**Blue Waters Petascale Semester Curriculum v1.0**

**Unit 4: OpenMP**

**Lesson 1: Race Conditions**

**References / Further Reading**

*Developed by David P. Bunde for the Shodor Education Foundation, Inc.*



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*Browse and search the full curriculum at*[*http://shodor.org/petascale/materials/semester-curriculum*](http://shodor.org/petascale/materials/semester-curriculum)

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Background on the Mandelbrot set (Wikipedia page):

<https://en.wikipedia.org/wiki/Mandelbrot_set>

This lesson is based on the second module from the following:

D.P. Bunde. “Modules for introducing threads”. In Prasad, Gupta, Sussman, and Weems editors, *Topics in parallel and distributed computing: Introducing concurrency in undergraduate courses*, chapter 4, pages 59-82, Morgan Kaufmann, 2015.

<https://tcpp.cs.gsu.edu/curriculum/?q=system/files/ch4.pdf>

That lesson shows the first kind of race conditions as we do here. It does not cover reductions, but does show load balance and loop scheduling. It creates a .bmp file instead of a .ppm file. Using .bmp causes the race condition to cause color differences, but the file format is significantly more complicated.