 seconds
6: MultiProc, Default cores, 927 points per axis, ET: 39.202526 seconds
7: MultiProc, 1 cores, 927 points per axis, ET: 74.542751 seconds
8: MultiProc, 2 cores, 927 points per axis, ET: 55.219965 seconds
9: MultiProc, 3 cores, 927 points per axis, ET: 37.576099 seconds
10: MultiProc, 4 cores, 927 points per axis, ET: 38.716878 seconds
11: MultiProc JIT, 4 cores, 927 points per axis, ET: 5.218324 seconds
12: MultiProc JIT, 4 cores, 927 points per axis, ET: 5.232026 seconds
13: MultiProc JIT, 4 cores, 927 points per axis, ET: 5.33254 seconds
14: MultiProc JIT, 4 cores, 927 points per axis, ET: 5.126612 seconds
15: MultiProc JIT, 4 cores, 927 points per axis, ET: 5.028151 seconds
16: MultiProc JIT, 3 cores, 927 points per axis, ET: 4.461926 seconds
17: MultiProc JIT, 2 cores, 927 points per axis, ET: 4.004707 seconds
18: MultiProc JIT, 1 cores, 927 points per axis, ET: 3.780769 seconds
19: MultiProc JIT, Default cores, 927 points per axis, ET: 5.296282 seconds



Mandelbrot Set

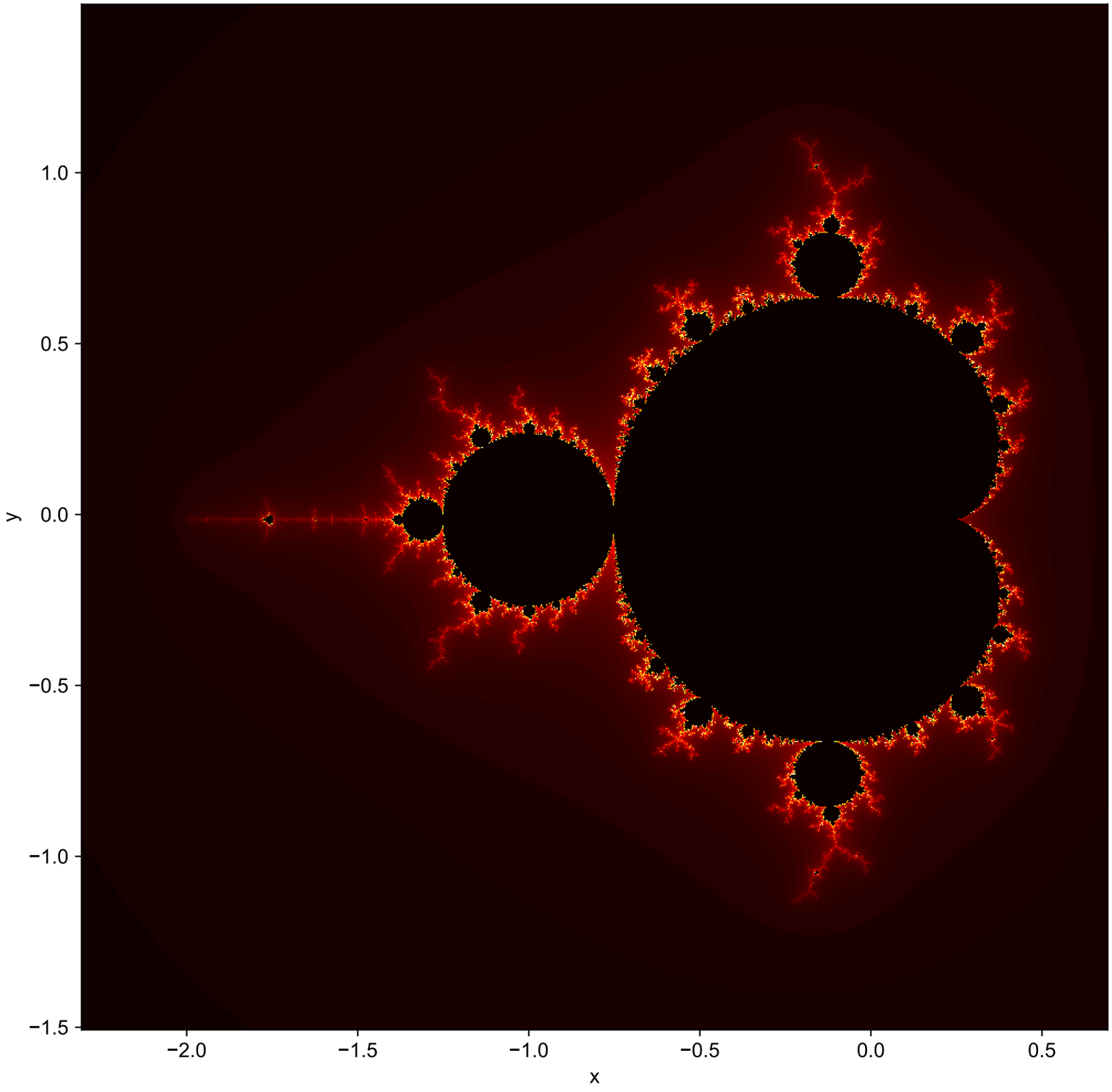
Computation Method: Naïve
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 69.29483929999998 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

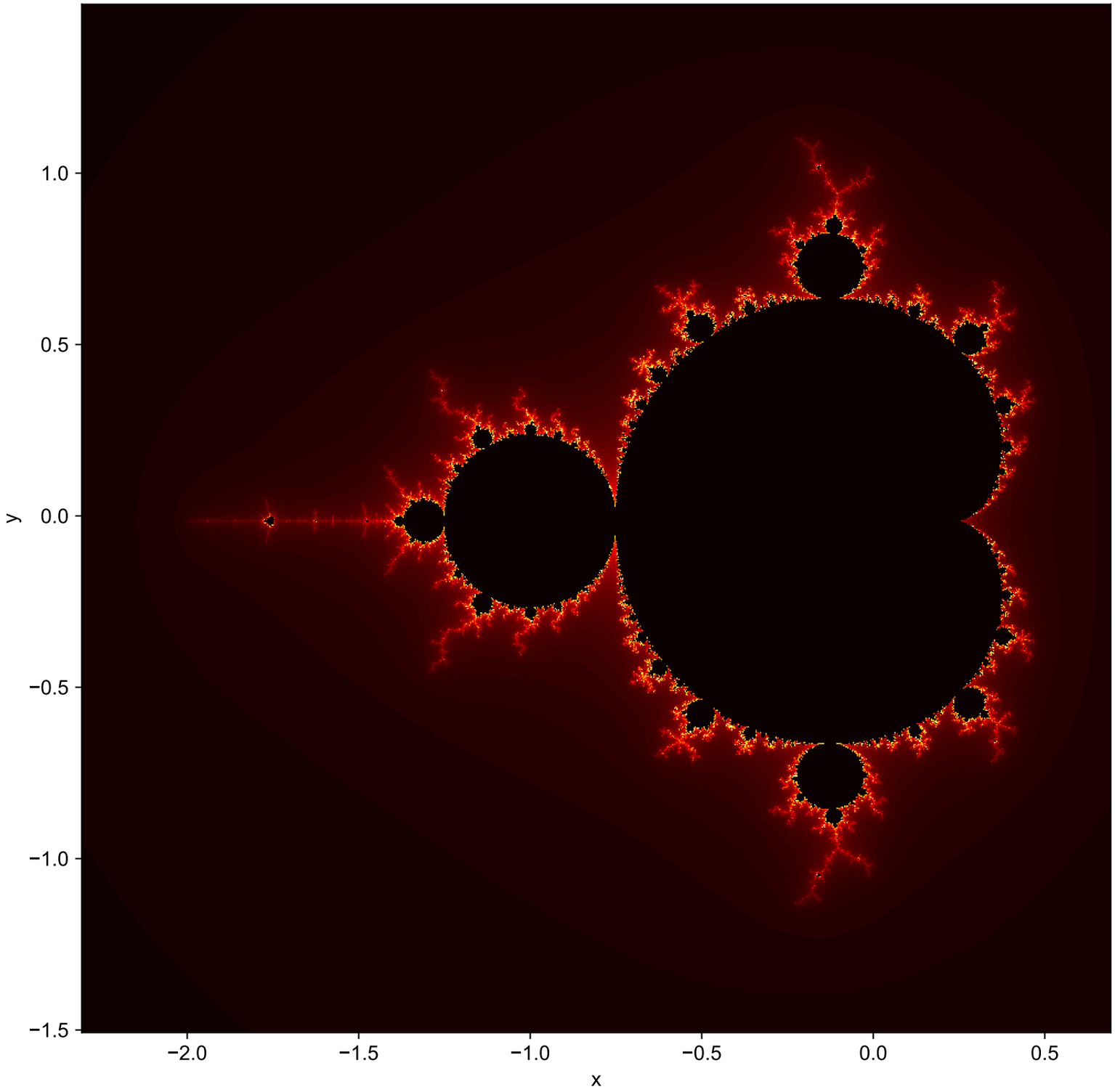
Computation Method: MultiProc
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 38.71687750000001 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

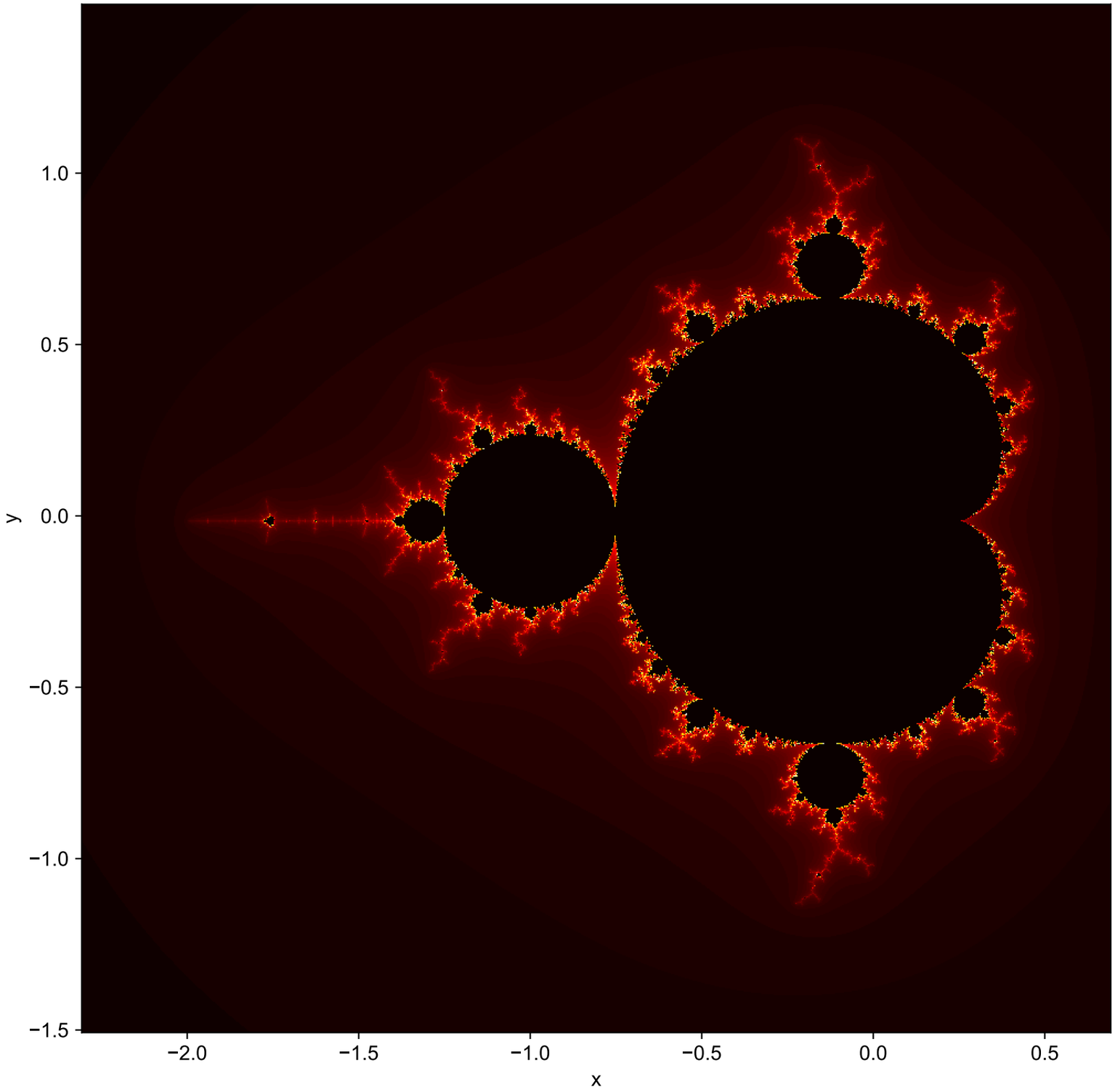
Computation Method: MultiProc JIT
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 5.218324200000097 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc JIT
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 5.232025599999815 seconds



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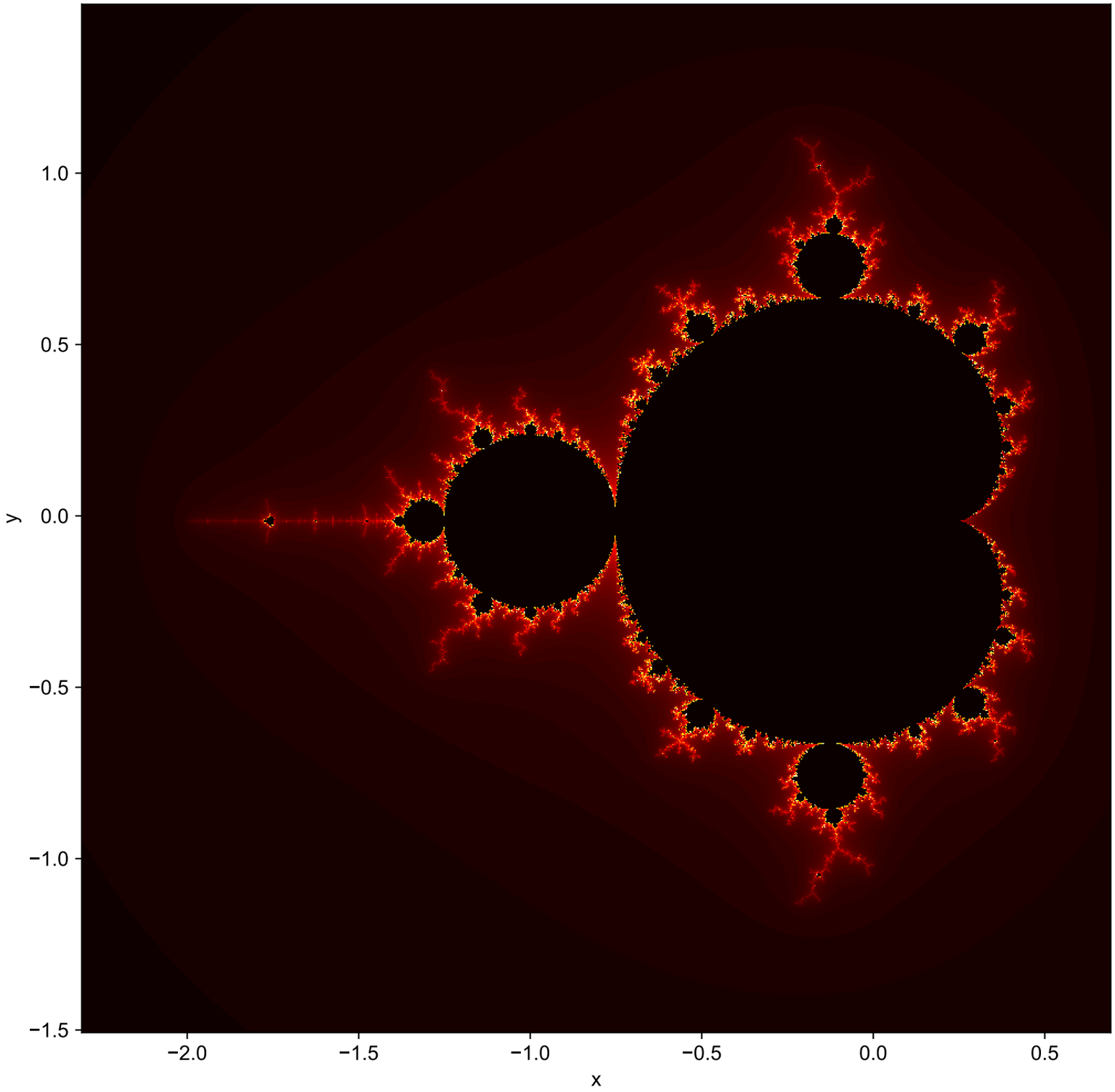
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc JIT
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 5.332540299999891 seconds



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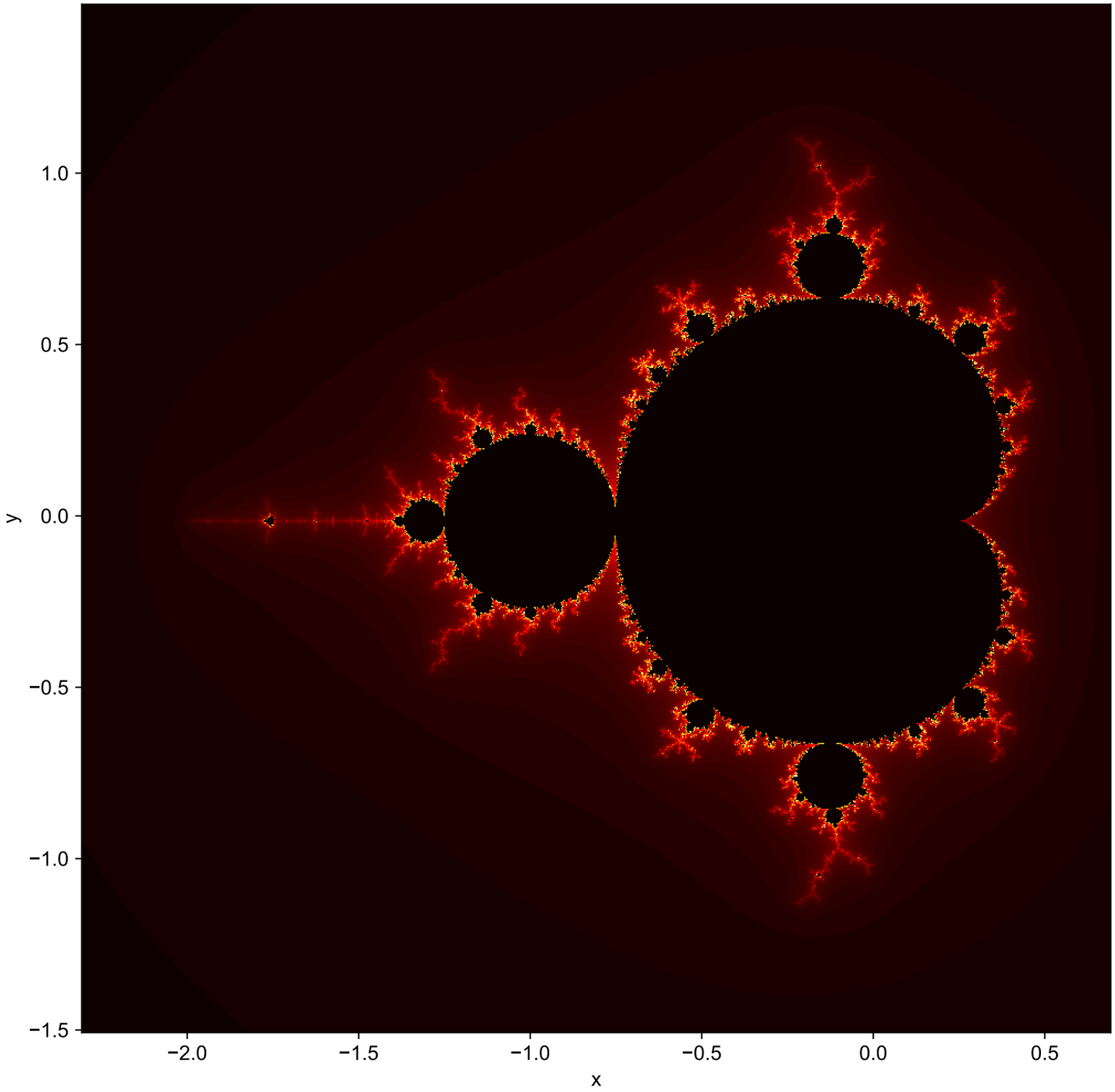
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc JIT
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 5.126612100000102 seconds



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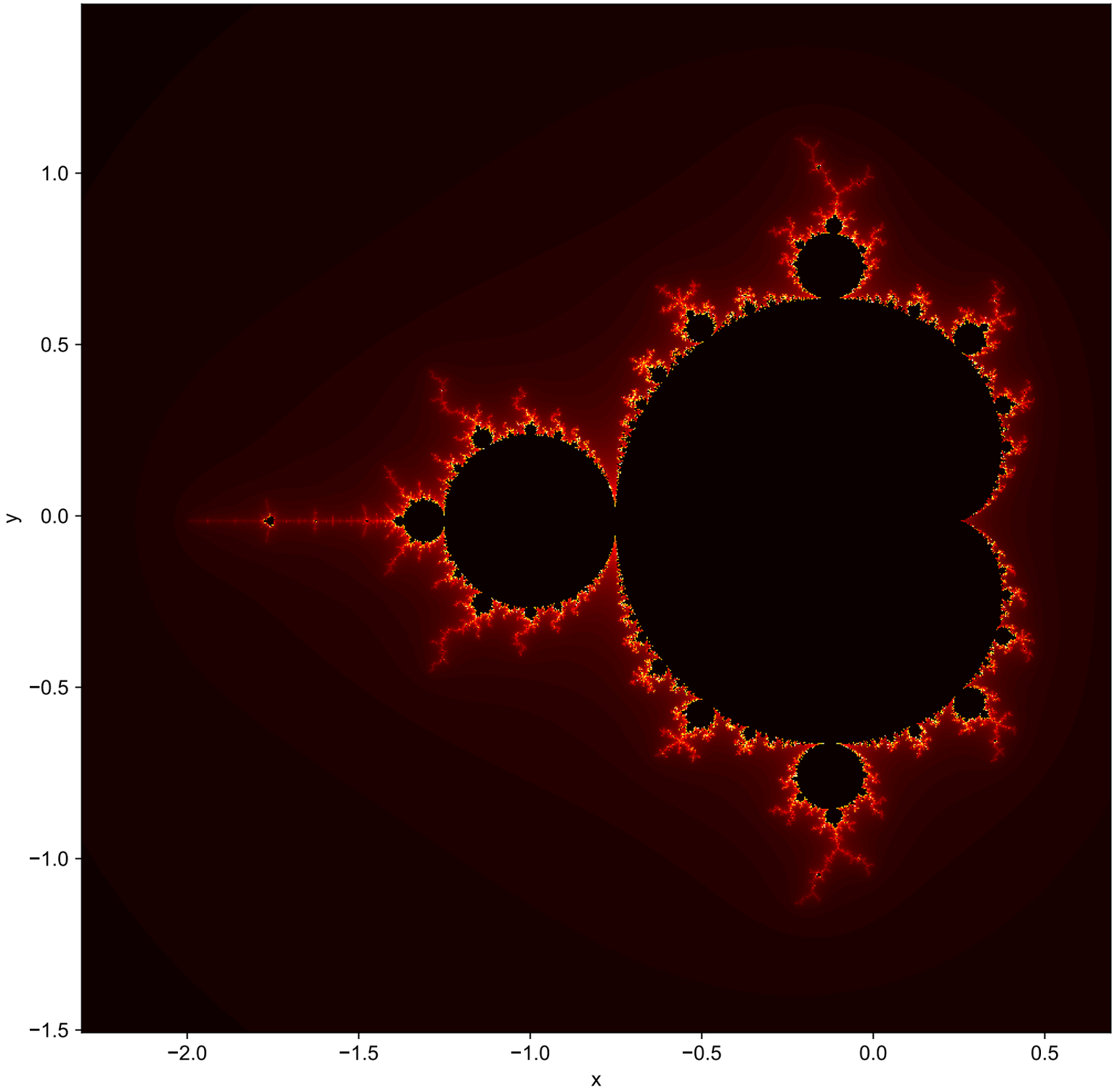
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc JIT
Number of cores: 4
Number of points per axis: 927
Elapsed computation time: 5.028150600000117 seconds



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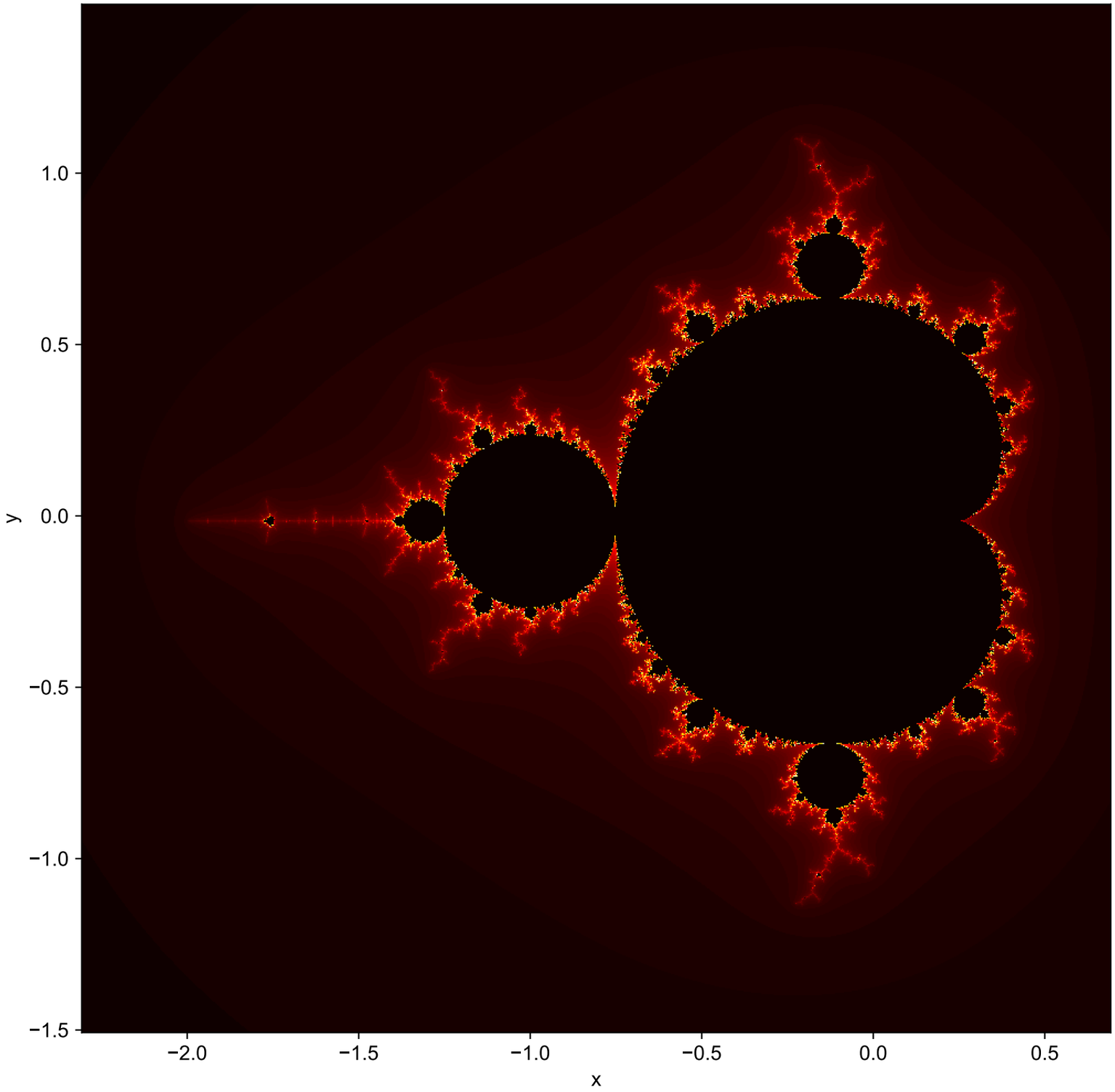
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

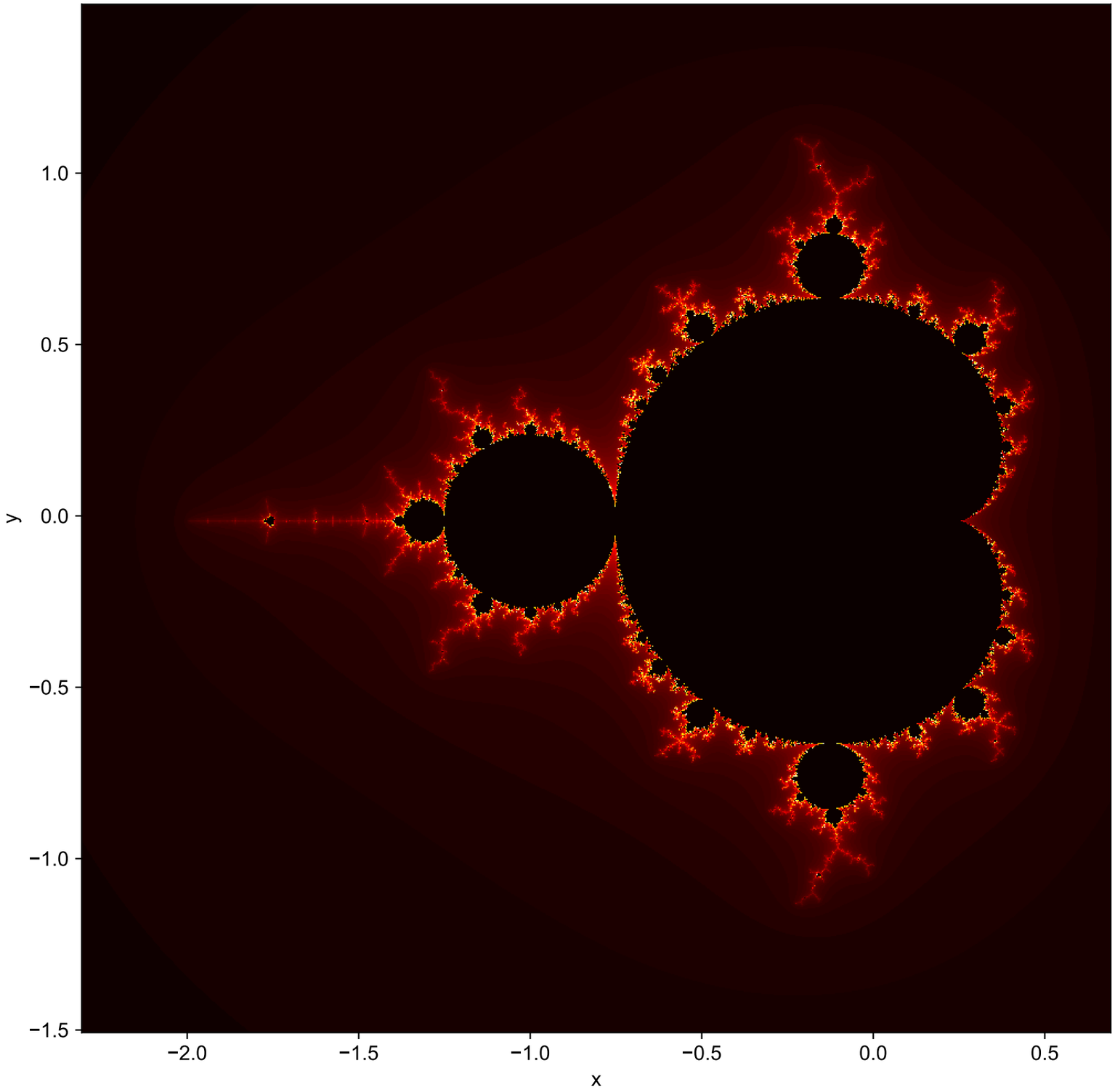
Computation Method: MultiProc JIT
Number of cores: 3
Number of points per axis: 927
Elapsed computation time: 4.461925599999859 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

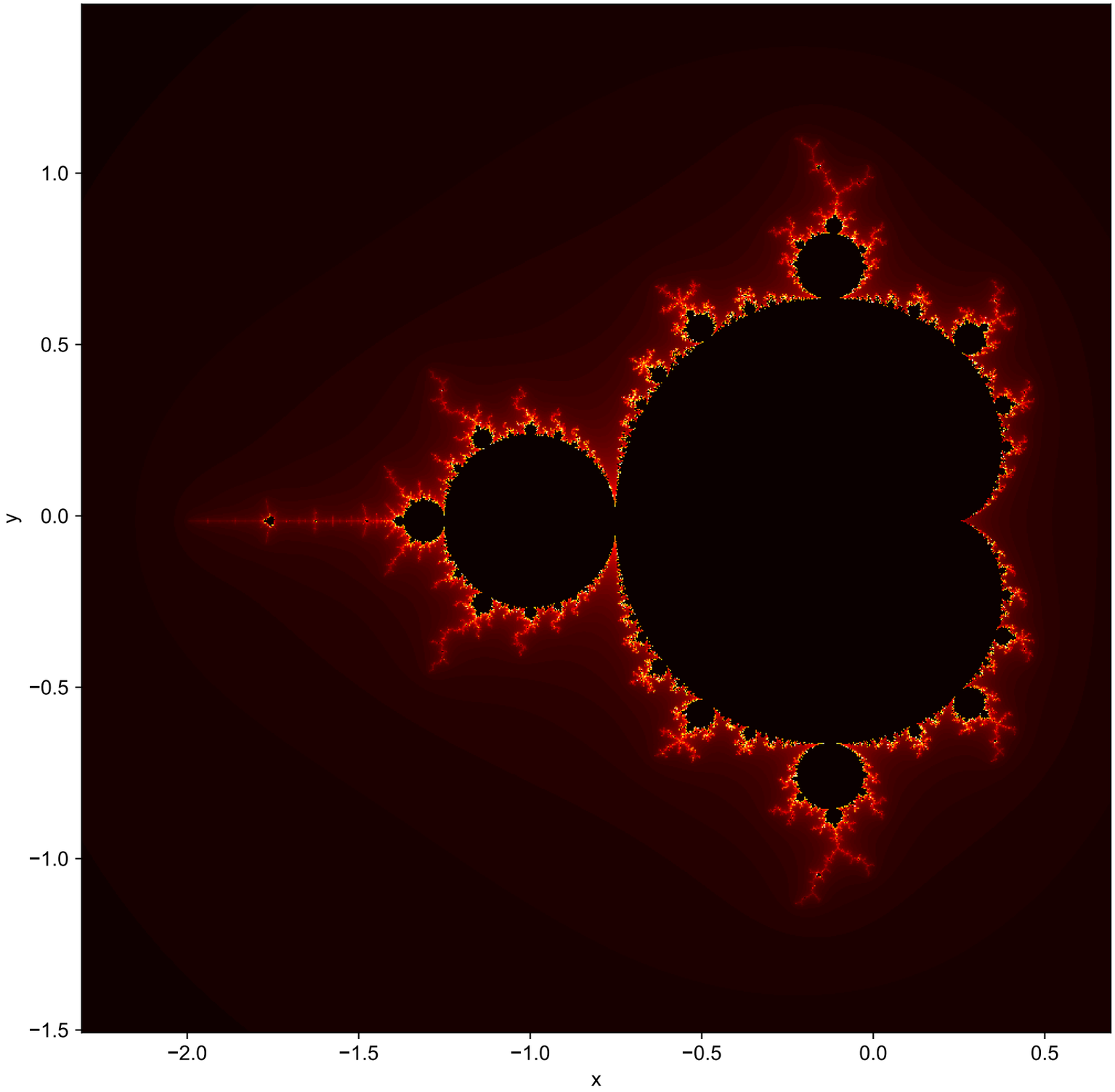
Computation Method: MultiProc JIT
Number of cores: 2
Number of points per axis: 927
Elapsed computation time: 4.004707499999995 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

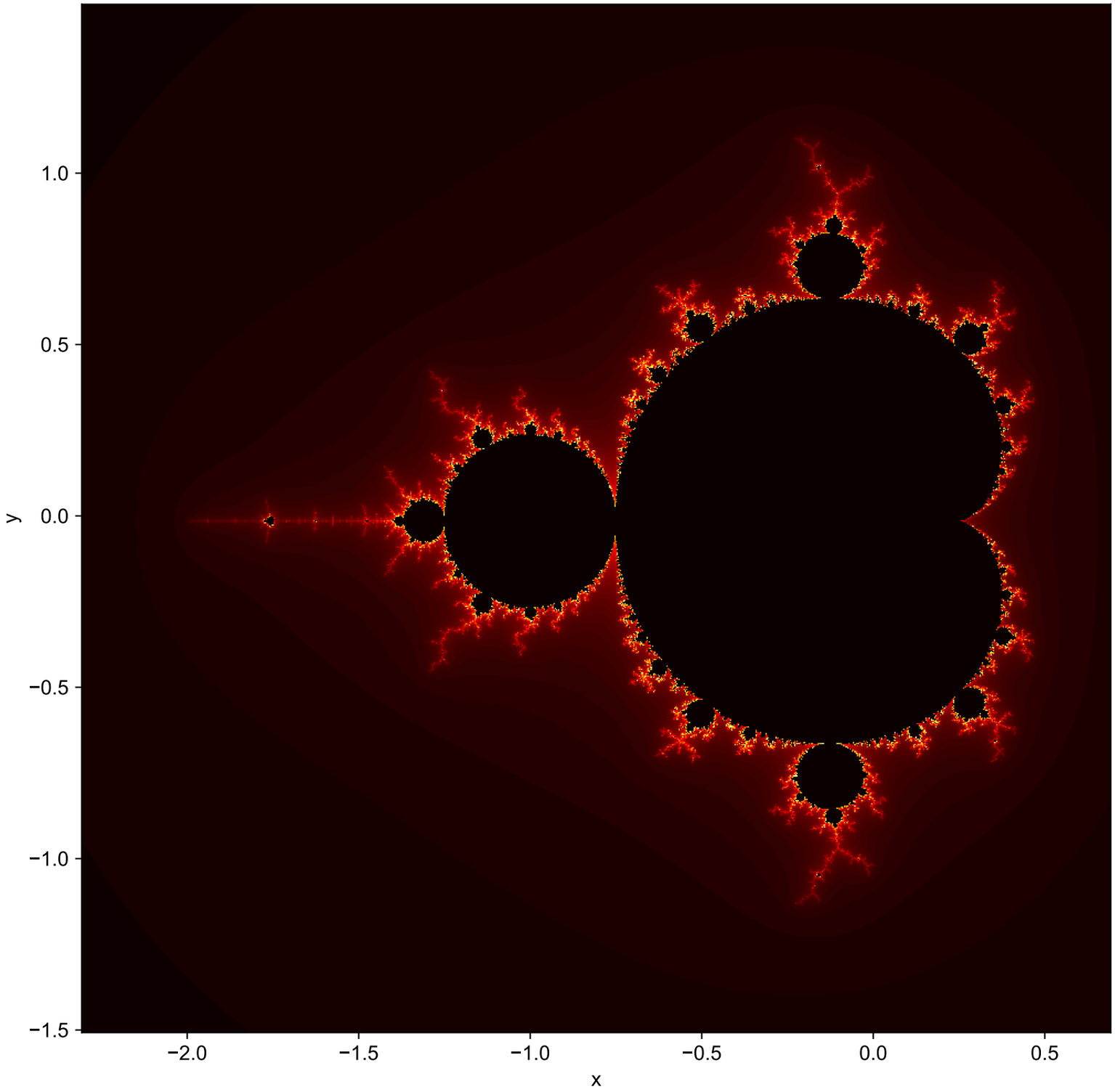
Computation Method: MultiProc JIT
Number of cores: 1
Number of points per axis: 927
Elapsed computation time: 3.780769100000043 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

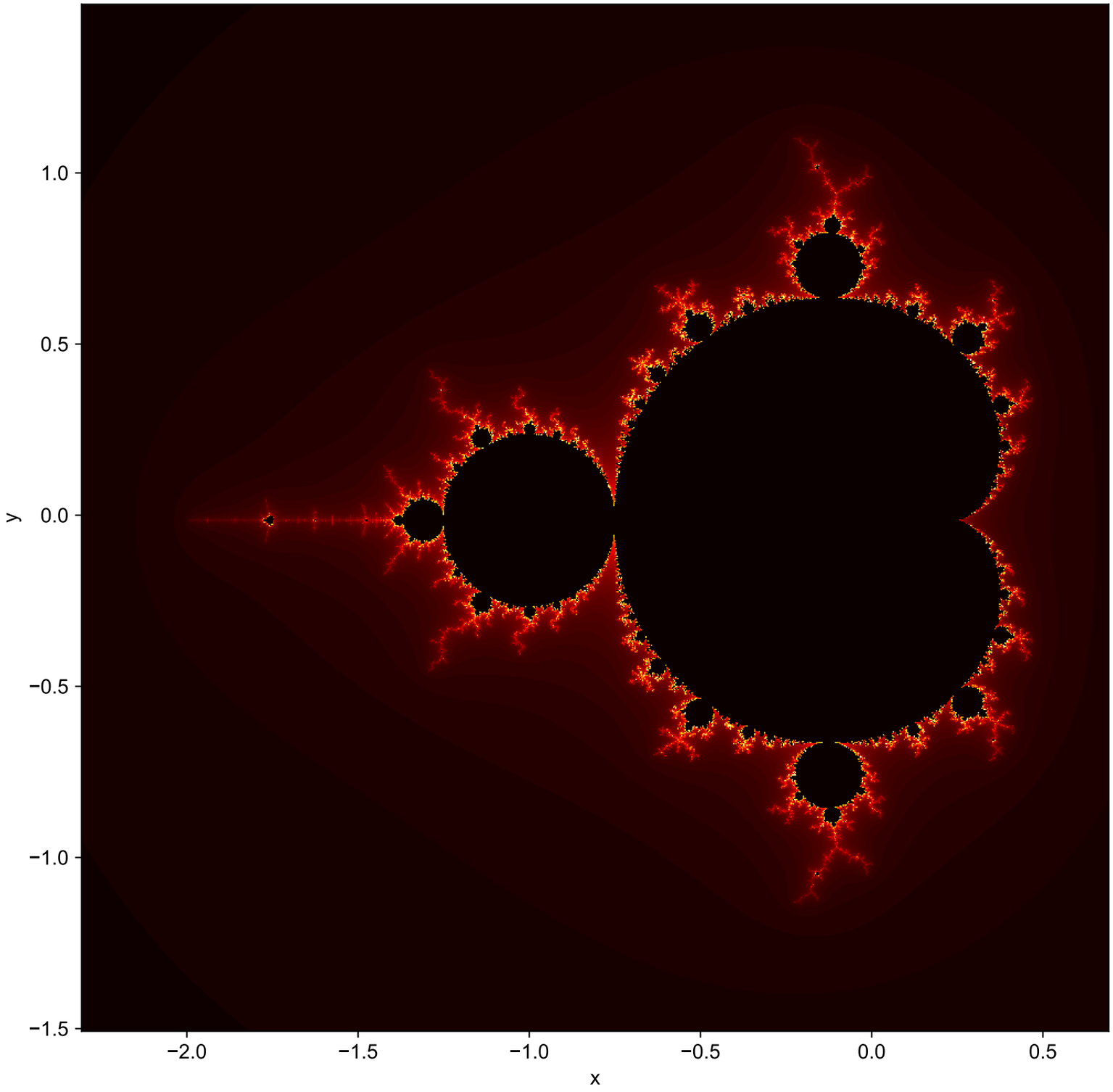
Computation Method: MultiProc JIT
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 5.296281500000077 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: JIT
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 2.176717900000085 seconds



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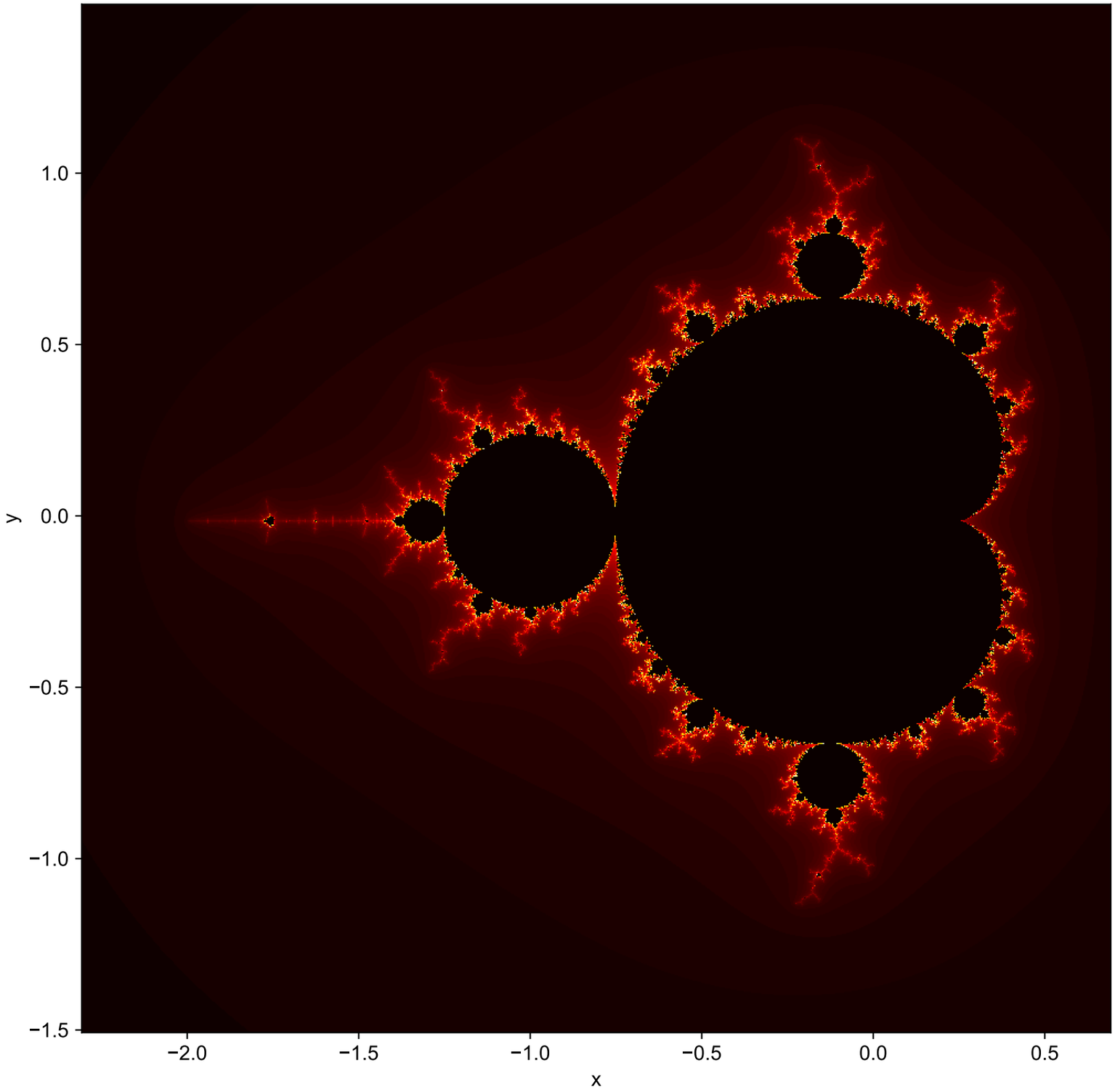
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: JIT
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 0.3516122000000905 seconds



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x min | x max: -2.3075376884422107 | 0.692462311557789
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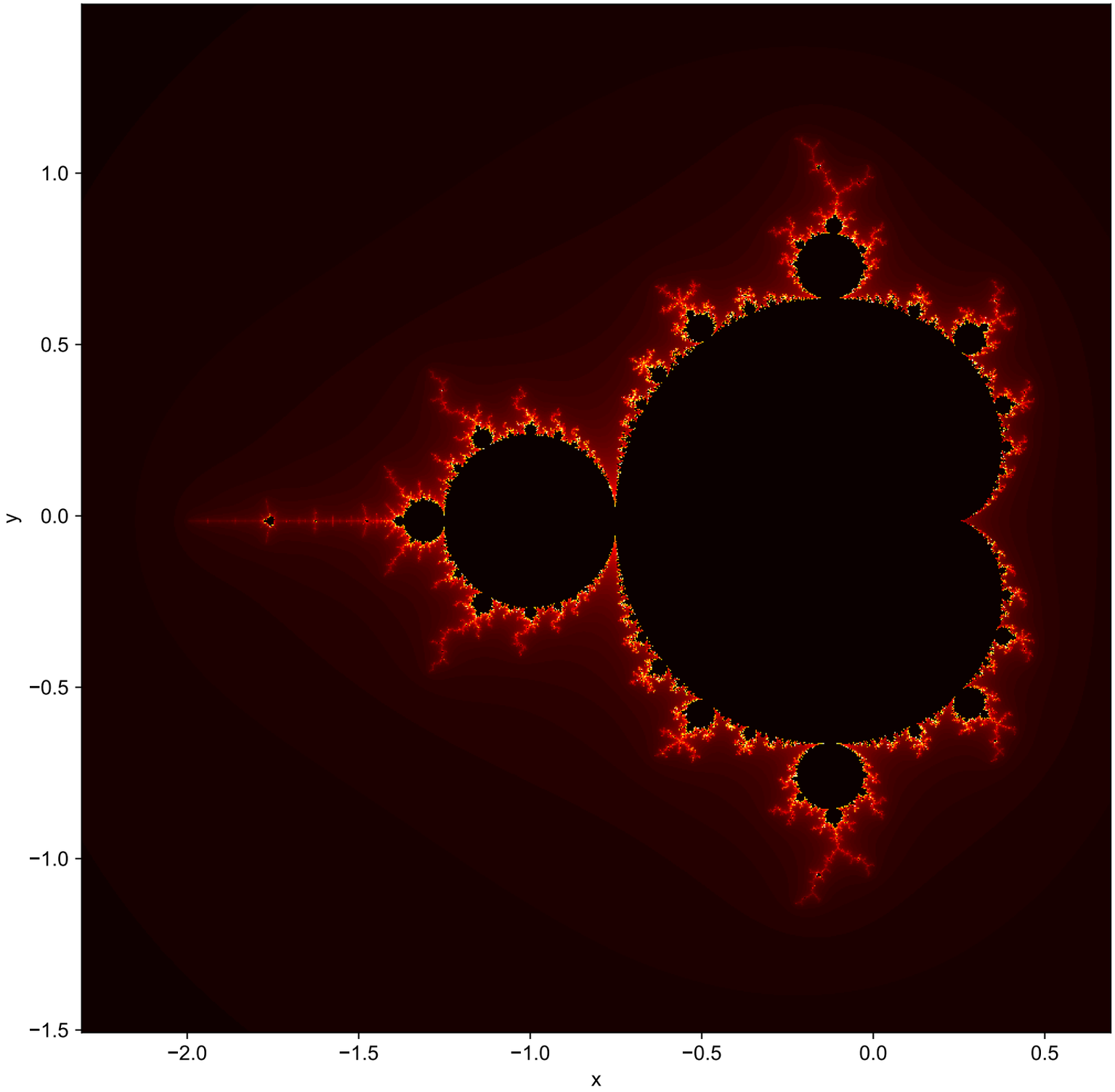
Mandelbrot Set

Computation Method: JIT Parallel
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 1.1273722999999336 seconds



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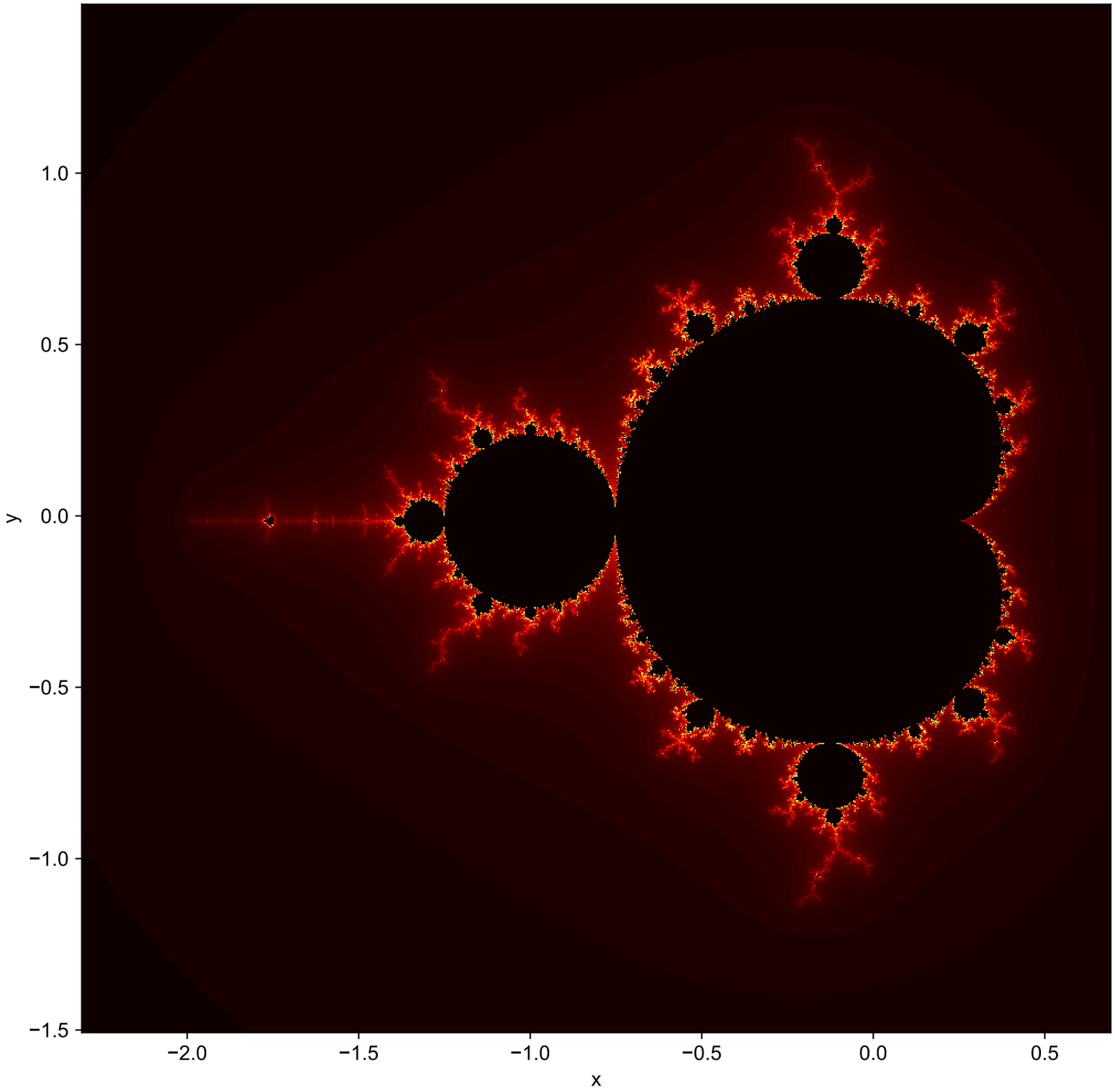
Mandelbrot Set

Computation Method: JIT Parallel
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 0.31381579999992937 seconds



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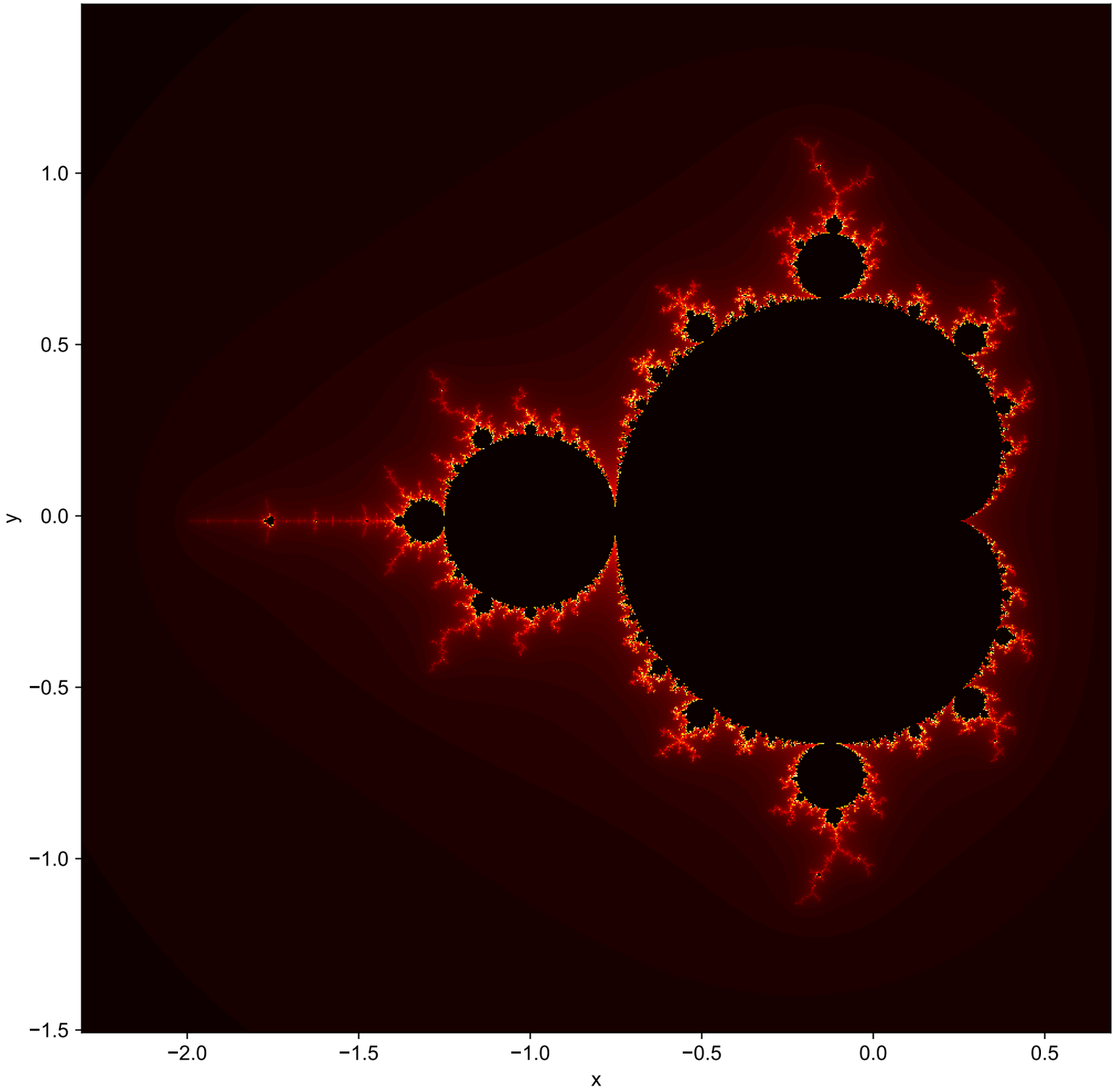
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc
Number of cores: Default
Number of points per axis: 927
Elapsed computation time: 39.202525899999955 seconds



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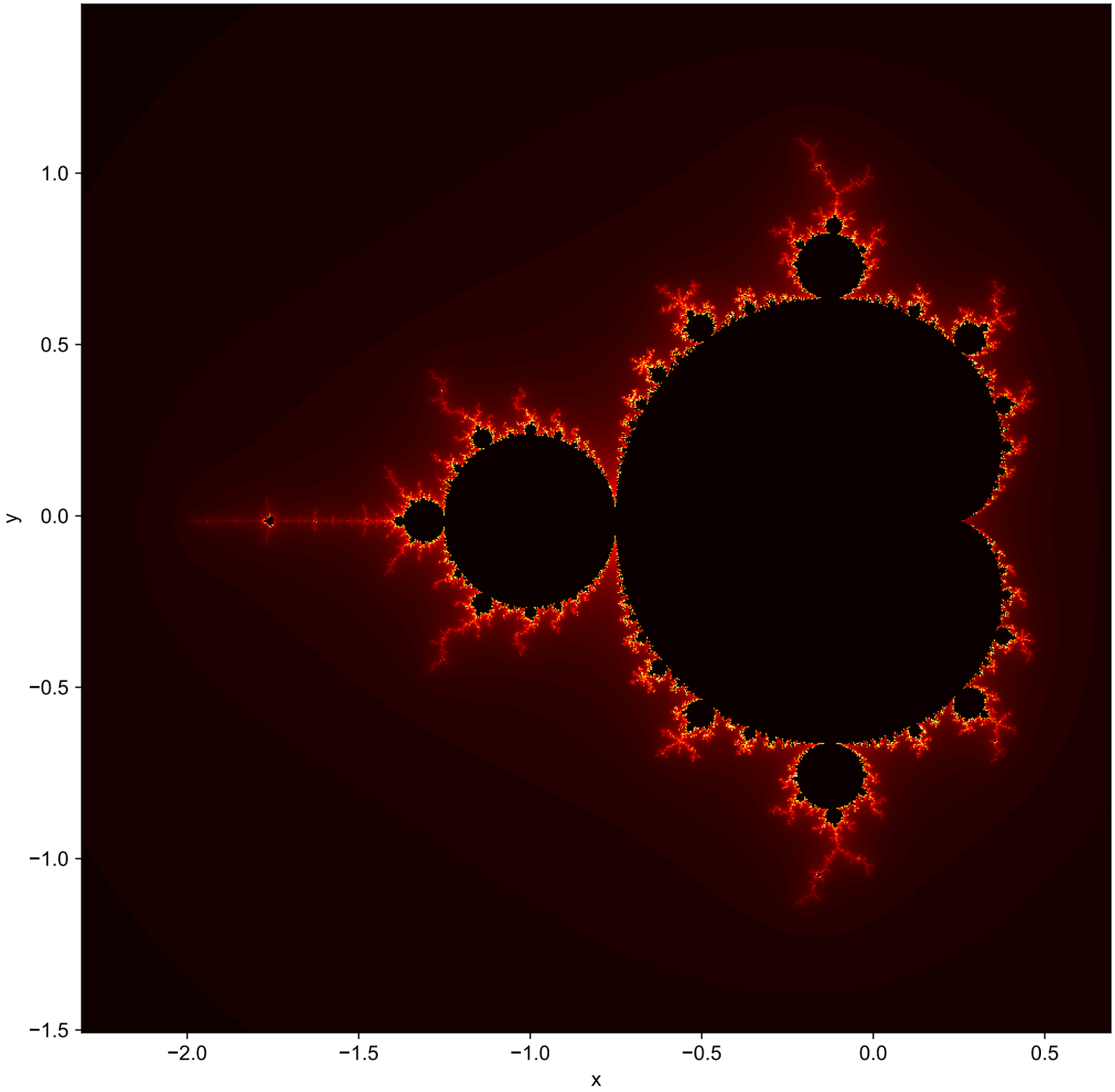
Mandelbrot Set

Computation Method: MultiProc
Number of cores: 1
Number of points per axis: 927
Elapsed computation time: 74.54275130000019 seconds



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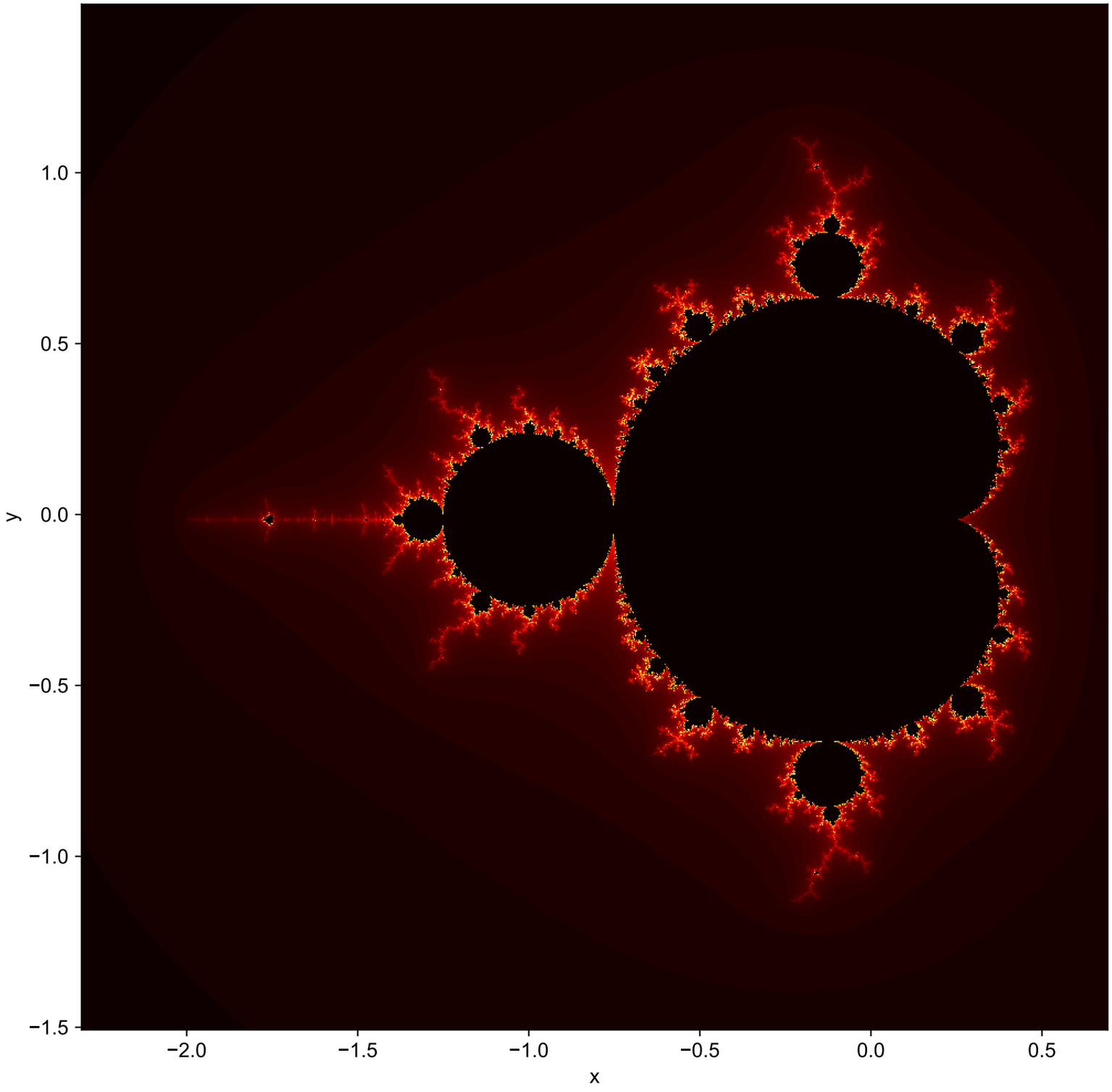
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

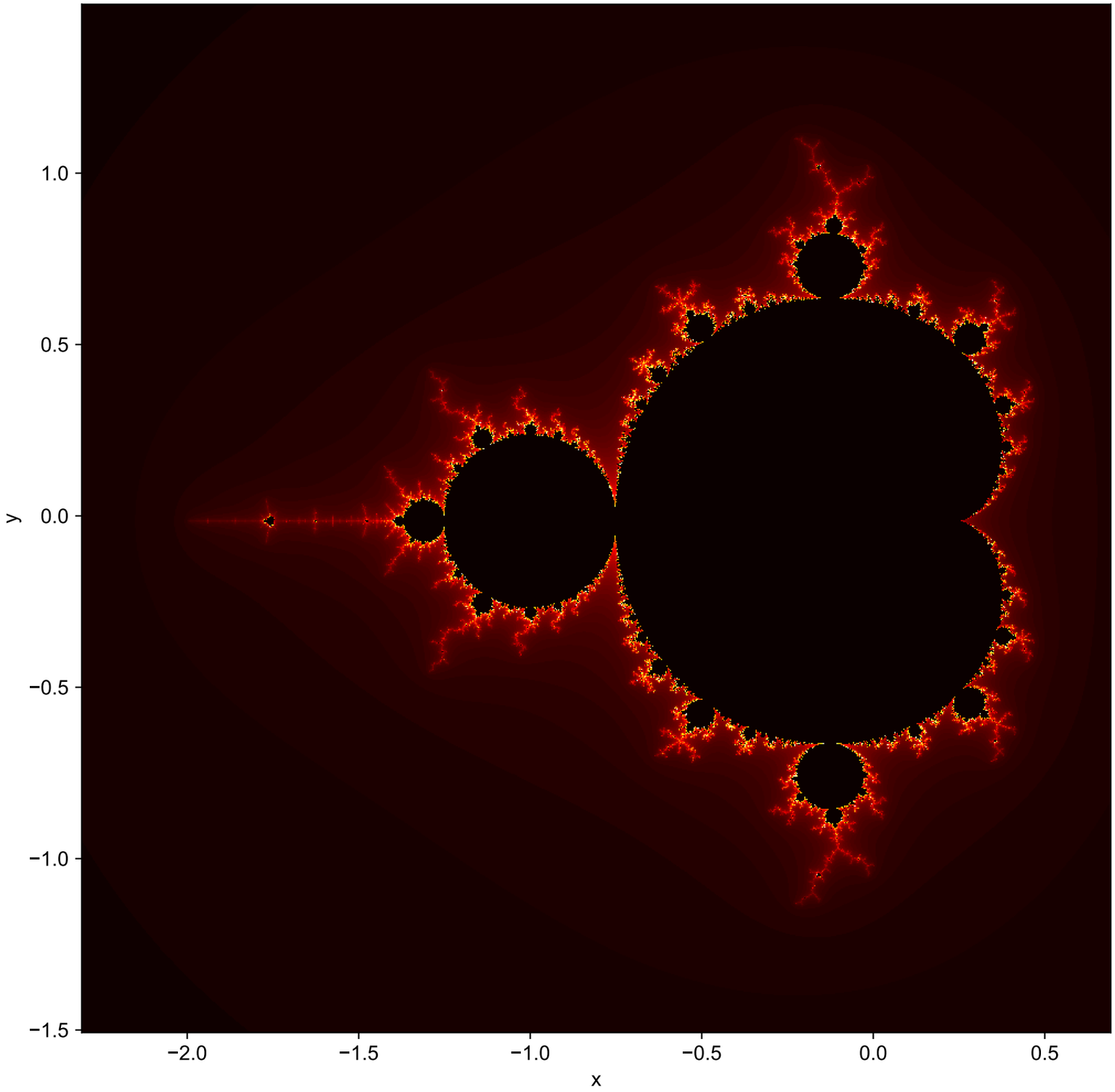
Computation Method: MultiProc
Number of cores: 2
Number of points per axis: 927
Elapsed computation time: 55.219965 seconds



Value range: 3.0
x min | x max: -2.3075376884422107 | 0.692462311557789
y min | y max: -1.5075376884422111 | 1.4924623115577889

Mandelbrot Set

Computation Method: MultiProc
Number of cores: 3
Number of points per axis: 927
Elapsed computation time: 37.576099299999896 seconds



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