

Mandelbrot Set Experiments

Study of processing time using various computation methods

Experiments conducted on Wednesday, the 11th of August 2021, at 11:53:52

20 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 165 Stepping 2, GenuineIntel

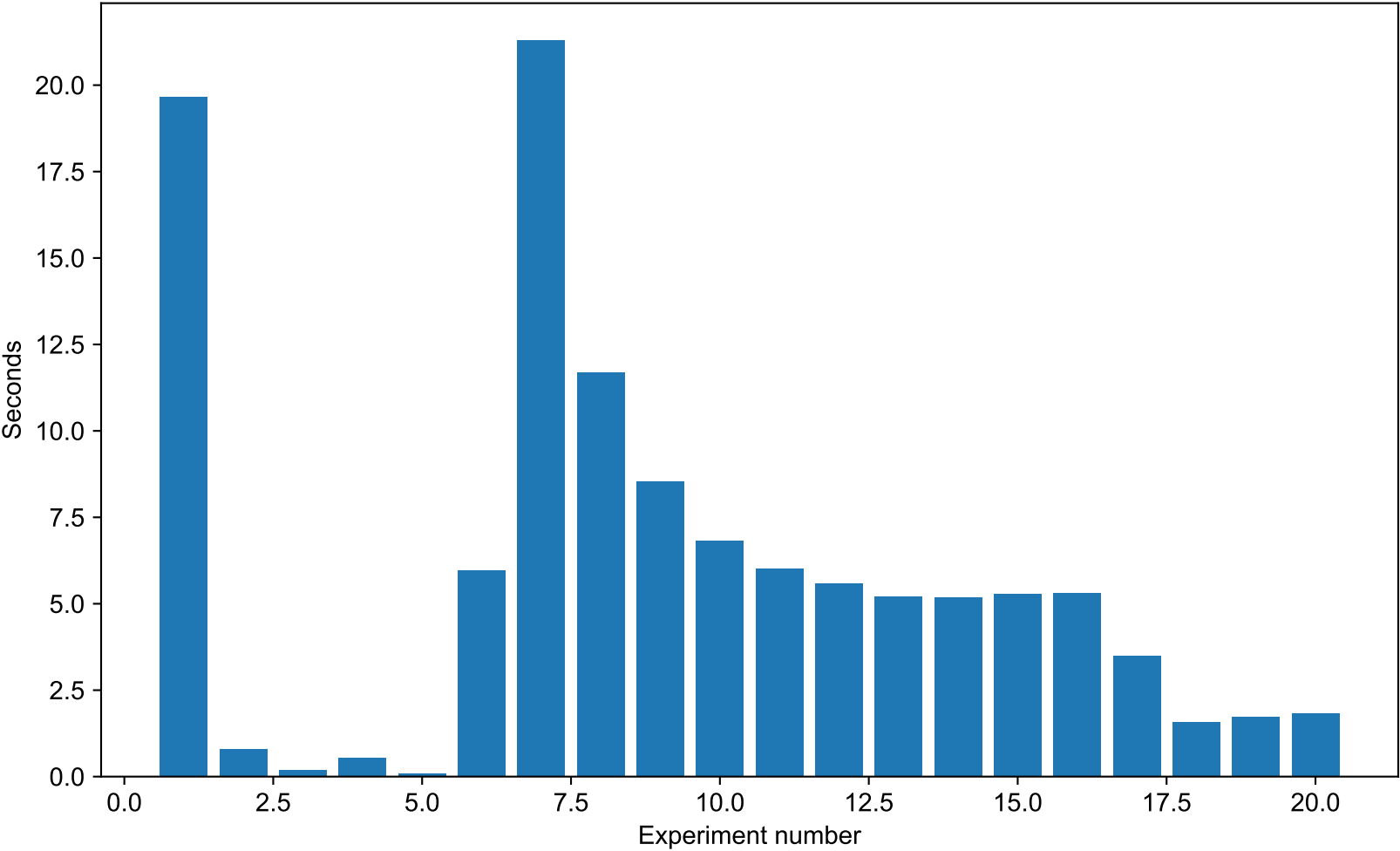
RAM installed: 34.06 GB

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: 19.654094 seconds
- 2: JIT, Default cores, 927 points per axis, ET: 0.804311 seconds
- 3: JIT, Default cores, 927 points per axis, ET: 0.182812 seconds
- 4: JIT Parallel, Default cores, 927 points per axis, ET: 0.543331 seconds
- 5: JIT Parallel, Default cores, 927 points per axis, ET: 0.097184 seconds
- 6: MultiProc, Default cores, 927 points per axis, ET: 5.966924 seconds
- 7: MultiProc, 1 cores, 927 points per axis, ET: 21.30565 seconds
- 8: MultiProc, 2 cores, 927 points per axis, ET: 11.687106 seconds
- 9: MultiProc, 3 cores, 927 points per axis, ET: 8.548627 seconds
- 10: MultiProc, 4 cores, 927 points per axis, ET: 6.815163 seconds
- 11: MultiProc, 5 cores, 927 points per axis, ET: 6.012386 seconds
- 12: MultiProc, 6 cores, 927 points per axis, ET: 5.583455 seconds
- 13: MultiProc, 7 cores, 927 points per axis, ET: 5.217657 seconds
- 14: MultiProc, 8 cores, 927 points per axis, ET: 5.175174 seconds
- 15: MultiProc, 9 cores, 927 points per axis, ET: 5.287675 seconds
- 16: MultiProc, 10 cores, 927 points per axis, ET: 5.305534 seconds
- 17: MultiProc JIT, Default cores, 927 points per axis, ET: 3.496285 seconds
- 18: MultiProc JIT, 1 cores, 927 points per axis, ET: 1.584861 seconds
- 19: MultiProc JIT, 2 cores, 927 points per axis, ET: 1.71823 seconds
- 20: MultiProc JIT, 3 cores, 927 points per axis, ET: 1.825704 seconds



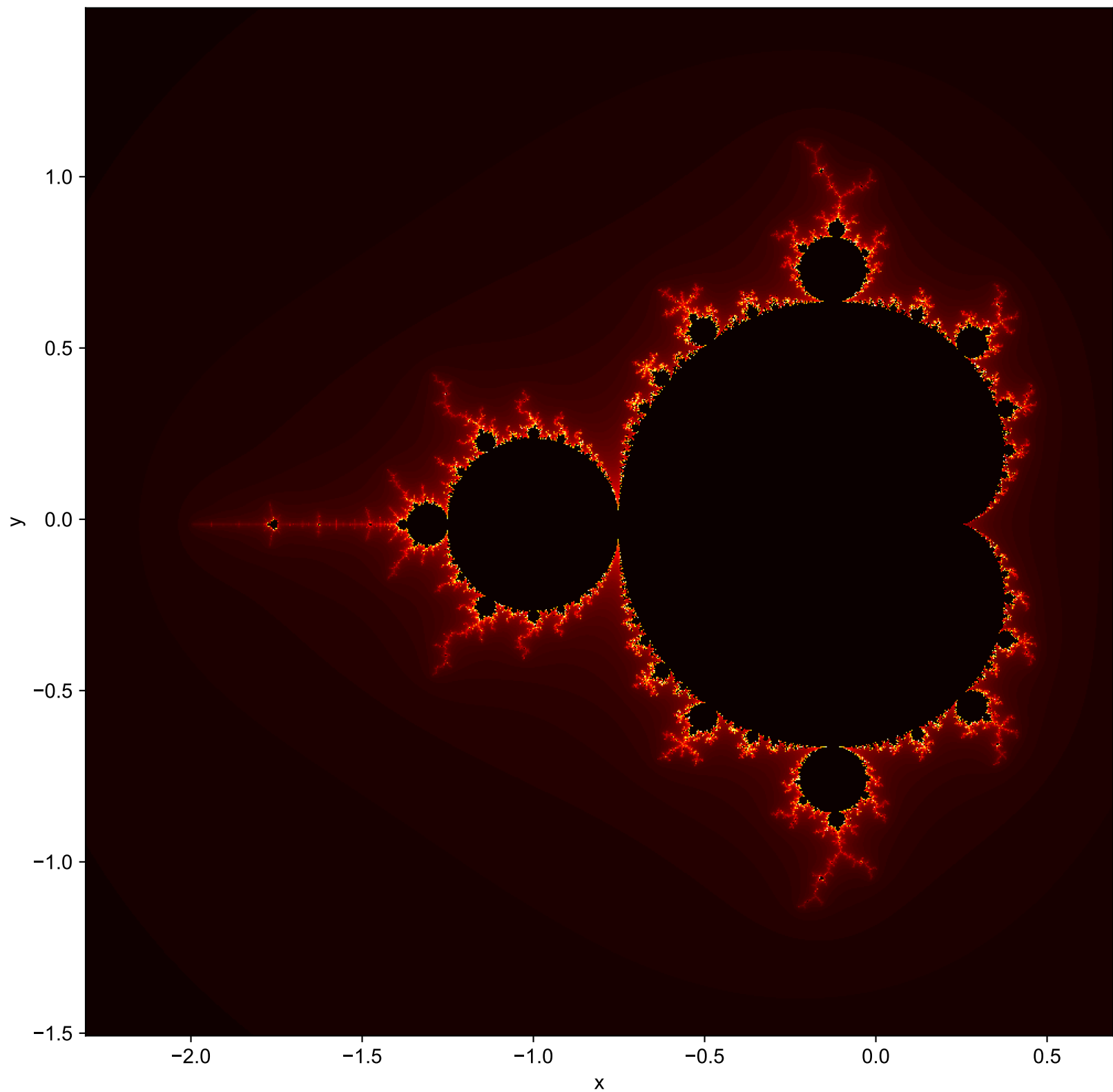
Mandelbrot Set

Computation Method: Naïve

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 19.654094400000005 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

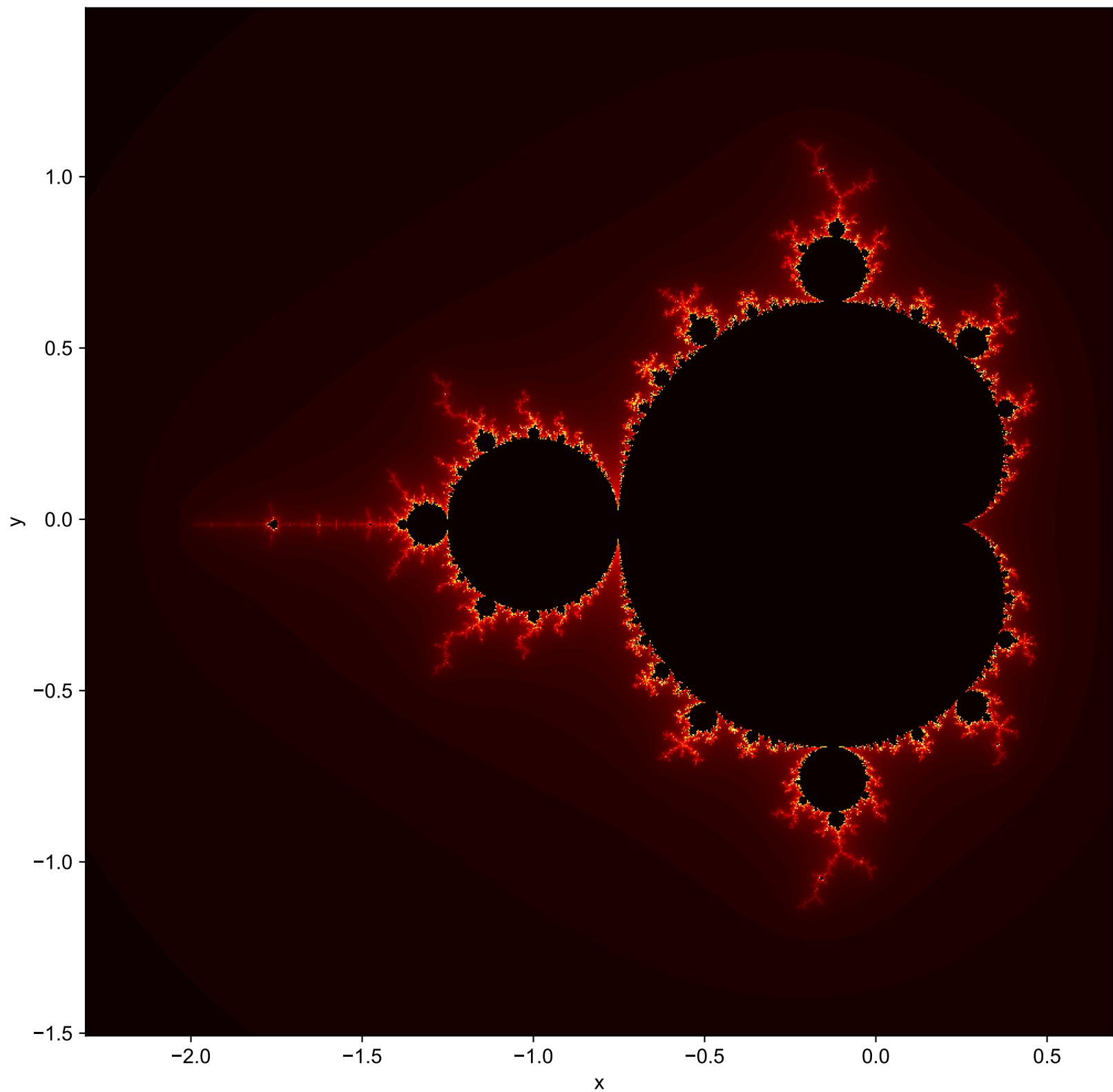
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 4

Number of points per axis: 927

Elapsed computation time: 6.815163200000001 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

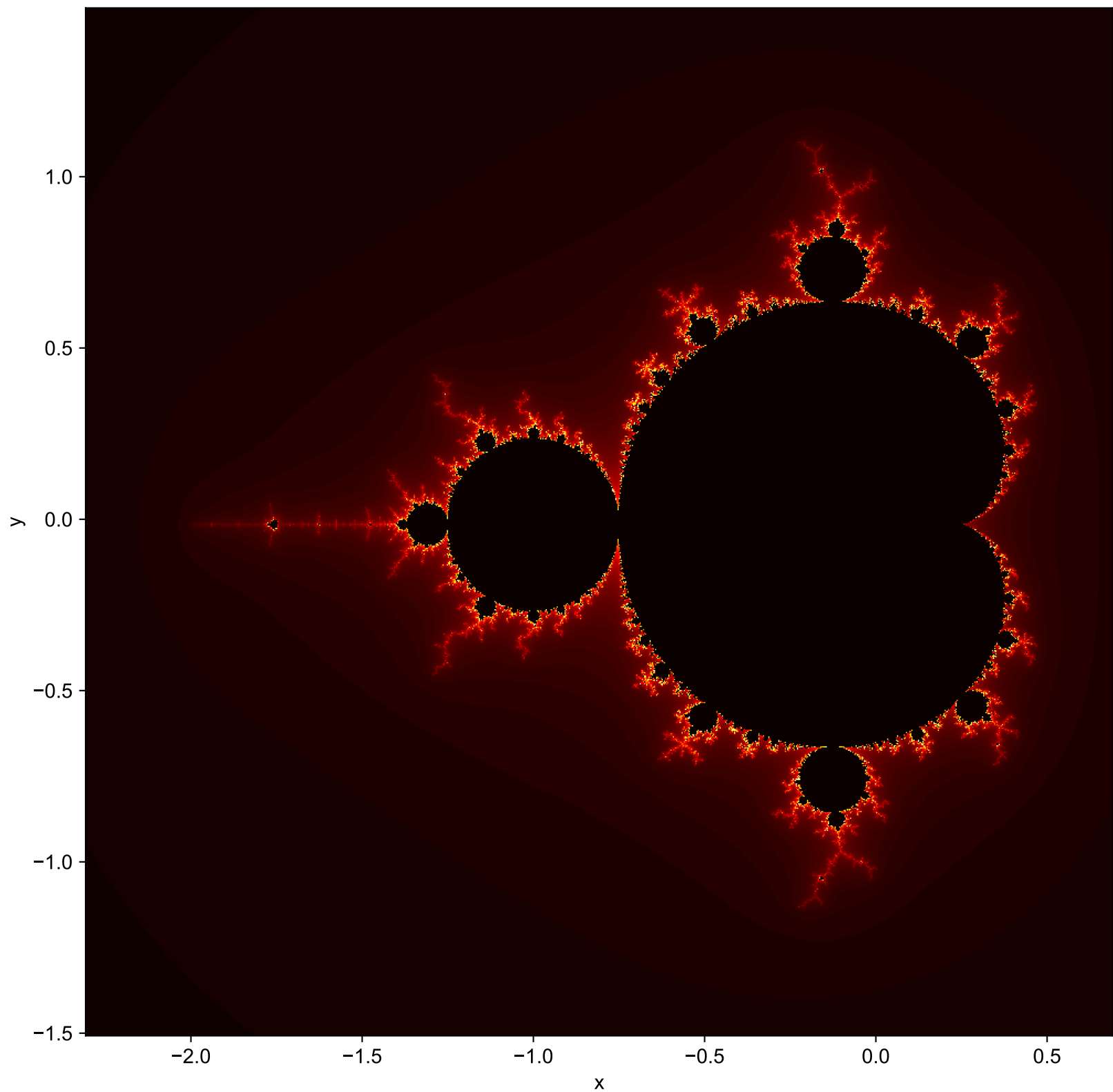
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 5

Number of points per axis: 927

Elapsed computation time: 6.012385800000004 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

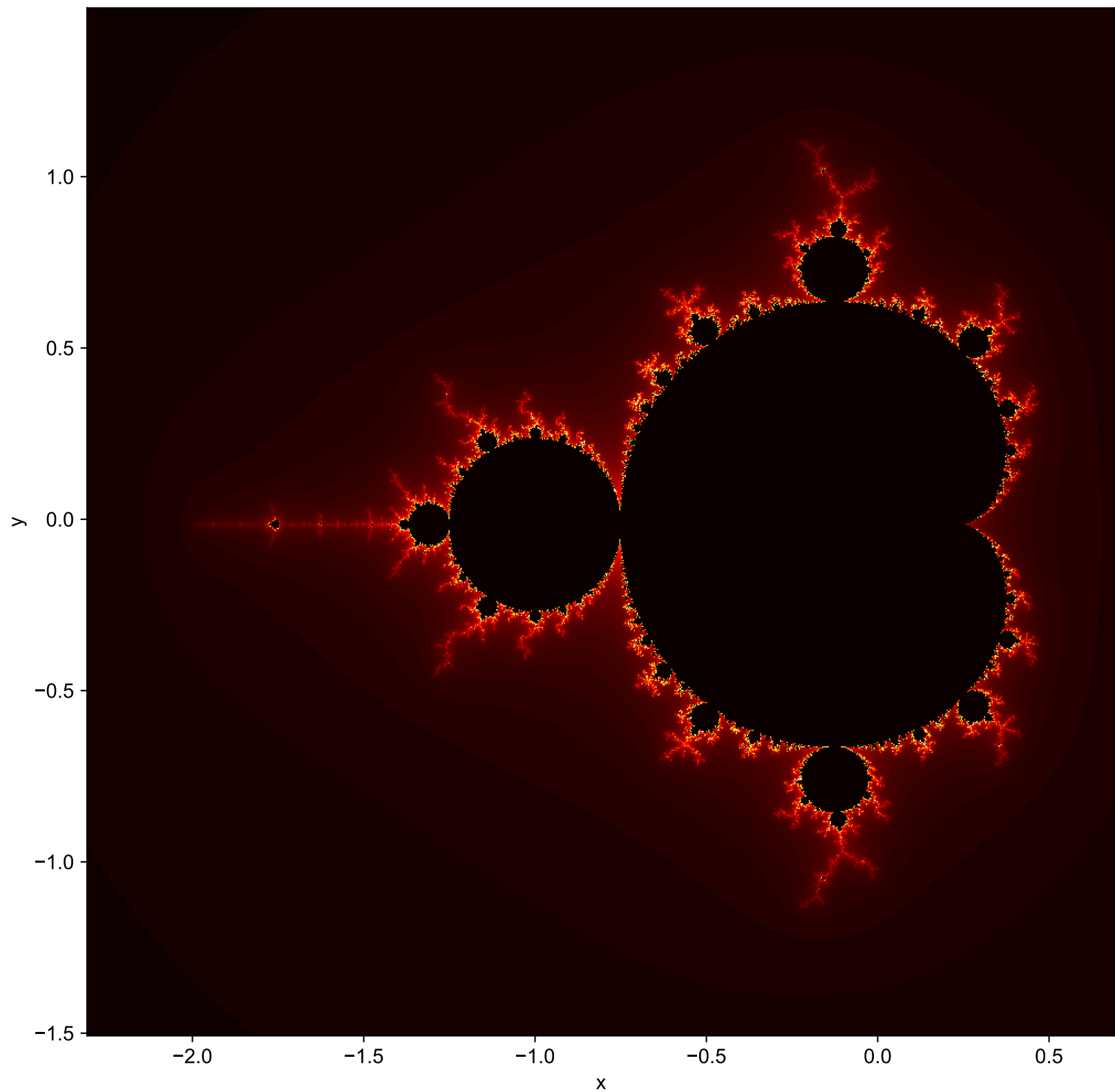
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 6

Number of points per axis: 927

Elapsed computation time: 5.583454500000016 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

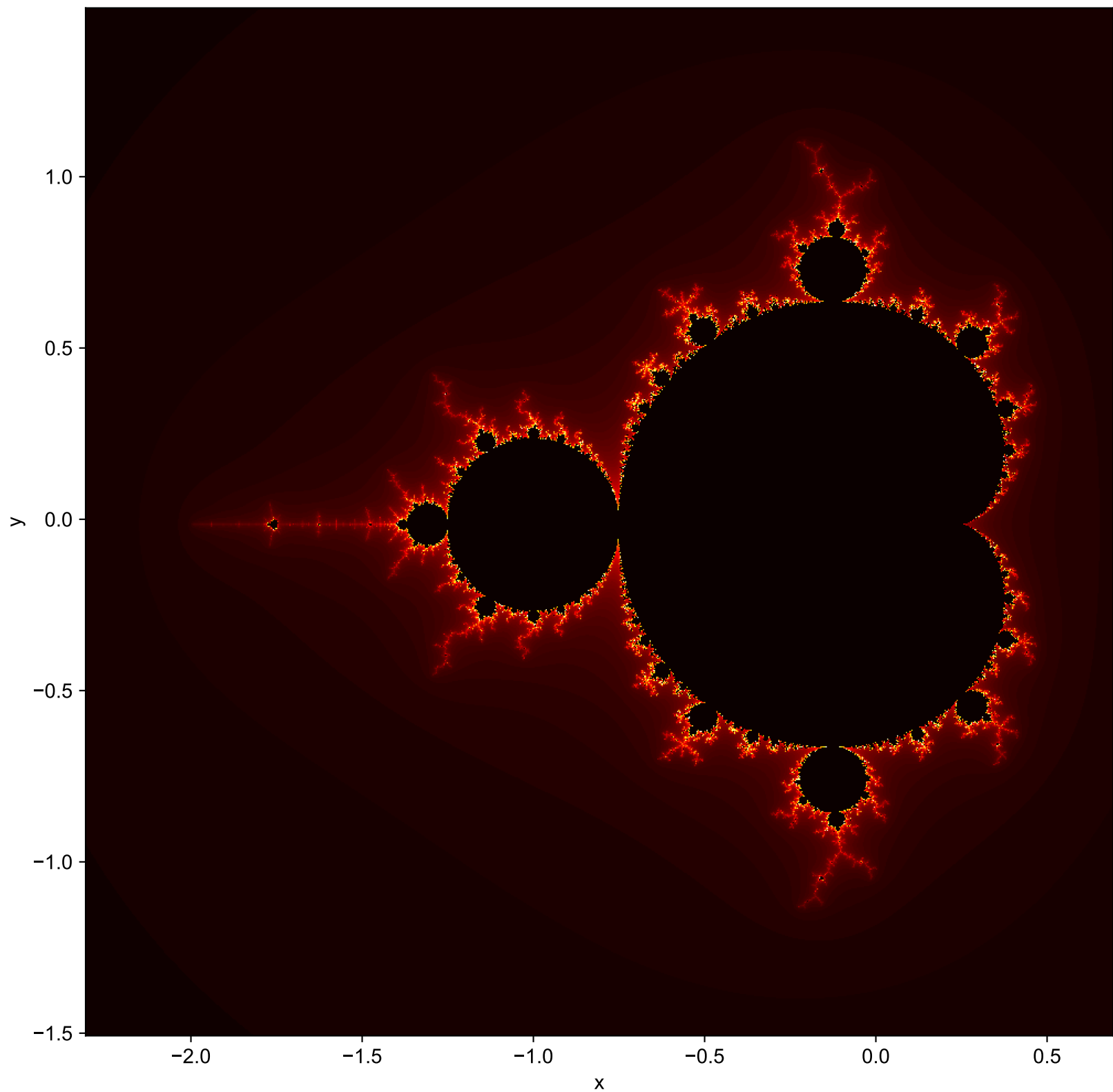
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 7

Number of points per axis: 927

Elapsed computation time: 5.217656599999998 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

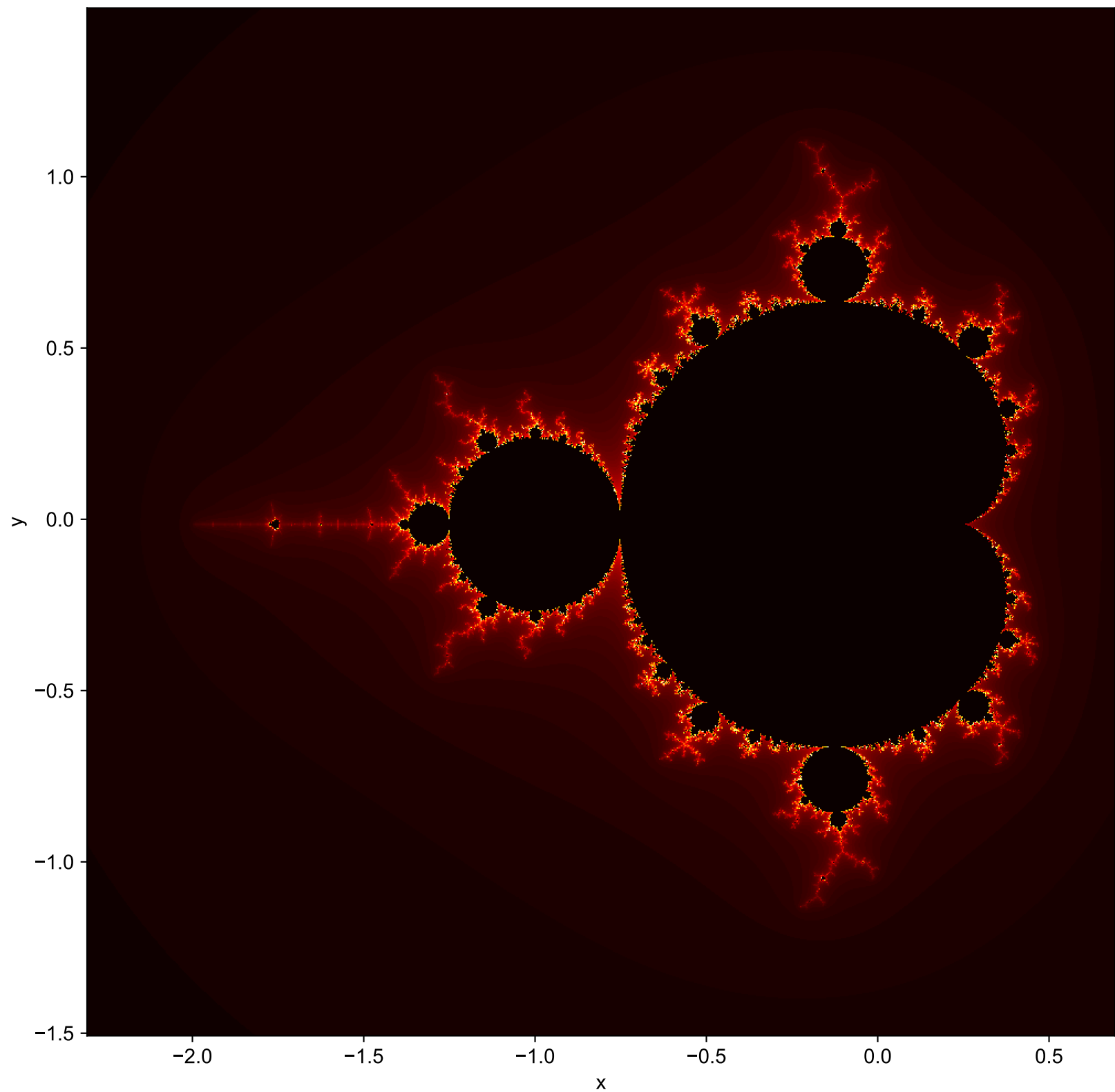
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 8

Number of points per axis: 927

Elapsed computation time: 5.175173700000016 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

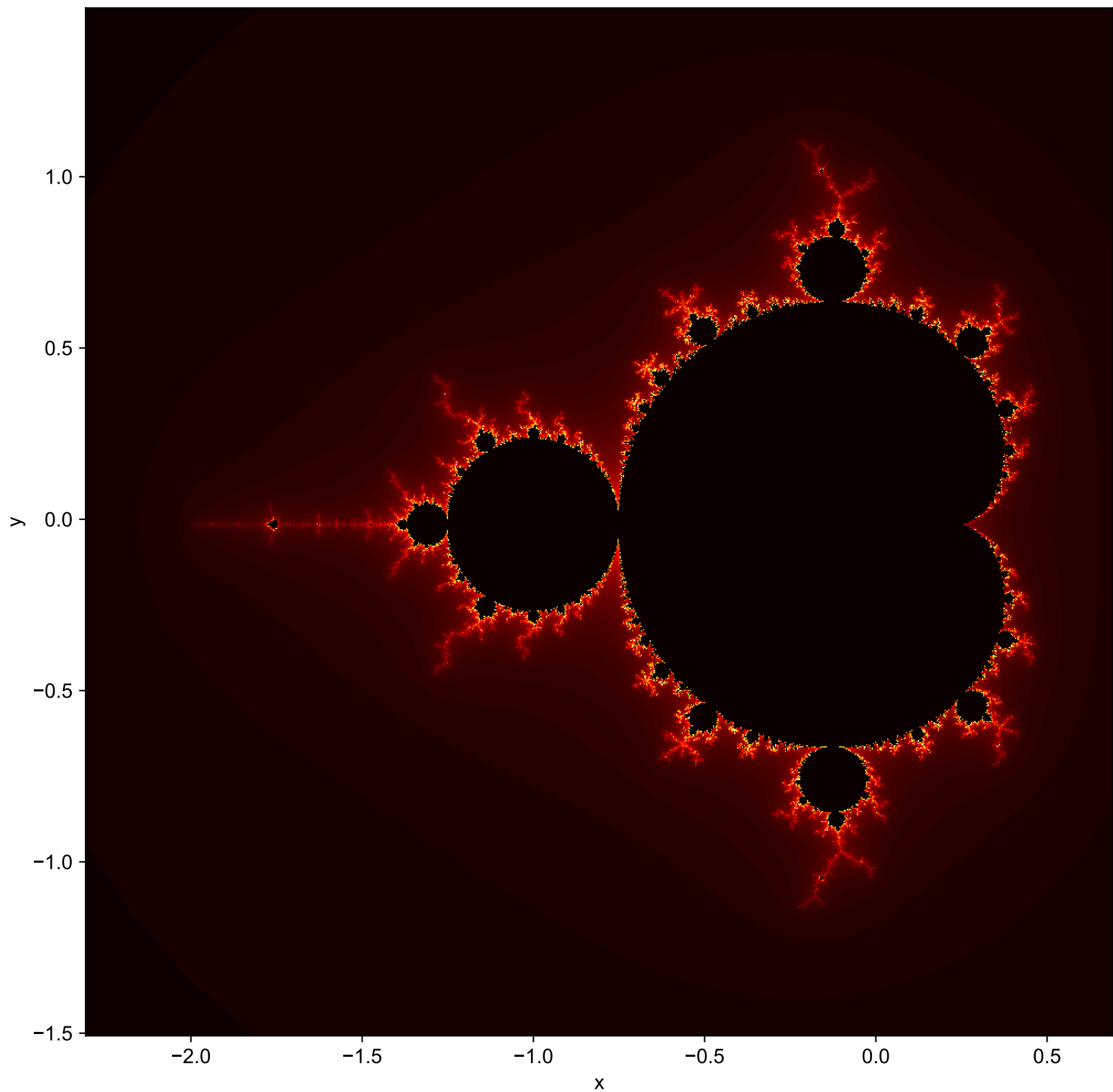
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 9

Number of points per axis: 927

Elapsed computation time: 5.287674899999985 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

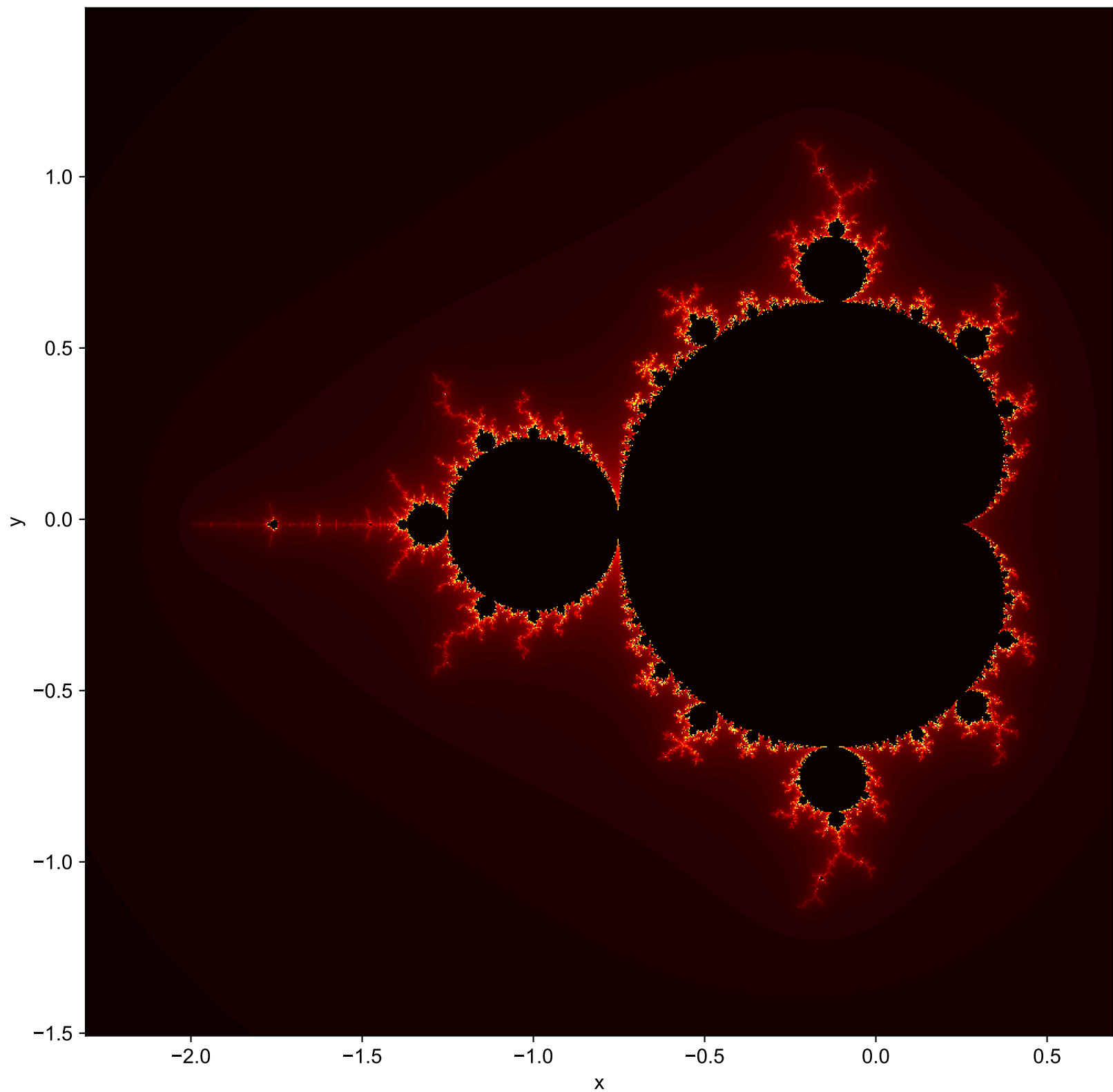
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 10

Number of points per axis: 927

Elapsed computation time: 5.305533900000029 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

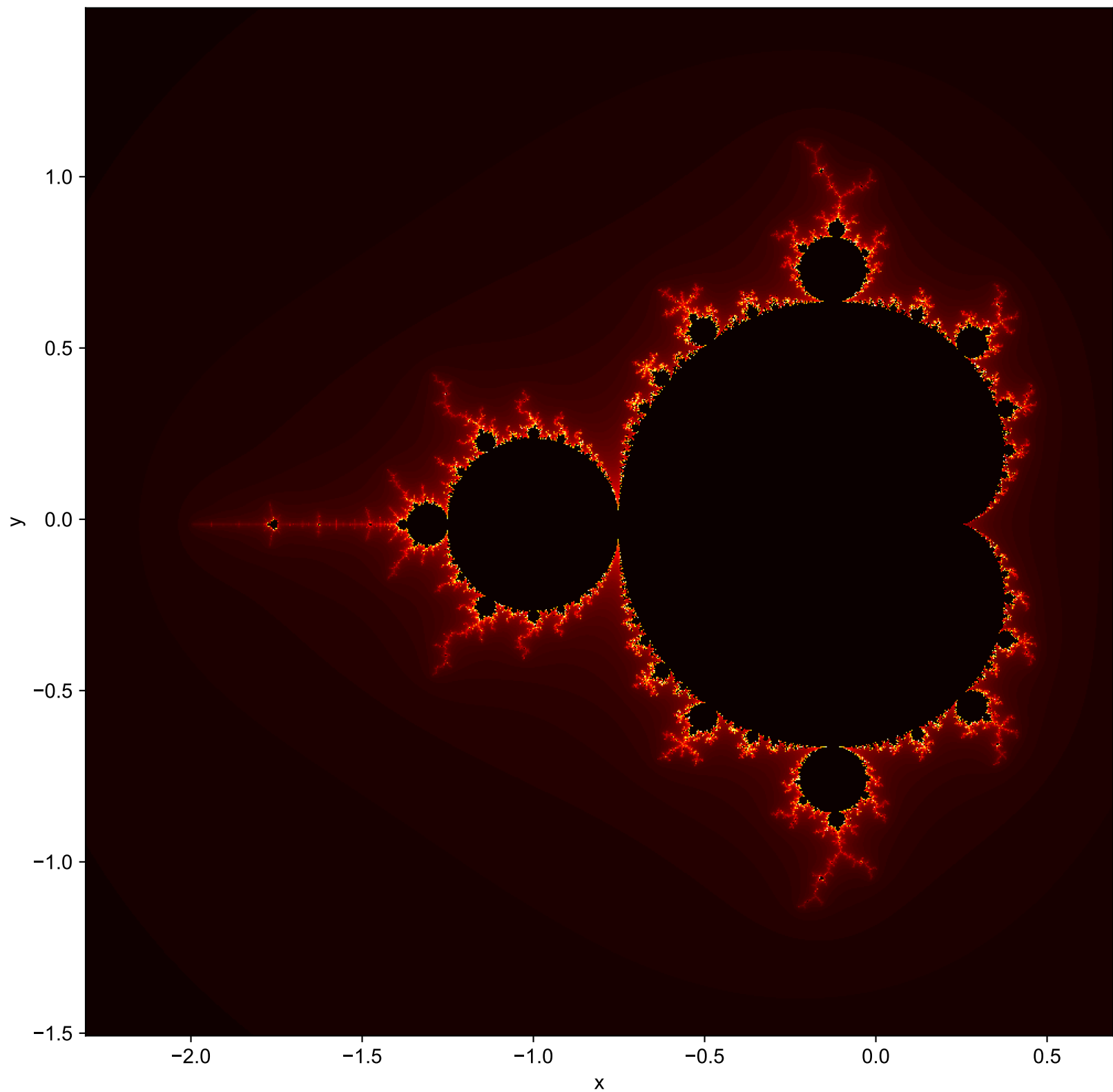
Mandelbrot Set

Computation Method: MultiProc JIT

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 3.4962854000000334 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

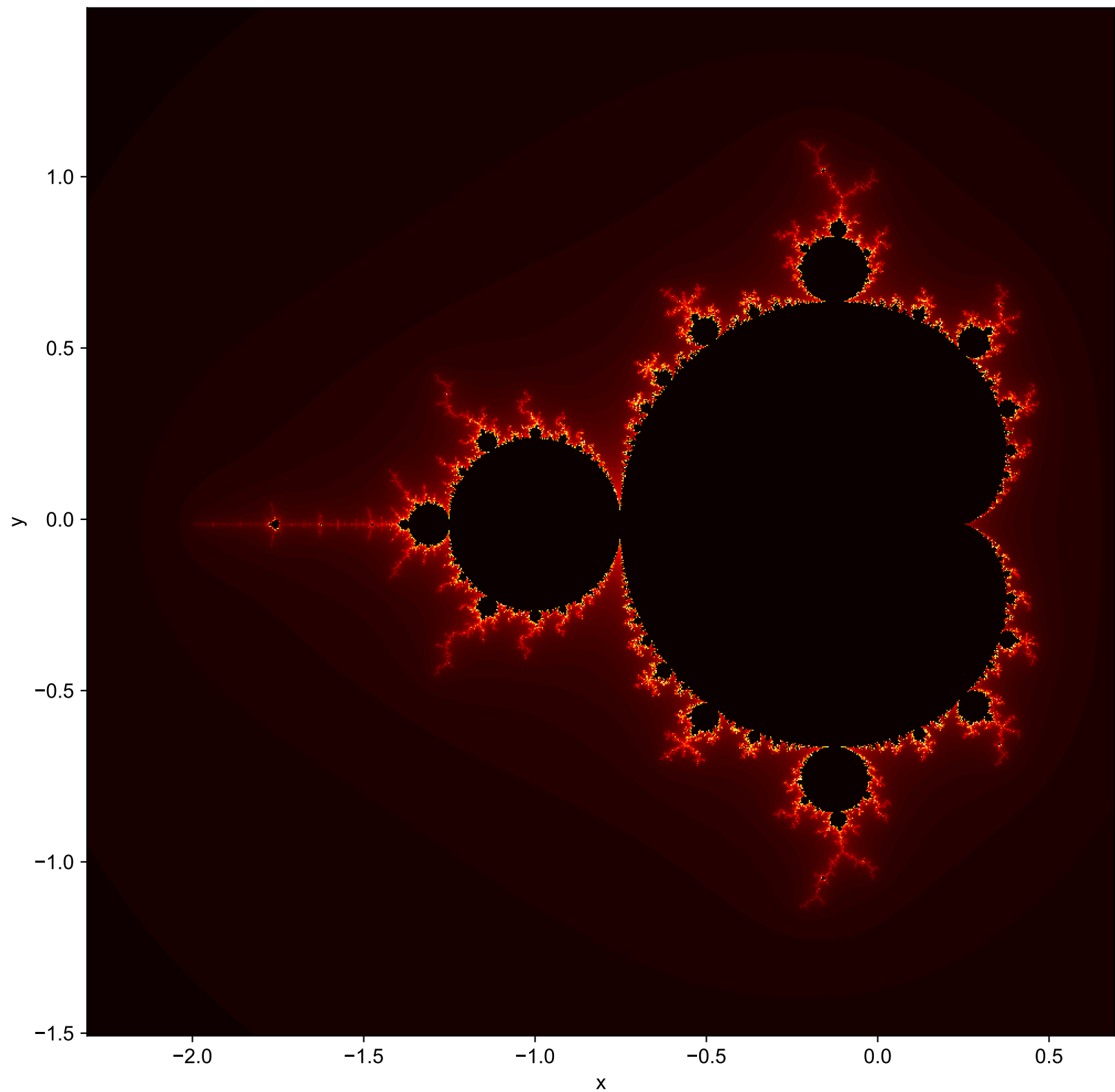
Mandelbrot Set

Computation Method: MultiProc JIT

Number of cores: 1

Number of points per axis: 927

Elapsed computation time: 1.5848613999999657 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

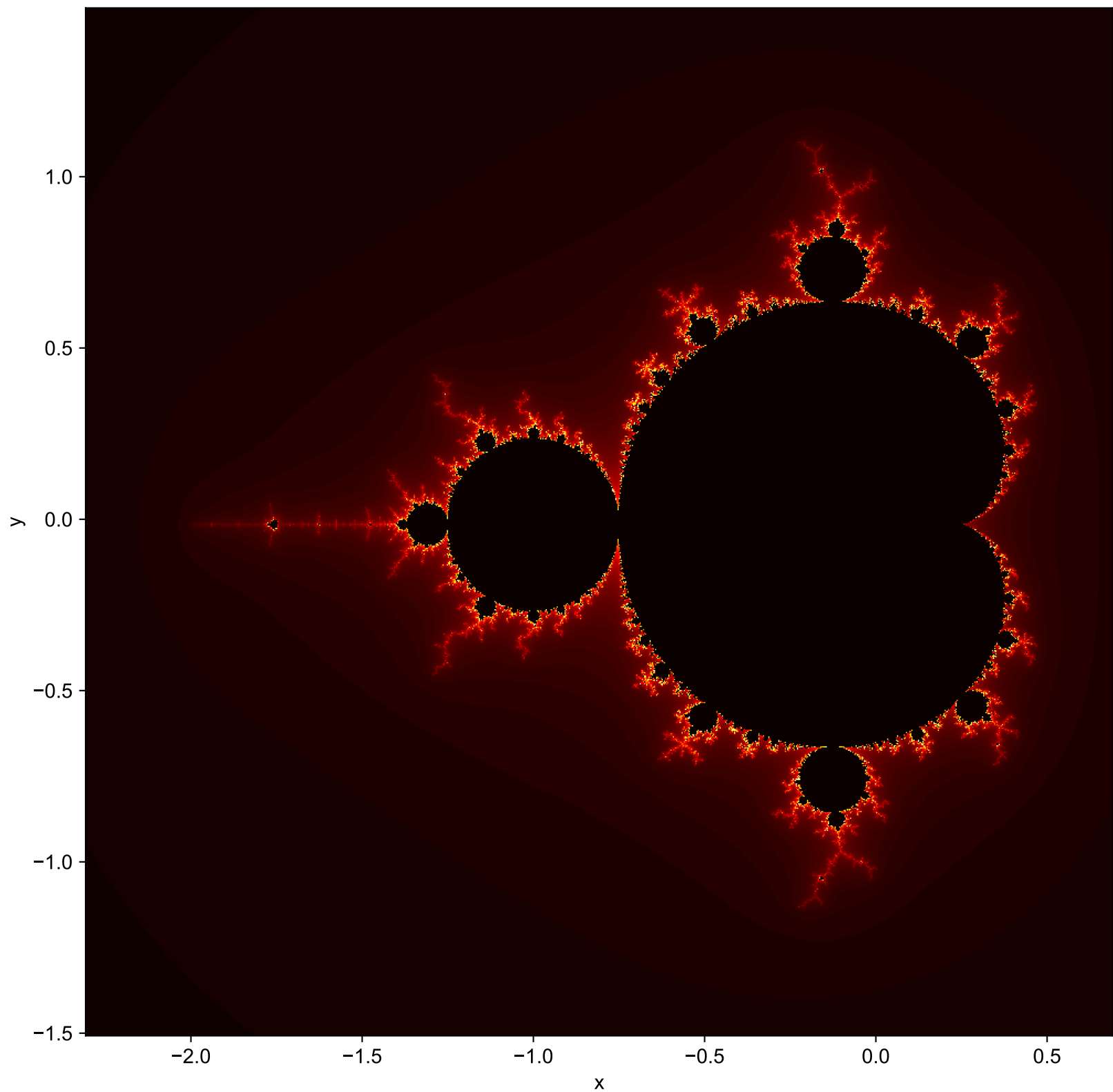
Mandelbrot Set

Computation Method: MultiProc JIT

Number of cores: 2

Number of points per axis: 927

Elapsed computation time: 1.718230300000016 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

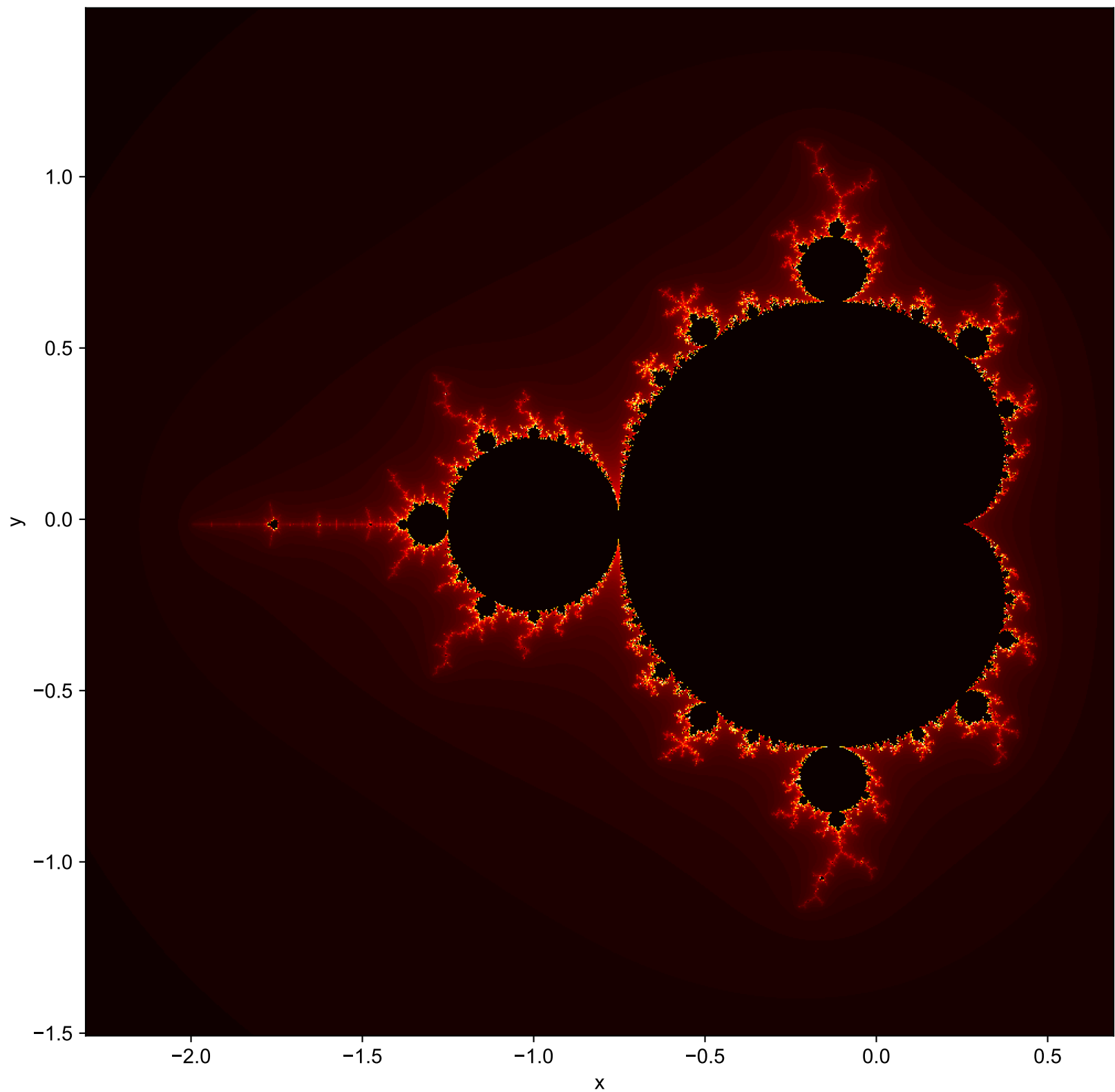
Mandelbrot Set

Computation Method: JIT

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 0.8043114999999972 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

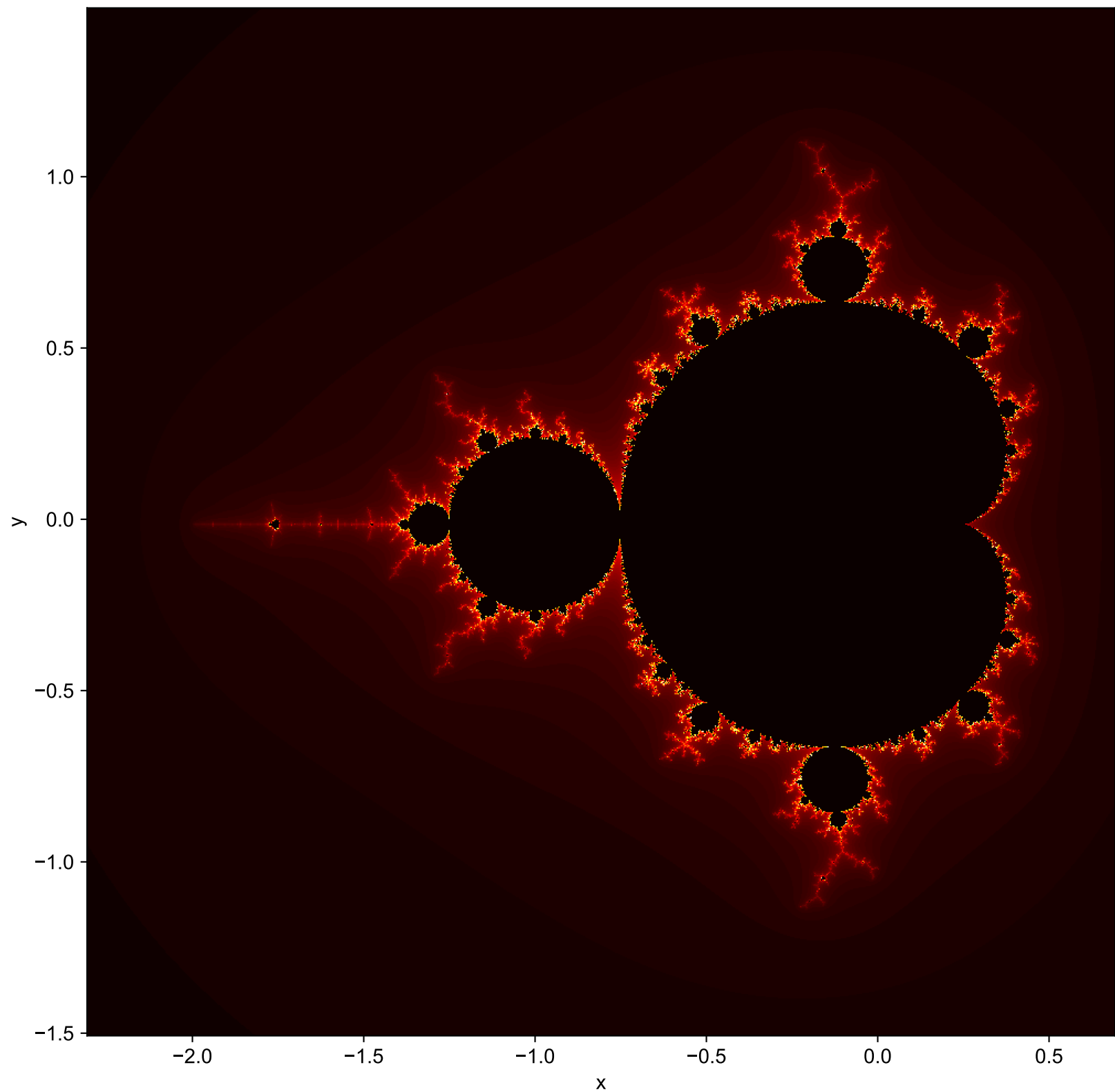
Mandelbrot Set

Computation Method: MultiProc JIT

Number of cores: 3

Number of points per axis: 927

Elapsed computation time: 1.8257039999999733 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

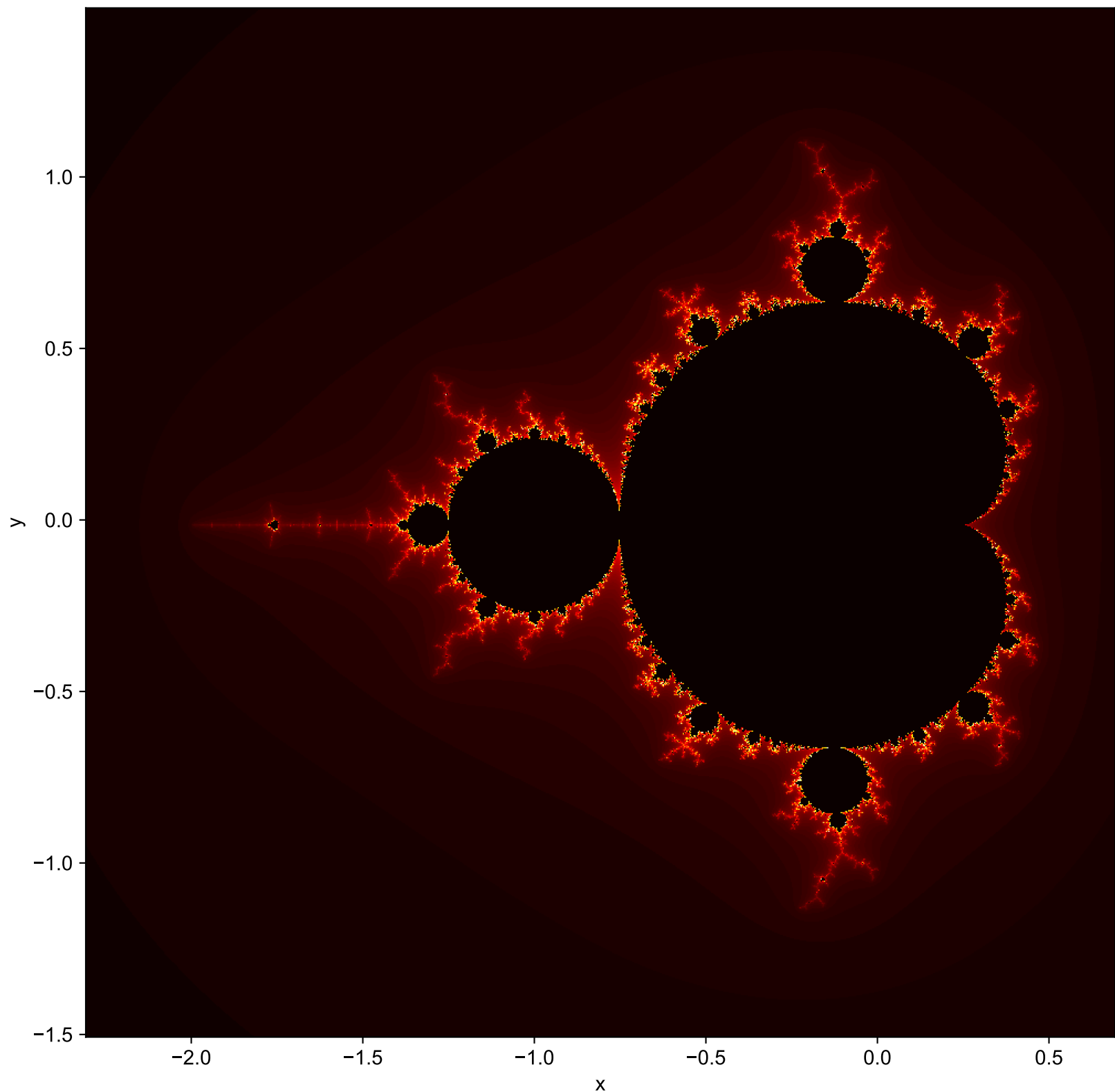
Mandelbrot Set

Computation Method: JIT

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 0.18281190000000436 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

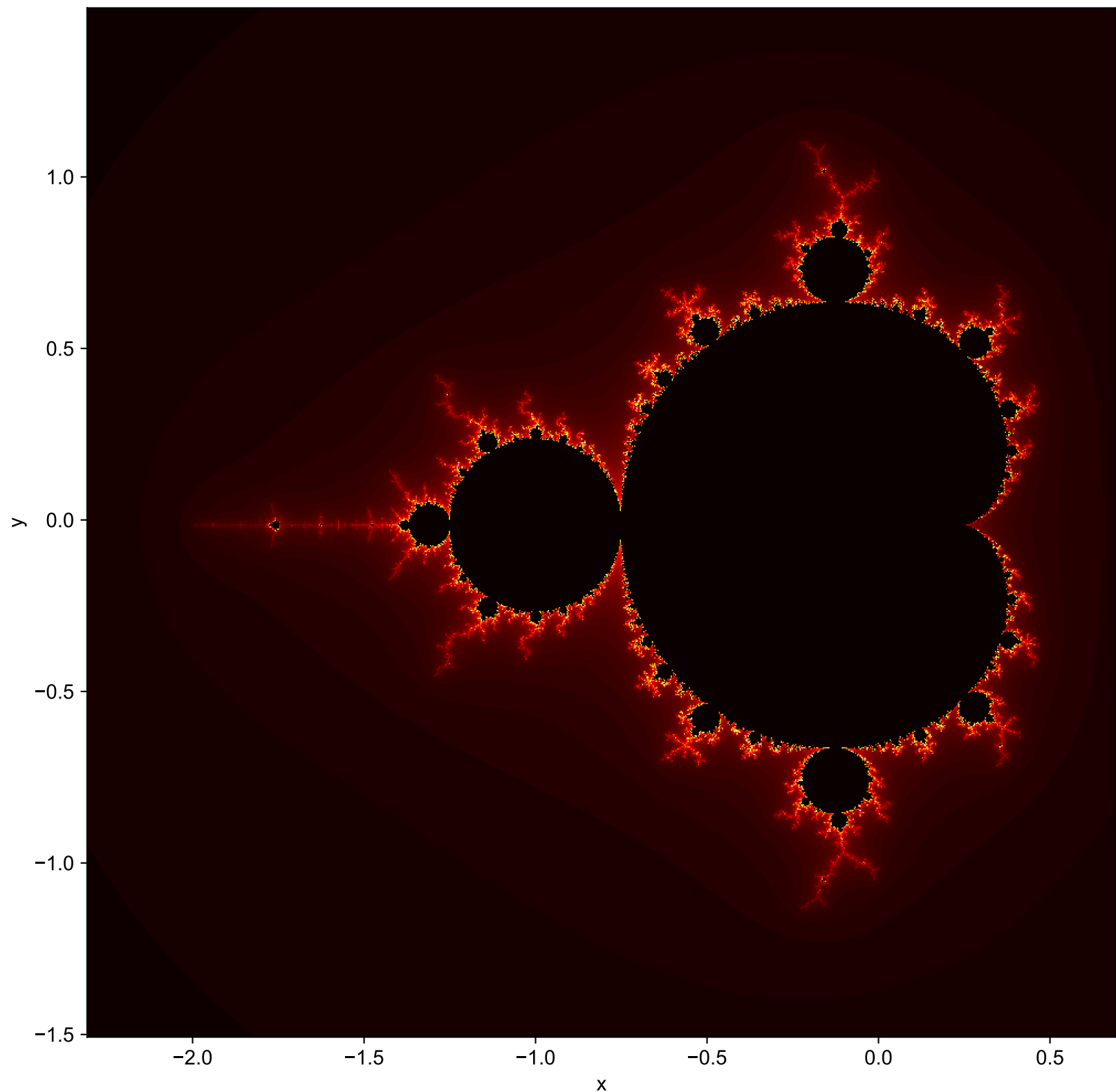
Mandelbrot Set

Computation Method: JIT Parallel

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 0.54333149999999936 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

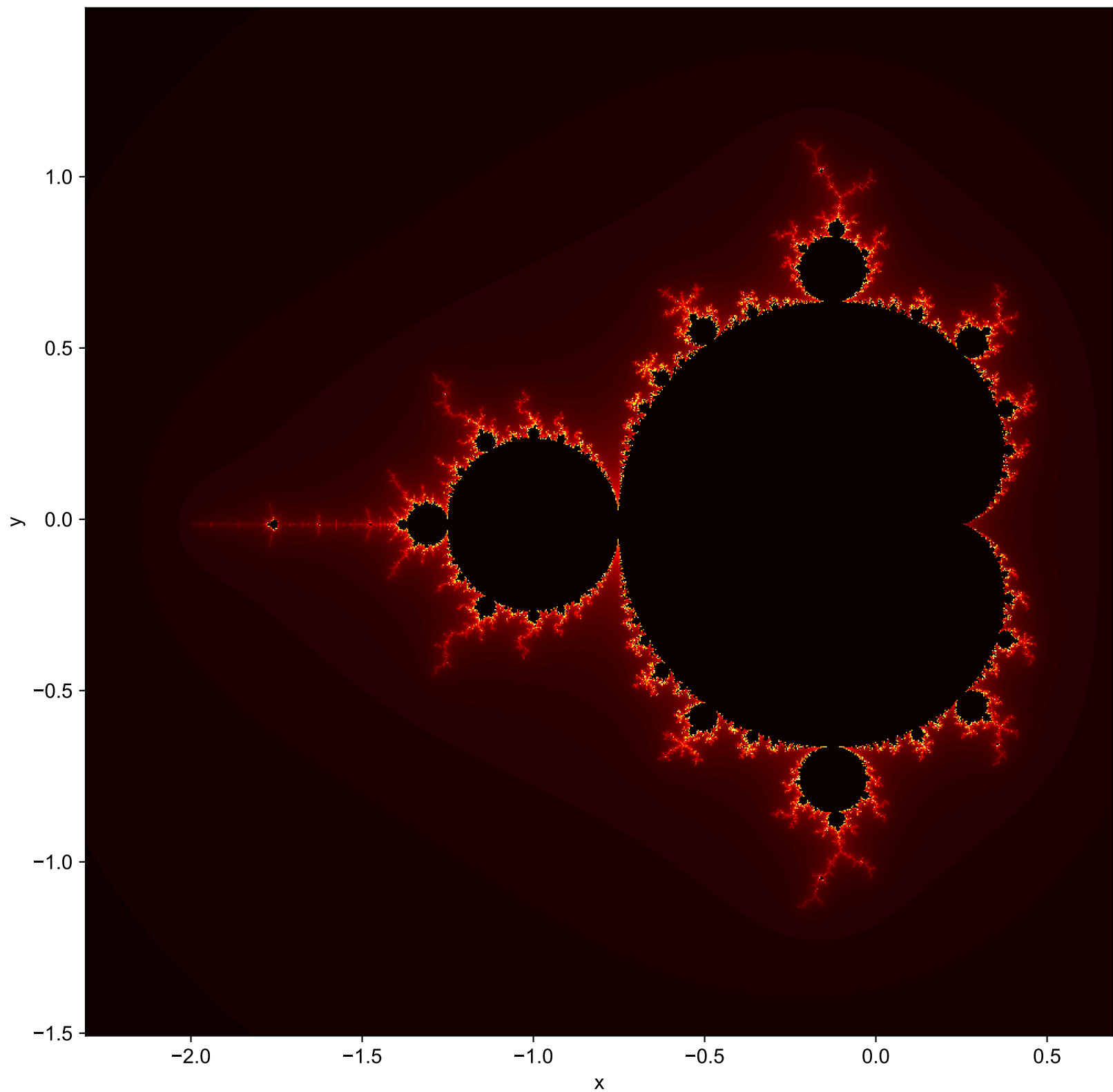
Mandelbrot Set

Computation Method: JIT Parallel

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 0.09718449999999734 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

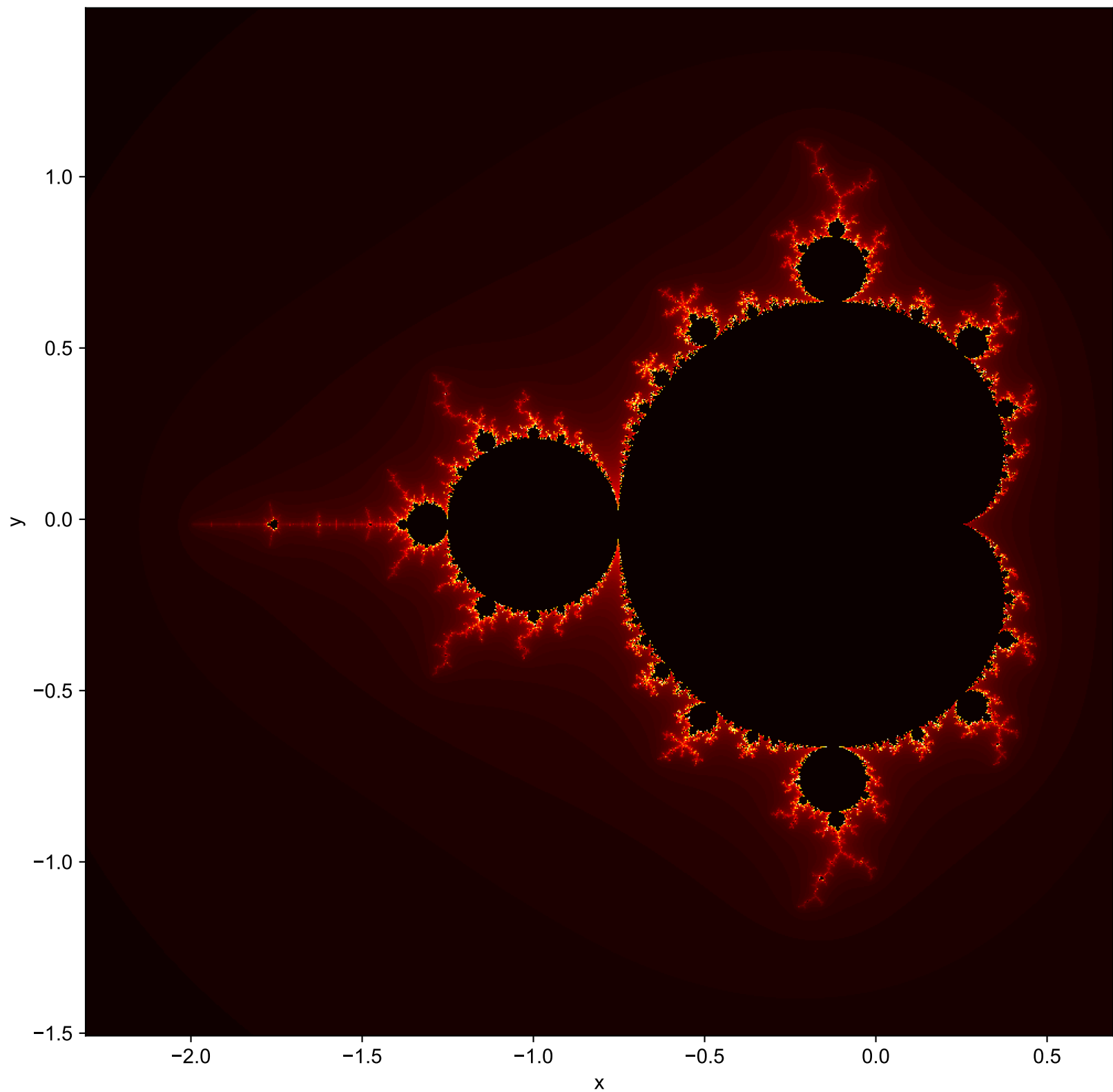
Mandelbrot Set

Computation Method: MultiProc

Number of cores: Default

Number of points per axis: 927

Elapsed computation time: 5.966924399999996 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

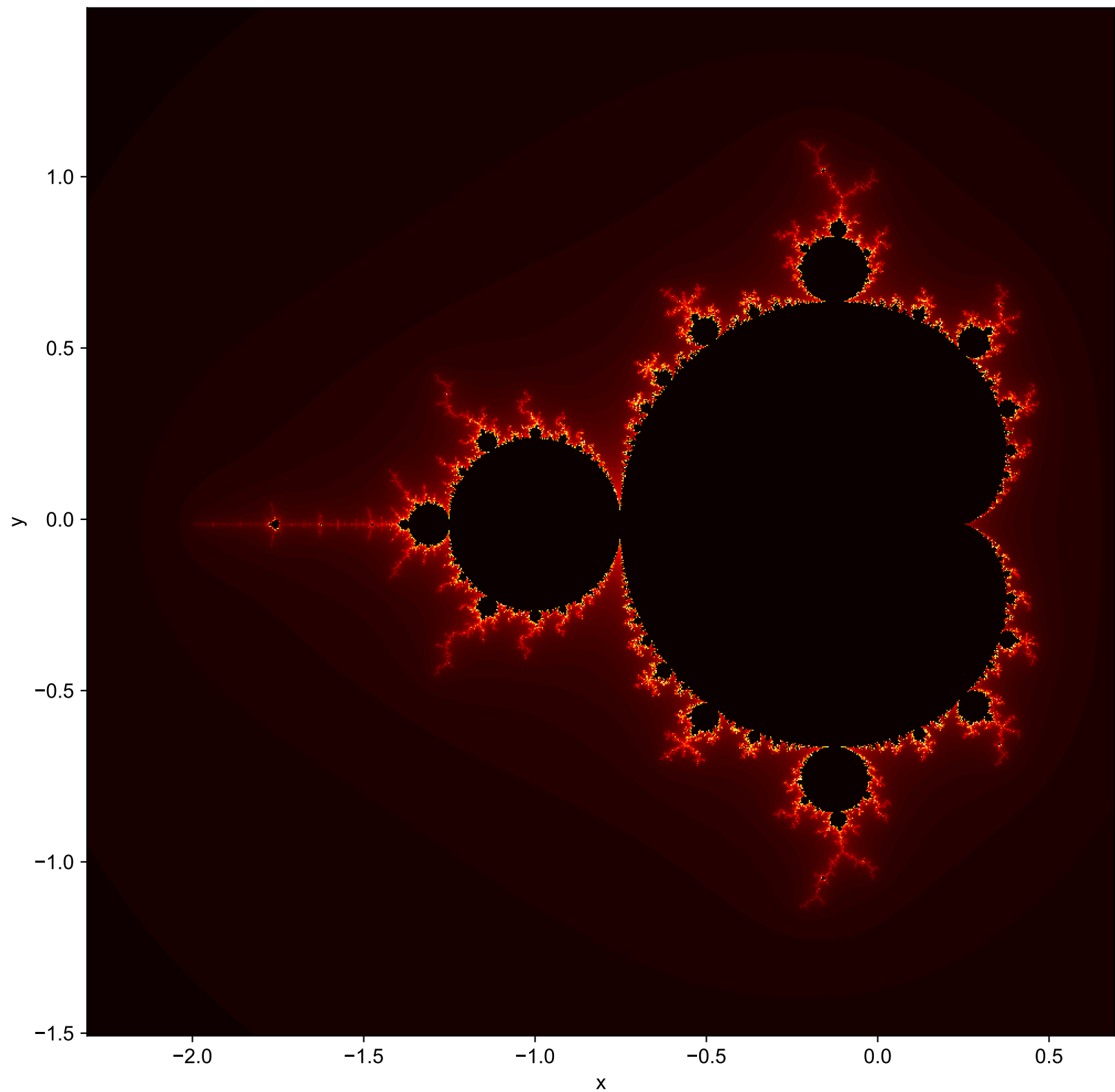
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 1

Number of points per axis: 927

Elapsed computation time: 21.30564960000001 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

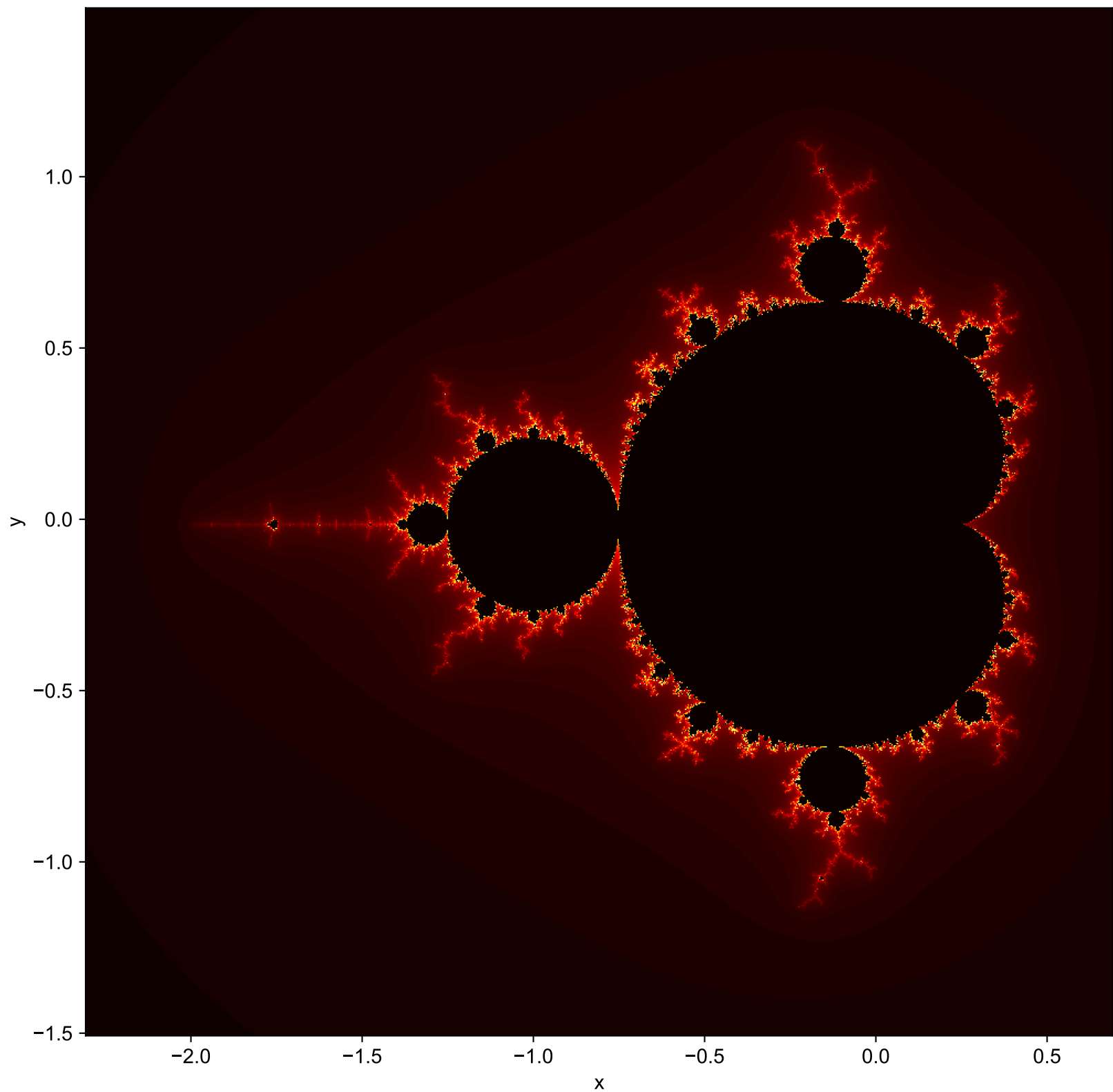
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 2

Number of points per axis: 927

Elapsed computation time: 11.687106499999999 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889

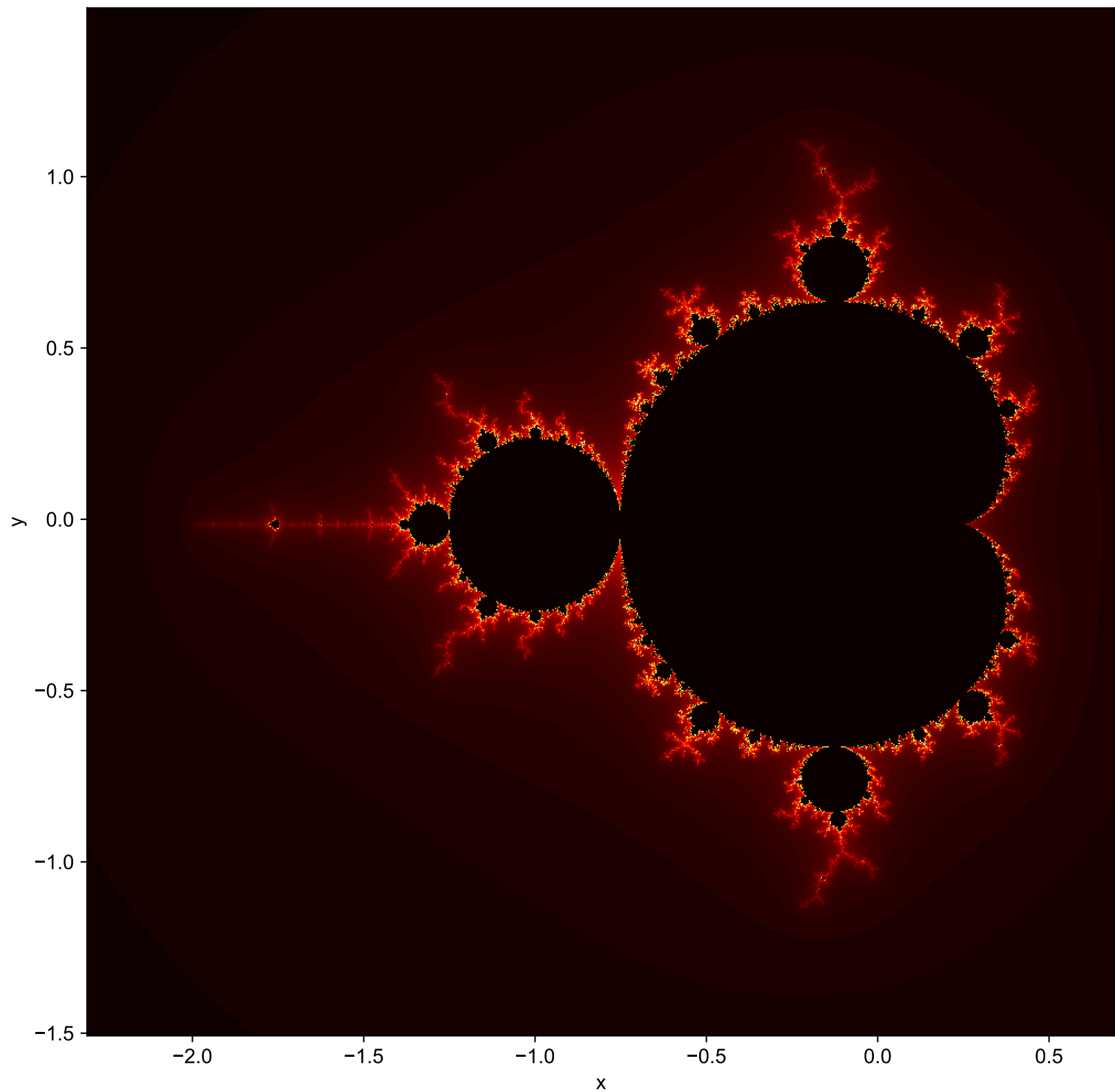
Mandelbrot Set

Computation Method: MultiProc

Number of cores: 3

Number of points per axis: 927

Elapsed computation time: 8.548627400000015 seconds



Value range: 3.0

x min | x max: -2.3075376884422107 | 0.692462311557789

y min | y max: -1.5075376884422111 | 1.4924623115577889