MYE023: Homework #1

Due on Monday, April 7, 2017

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Contents

1 Exercise #1

1.1 About

This exercise is about the calculation of the mathematical constant π using `POSIX` threads and dynamic scheduling. During dynamic scheduling the parallelizable loops are divided into chunks of iterations (tasks) and are dispatched to the threads available to the runtime system for execution. The dispatch takes place in respect to the current processor workload where the thread executes and as a result load balancing is achieved. In case chunk size is one (1) iteration, we refer to this technique as self-scheduling.

The purpose of this exercise is to time the calculation of π and observe how altering the number of threads and chunk size will affect execution time.

1.2 Experiment details

The calculation consists of $5 * 10^8$ loop iterations, while thread number takes value in {1, 4, 16} and chunk size in {1, 10, 10^2, 10^3, 10^4 and 10^5}.

1.2.1 System

The experiments were conducted on a Dell OptiPlex 7020:

- CPU: Intel® Core™ i5-4590 CPU @ 3.30GHz (64 bit)
- RAM: 2 DIMMs x4GiB @ 1600MHz DDR3
- Cache line size: 64B (in all levels)
- Cache associativity:
  - L1, L2: 8-way set associative
  - L3: 12-way set associative

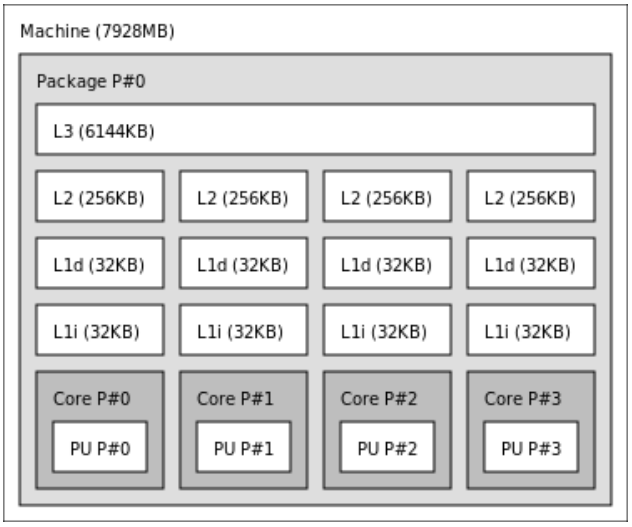

Figure 1: Topology information of a Dell OptiPlex 7020

1.3 Timing Results

In the following tables and plots the recorded execution times are displayed.

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
1	1	18.451202	18.443870	18.444319	18.441278	18.44516725
1	4	98.559317	98.393137	99.515415	98.189223	98.664273
1	16	95.482310	95.205719	95.275233	95.197046	95.290077

Table 1: Timing results of π calculation using chunk size = 1 iteration

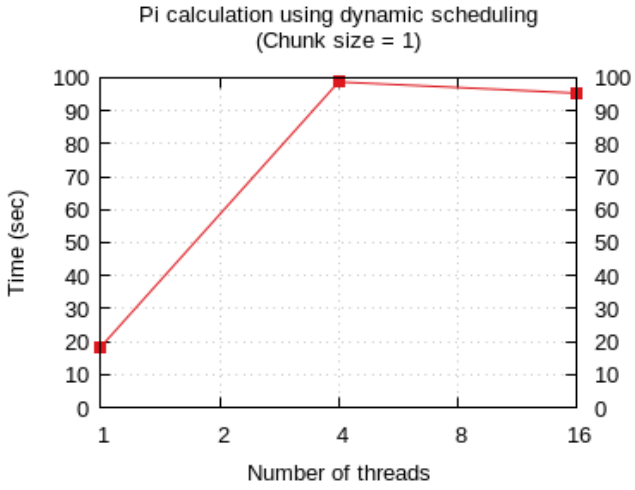

Figure 2: Timing results of π calculation using chunk size = 1 iteration

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
10	1	6.505206	6.510850	6.507051	6.511070	6.50854425
10	4	10.843631	10.728116	10.715714	10.832101	10.7798905
10	16	10.829372	10.820372	10.842818	10.748566	10.810282

Table 2: Timing results of π calculation using chunk size = 10 iteration

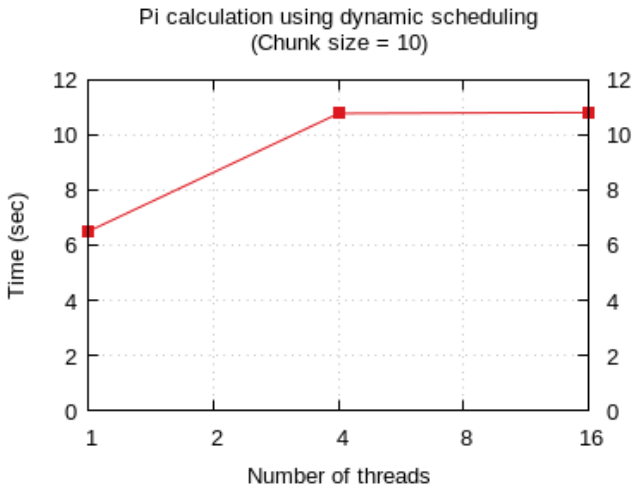

Figure 3: Timing results of π calculation using chunk size = 10 iterations

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
100	1	6.275921	6.279012	7.893470	6.281098	6.68237525
100	4	2.428611	2.464799	2.463414	2.425332	2.445539
100	16	2.425184	2.459710	2.432488	2.458897	2.44406975

Table 3: Timing results of π calculation using chunk size = 100 iteration

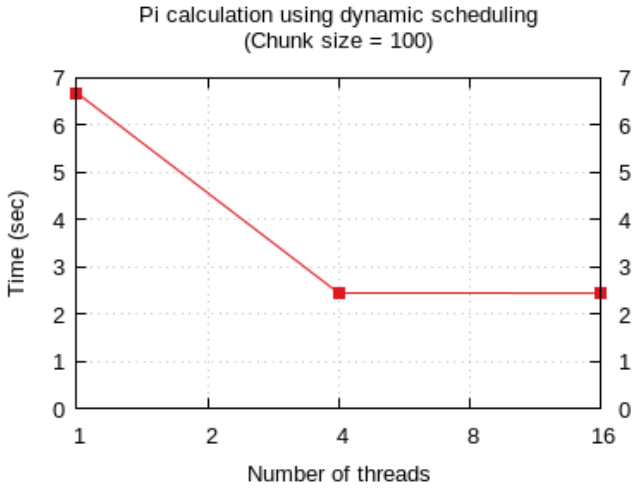

Figure 4: Timing results of π calculation using chunk size = 100 iterations

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
1000	1	6.248489	6.254362	6.254913	6.251492	6.252314
1000	4	1.733363	1.735331	1.732440	1.734742	1.733969
1000	16	1.731060	1.726669	1.730891	1.732937	1.73038925

Table 4: Timing results of π calculation using chunk size = 1000 iteration

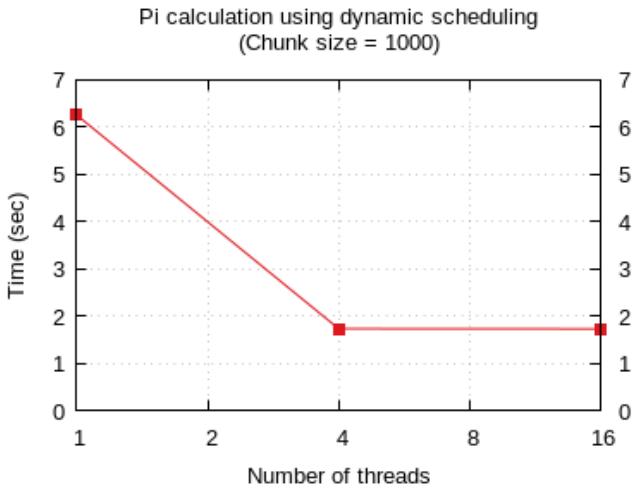

Figure 5: Timing results of π calculation using chunk size = 1000 iterations

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
10000	1	6.244337	6.252478	6.250002	6.252064	6.24972025
10000	4	1.664214	1.659239	1.660260	1.659163	1.660719
10000	16	1.660762	1.664066	1.661164	1.658869	1.66121525

Table 5: Timing results of π calculation using chunk size = 10000 iteration

Timing results of π calculation (Time unit: seconds)						
Chunk Size	# of threads	1st run	2nd run	3rd run	4thr run	Average time
100000	1	6.237799	6.234975	6.244593	6.235083	6.2381125
100000	4	1.661888	1.658459	1.667569	1.651900	1.659954
100000	16	1.653965	1.652250	1.651300	1.651015	1.6521325

Table 6: Timing results of π calculation using chunk size = 100000 iteration

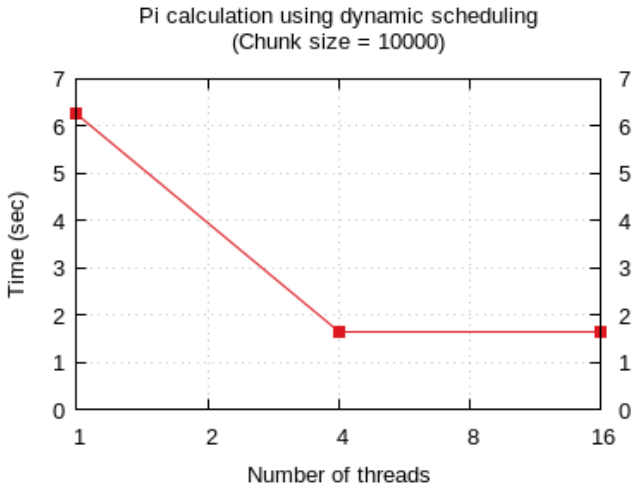

Figure 6: Timing results of π calculation using chunk size = 10000 iterations

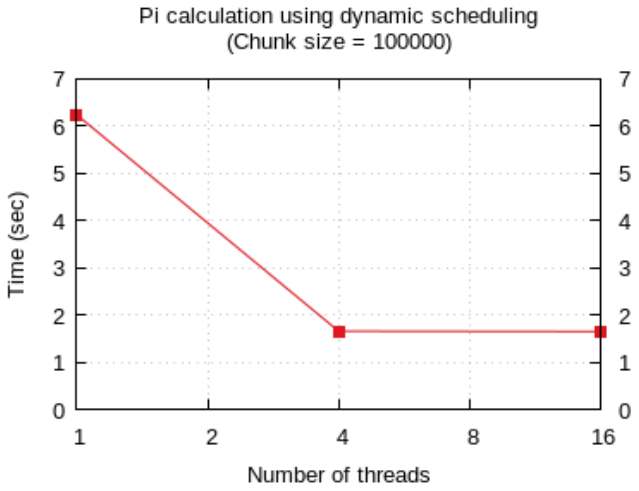

Figure 7: Timing results of π calculation using chunk size = 100000 iterations

1.4 Conclusion

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