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Report

Introduction

We are investigating the OpenMP parallel scheduling using the Collatz conjecture as a test problem. The three main parallel approaches used during this investigation are Static, Dynamic, and Guided.

1. Table of scheduling options

Type	Description
Static	Divide the loop into equal-sized chunks or as equal as possible in the case where the number of loop iterations is not evenly divisible by the number of threads multiplied by the chunk size. By default, chunk size is loop_count/number_of_threads.Set chunk to 1 to interleave the iterations.
Dynamic	Use the internal work queue to give a chunk-sized block of loop iterations to each thread. When a thread is finished, it retrieves the next block of loop iterations from the top the work queue. By default, the chunk size is 1. Be careful when using this scheduling type because of the extra overhead involved.
Guided	Similar to dynamic scheduling, but the chunk size starts off large and decreases to better handle load imbalance between iterations. The optional chunk parameter specifies the minimum size chunk to use. By default, the chunk size is approximately loop_count/number_of_threads.

During the experiment, we used the same number of threads (8) to eliminate any variance due to the number of threads. We only varied the problem size, 2000 to 20000 to 200000 to 2000000, and the chunk sizes for each scheduling scheme.

Results

2. Table comparing scheduling types against Serial code with default chunck_sizes

Nmax	High	Static Avg	Dynamic Avg	Guided Avg	Serial Avg
2000	1276936	2.00E-02	1.06E-02	7.55E-03	2.93E-03
20000	27114424	2.59E-02	2.05E-02	2.57E-02	1.45E-02
200000	17202377752	1.98E-01	2.12E-01	2.09E-01	1.34E-01
2000000	156914378224	2.12E+00	2.08E+00	2.04E+00	1.48E+00

3. Table comparing scheduling types against each other with varying chunk_sizes

Nmax	Chunk Size(def)	Static Avg	Static Speed up	Dynamic Avg	Dynamic Speedup	Guided Avg	Guided Speedup
	250000	2.12E+00	1.00E+00	2.08E+00	1.00E+00	2.04E+00	1.00E+00
2000000	1024	1.92E+00	1.10E+00	2.26E+00	9.22E-01	2.37E+00	8.60E-01
High	128	2.09E+00	1.02E+00	2.02E+00	1.03E+00	2.24E+00	9.08E-01
156914378	64	1.68E+00	1.26E+00	1.68E+00	1.24E+00	1.66E+00	1.23E+00
224	4	1.71E+00	1.24E+00	1.63E+00	1.28E+00	1.66E+00	1.22E+00

Conclusions

After analysis, we notice that depending on the Nmax value, the runtime varies. The greater the Nmax, the longer the runtime across all the scheduling methods. By varying the chuck sizes, we also registered different speedups, thus revealing that runtimes do depend on how the loop is scheduled.