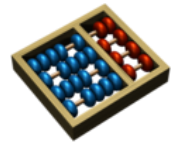




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Projeto 3

Experimental ferramentas e coletar dados

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1 Introdução

2 Ambiente de Experimentação

O computador utilizado em todos os experimentos está descrito conforme segue e será denominado “Laptop Rubens”:

- Notebook HP model ??????????
- Memória RAM: 16 Gbytes
- Sistema Operacional
 - Ubuntu 22.04.2 LTS (GNU/Linux 5.15.90.1-microsoft-standard-WSL2 x86_64)
- CPU:
 - Model name: Intel(R) Core(TM) i7-2620M CPU @ 2.70GHz
 - Architecture: x86_64
 - CPU op-mode(s): 32-bit, 64-bit
 - Address sizes: 36 bits physical, 48 bits virtual
 - Byte Order: Little Endian
 - CPU(s): 4
 - Vendor ID: GenuineIntel
 - CPU family: 6
 - Thread(s) per core: 2
 - Core(s) per socket: 2
 - L1d cache: 64 KiB (2 instances)
 - L1i cache: 64 KiB (2 instances)
 - L2 cache: 512 KiB (2 instances)
 - L3 cache: 4 MiB (1 instance)

3 Ferramentas experimentadas

As ferramentas utilizadas para avaliações em arquitetura de computadores foram SPEC CPU 2017, Simulador multi-core Sniper, Perf profiler, Parsec benchmark, Rodinia benchmark, Intel Pin e Dinero

cache simulator. Os dados coletados para cada uma das ferramentas são apresentados nas próximas seções.

3.1 SPEC CPU 2017 benchmark *

O SPEC CPU 2017 é um pacote de benchmark que contém a próxima geração de SPECs (*Standard Performance Evaluation Corporation*), pacotes de processamento intensivo de CPU para medição e comparação de desempenho computacional, sobrecarregando o processador do sistema, memória e compilador. Esta ferramenta oferece 4 suites para benchmark considerando velocidade (*speed*) e throughput (*rate*) para números inteiros e em ponto flutuante: *intspeed*, *fpspeed*, *intrate* e *fprate*.

A Tabela 1 apresenta o resumo da experimentação do SPEC CPU 2017 no laptop Rubens com os parâmetros de execução como número de cópias, *threads*, número de iterações, tempo de execução e métrica final da execução (base).

Resultados da execução do SPEC CPU 2017						
Suíte	Cópias	Threads	Nº Iterações	Qtde de Benchmarks	Tempo de execução	Métrica Final (base)
intspeed	4	4	3	9	17993 s - 4,99 hs	3,42
intspeed	8	8	3	10	18438 s – 5,12 hs	3,35
intspeed	16	16	3	10	32523 s - 9,03 hs	1,96
intrate	4	4	3	10	38073 s - 10,57 hs	5,32
intrate	8	8	3	9	65121 s – 18,08 hs	5,03
fpspeed	4	4	3	9	79708 s - 22,14 hs	3,11
fprate	4	4	3	13	58396 s - 16,22 hs	6,25
Duração total das execuções					310252 s - 86.18 hs	

Tabela 1. Suites executadas na ferramenta SPEC CPU 2017 com seus parâmetros da execução, o tempo de execução e a métrica final da execução.

A Tabela 2 apresenta a comparação do computador utilizado no experimento (Laptop Rubens) e outros computadores selecionados da lista de resultados disponível no site do SPEC CPU 2017 (<https://www.spec.org/cpu2017/results/cpu2017.html>). Os computadores selecionados são aqueles que mais se aproximam das características do computador “Laptop Rubens” a fim de que as comparações das métricas finais possam ser equilibradas e justas.

Suite	Threads	Métrica obtida do Laptop Rubens	Outros computadores	Métrica
intspeed	4	int_base: 3,42	SuperWorkstation 5039C-T (X11SCA , Intel Core i3-8100)	int_base: 7,58
intspeed	8	Int_base: 3,35	SuperWorkstation 5039C-T (X11SCA , Intel Core i7-9700K)	int_base: 10,6
intspeed	16	int_base: 1,96	Não localizado computador equivalente com thread = 16	---
intrate	4	int_base: 5,32	ASUS Z170M-PLUS Motherboard (Intel Core i7-6700K)	int_base: 23,5
intrate	8	int_base: 5,03	SuperWorkstation 5039C-T (X11SCA , Intel Core i7-9700K)	int_base: 44,8
fpspeed	4	fp_base: 3,11	SuperWorkstation 5039C-T (X11SCA , Intel Core i7-9700K)	fp_base: 32,2
fprate	4	fp_base: 6,25	SuperWorkstation 5039C-T (X11SCA , Intel Core i7-9700K)	fp_base: 42,6

Tabela 2. Comparação das métricas dos benchmarks executados no laptop Rubens e outros computadores.

A Tabela 3 apresenta os comandos com os parâmetros utilizados na execução de cada uma das suítes.

Suíte	Comando para execução do SPEC CPU 2017
intspeed	<code>runcpu --config=rubens-try1 --noreportable --iterations=3 600.perlbench_s 602.gcc_s 605.mcf_s 620.omnetpp_s 623.xalancbmk_s 625.x264_s 631.deepsjeng_s 641.leela_s 648.exchange2_s 998.specrand_is</code>
intrate	<code>runcpu --config=rubens-try1 --reportable --iterations=3 intrate</code>
fpspeed	<code>runcpu --config=rubens-try1 --noreportable --iterations=3 603.bwaves_s 607.cactuBSSN_s 619.lbm_s 621.wrf_s 628.pop2_s 638.imagick_s 644.nab_s 649.fotonik3d_s 654.roms_s 996.specrand_fs</code>
fprate	<code>runcpu --config=rubens-try1 --reportable --iterations=3 fprate</code>

Tabela 3. Comandos SPEC CPU 2017 executados para as suítes inspeed, intrate, fpspeed e fprate.

3.2 Simulador multi-core Sniper

→ Compilado e iniciando execução com a seleção de 3 programas

3.3 Perf profiler *

Perf profiler é uma ferramenta Linux que coleta e analisa dados de desempenho de programas ou do sistema operacional.

Os programas selecionados para avaliação são: fft, fork, signal, smc e true.

A apresenta os comandos com os parâmetros utilizados na execução de cada um dos programas selecionados.

Programa	Comando de execução
fft	perf stat -B ./fft
Resultado da Execução	
<pre>FFT with Blocking Transpose 1024 Complex Doubles 1 Processors 65536 Cache lines 16 Byte line size 4096 Bytes per page PROCESS STATISTICS Computation Transpose Transpose Proc Time Time Fraction 0 303 61 0.20132 TIMING INFORMATION Start time : 695908542 Initialization finish time : 695908777 Overall finish time : 695909080 Total time with initialization : 538 Total time without initialization : 303 Overall transpose time : 61 Overall transpose fraction : 0.20132 Performance counter stats for './fft': 1.06 msec task-clock # 0.746 CPUs utilized 0 context-switches # 0.000 /sec 0 cpu-migrations # 0.000 /sec 62 page-faults # 58.701 K/sec 2540158 cycles # 2.405 GHz 1814472 stalled-cycles-frontend # 71.43% frontend cycles idle 1042654 stalled-cycles-backend # 41.05% backend cycles idle 2132716 instructions # 0.84 insn per cycle # 0.85 stalled cycles per insn 195210 branches # 184.823 M/sec 6000 branch-misses # 3.07% of all branches 0.001415500 seconds time elapsed 0.001717000 seconds user 0.000000000 seconds sys</pre>	

Programa	Comando de execução
fft	perf stat -B ./fft if=/dev/zero of=/dev/null count=1000000
Resultado da Execução	
<pre> FFT with Blocking Transpose 1024 Complex Doubles 1 Processors 65536 Cache lines 16 Byte line size 4096 Bytes per page PROCESS STATISTICS Proc Computation Transpose Transpose Time Time Fraction 0 335 59 0.17612 TIMING INFORMATION Start time : 760328360 Initialization finish time : 760328587 Overall finish time : 760328922 Total time with initialization : 562 Total time without initialization : 335 Overall transpose time : 59 Overall transpose fraction : 0.17612 Performance counter stats for './fft if=/dev/zero of=/dev/null count=1000000': 1.01 msec task-clock # 0.731 CPUs utilized 0 context-switches # 0.000 /sec 0 cpu-migrations # 0.000 /sec 62 page-faults # 61.198 K/sec 2561675 cycles # 2.529 GHz 1839401 stalled-cycles-frontend # 71.80% frontend cycles idle 1031193 stalled-cycles-backend # 40.25% backend cycles idle 2135867 instructions # 0.83 insn per cycle # 0.86 stalled cycles per insn 195848 branches # 193.316 M/sec 5650 branch-misses # 2.88% of all branches 0.001386500 seconds time elapsed 0.001920000 seconds user 0.000000000 seconds sys </pre>	
Programa	Comando de execução
fork	perf stat -B ./fork
Resultado da Execução	
<pre> Hello world from parent Hello world from child Performance counter stats for './fork': 0.94 msec task-clock # 0.045 CPUs utilized 2 context-switches # 2.139 K/sec 0 cpu-migrations # 0.000 /sec 55 page-faults # 58.811 K/sec 1820753 cycles # 1.947 GHz 1528003 stalled-cycles-frontend # 83.92% frontend cycles idle 1222034 stalled-cycles-backend # 67.12% backend cycles idle </pre>	

	578101	instructions	#	0.32	insn per cycle
			#	2.64	stalled cycles per insn
	118406	branches	#	126.610	M/sec
	6079	branch-misses	#	5.13%	of all branches
0.020806800 seconds time elapsed					
0.001550000 seconds user					
0.000000000 seconds sys					
Programa	Comando de execução				
signal	perf stat -B ./signal				
Resultado da Execução					
Installing signal handler Dereferencing NULL pointer Received signal 11					
Performance counter stats for './signal':					
	0.45 msec	task-clock	#	0.545	CPUs utilized
	0	context-switches	#	0.000	/sec
	0	cpu-migrations	#	0.000	/sec
	30	page-faults	#	66.800	K/sec
	978289	cycles	#	2.178	GHz
	798099	stalled-cycles-frontend	#	81.58%	frontend cycles idle
	634507	stalled-cycles-backend	#	64.86%	backend cycles idle
	350129	instructions	#	0.36	insn per cycle
			#	2.28	stalled cycles per insn
	70957	branches	#	157.998	M/sec
	3626	branch-misses	#	5.11%	of all branches
0.000824699 seconds time elapsed					
0.000910000 seconds user					
0.000000000 seconds sys					
Programa	Comando de execução				
smc	perf stat -B ./smc				
Resultado da Execução					
Good morning!					
Performance counter stats for './smc':					
	0.47 msec	task-clock	#	0.588	CPUs utilized
	0	context-switches	#	0.000	/sec
	0	cpu-migrations	#	0.000	/sec
	29	page-faults	#	61.259	K/sec
	1070708	cycles	#	2.262	GHz
	842947	stalled-cycles-frontend	#	78.73%	frontend cycles idle
	621900	stalled-cycles-backend	#	58.08%	backend cycles idle
	493319	instructions	#	0.46	insn per cycle
			#	1.71	stalled cycles per insn
	92454	branches	#	195.298	M/sec
	3768	branch-misses	#	4.08%	of all branches
0.000805700 seconds time elapsed					
0.000894000 seconds user					
0.000000000 seconds sys					
Programa	Comando de execução				
true	perf stat -B ./true				
Resultado da Execução					

Performance counter stats for './true':

0.48 msec	task-clock	#	0.548 CPUs utilized
0	context-switches	#	0.000 /sec
0	cpu-migrations	#	0.000 /sec
28	page-faults	#	58.700 K/sec
855835	cycles	#	1.794 GHz
697077	stalled-cycles-frontend	#	81.45% frontend cycles idle
536036	stalled-cycles-backend	#	62.63% backend cycles idle
323449	instructions	#	0.38 insn per cycle
		#	2.16 stalled cycles per insn
64571	branches	#	135.369 M/sec
3028	branch-misses	#	4.69% of all branches
0.000870500 seconds time elapsed			
0.000992000 seconds user			
0.000000000 seconds sys			

Tabela 4. Comandos Perf profiler executados nos programas selecionados no experimento.

3.4 PARSEC Benchmark Suite 3.0 *

O PARSEC (*Princeton Application Repository for Shared-Memory Computers*) é um conjunto de benchmark composto por programas *multithread* com o propósito de possibilitar estudos de desempenho em computadores com múltiplos processadores.

A Tabela 5 apresenta a compilação dos pacotes de benchmark oferecidos no PARSEC com o resultado indicando sucesso ou os erros apresentados no processo de compilação (build).

Pacote	Comando para compilação	Resultado
blackscholes	parsecmgmt -a build -p blackscholes	Compilou com sucesso.
bodytrack	parsecmgmt -a build -p bodytrack	Compilou com sucesso.
facesim	parsecmgmt -a build -p facesim	make[2]: *** [/usr/local/parsec-3.0/pkgs/apps/facesim/obj/amd64-linux.gcc/Public_Library/Makefile.common:407: obj/Collisions_And_Interactions/COLLISION_BODY_LIST_3D.o] Error 1 make[2]: Leaving directory '/usr/local/parsec-3.0/pkgs/apps/facesim/obj/amd64-linux.gcc/Public_Library' make[1]: *** No rule to make target '/usr/local/parsec-3.0/pkgs/apps/facesim/obj/amd64-linux.gcc/lib/libPhysBAM.a', needed by 'facesim'. Stop. make[1]: Leaving directory '/usr/local/parsec-3.0/pkgs/apps/facesim/obj/amd64-linux.gcc/Benchmarks/facesim' make: *** [Makefile:16: all] Error 2 [PARSEC] Error: 'env version=threads PHYSBAM=/usr/local/parsec-3.0/pkgs/apps/facesim/obj/amd64-linux.gcc CXXFLAGS=-O3 -g -funroll-loops -fprefetch-loop-arrays -fpermissive -fno-exceptions -std=c++11 -static-libgcc -Wl,--hash-style=both,--as-needed -DPARSEC_VERSION=3.0-beta-20150206 -fexceptions /usr/bin/make' failed.
ferret	parsecmgmt -a build -p ferret	make: *** [Makefile:108: /usr/local/parsec-3.0/pkgs/apps/ferret/obj/amd64-linux.gcc/parsec/obj/LSH_query.o] Error 1 [PARSEC] Error: 'env version=threads CFLAGS=-I/usr/local/parsec-3.0/pkgs/libs/gsl/inst/amd64-linux.gcc/include -I/usr/local/parsec-3.0/pkgs/libs/libjpeg/inst/amd64-linux.gcc/include -O3 -g -funroll-loops -fprefetch-loop-arrays -static-libgcc -Wl,--hash-style=both,--as-needed -DPARSEC_VERSION=3.0-beta-20150206 LDFLAGS=-L/usr/local/parsec-3.0/pkgs/libs/gsl/inst/amd64-linux.gcc/lib -L/usr/local/parsec-3.0/pkgs/libs/libjpeg/inst/amd64-linux.gcc/lib -L/usr/lib64 -L/usr/lib /usr/bin/make' failed.
fluidanimate	parsecmgmt -a build -p fluidanimate	Compilou com sucesso.
frequine	parsecmgmt -a build -p frequine	Compilou com sucesso.
raytrace	parsecmgmt -a build -p raytrace	No package 'xext' found Consider adjusting the PKG_CONFIG_PATH environment variable if you installed software in a non-standard prefix. Alternatively, you may set the environment variables XLIBGL_CFLAGS and XLIBGL_LIBS to avoid the need to call pkg-config. See the pkg-config man page for more details. [PARSEC] Error: 'env ./configure --with-driver=xlib --enable-glut --enable-static --disable-shared --prefix=/usr/local/parsec-3.0/pkgs/libs/mesa/inst/amd64-linux.gcc' failed.
swaptions	parsecmgmt -a build -p swaptions	~~~~~ make[1]: *** [../build/Makefile.tbmalloc:70: proxy.o] Error 1 make[1]: Leaving directory '/usr/local/parsec-3.0/pkgs/libs/tbllib/obj/amd64-linux.gcc/build/linux_intel64_gcc_cc11.3.0_libc2.35_kernel5.15.90.1_debu g' make: *** [Makefile:49: tbmalloc] Error 2 [PARSEC] Error: 'env compiler=gcc PATH=/usr/bin:/usr/local/parsec-3.0/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/snap/bi

		n:/usr/local/parsec-3.0/bin CXXFLAGS=-O3 -g -funroll-loops -fprefetch-loop-arrays -fpermissive -fno-exceptions -static-libgcc -Wl,--hash-style=both,--as-needed -DPARSEC_VERSION=3.0-beta-20150206 -fexceptions /usr/bin/make' failed.
vips	parsecmgmt -a build -p vips	Compilou com sucesso.

Tabela 5. Resultado da compilação dos pacotes do PARSEC.

O PARSEC possibilita definir a região de interesse (ROI – *Region Of Interest*) baseada em seis tipos de entrada possíveis na execução dos benchmarks. As entradas são: tes, simdev, simsmall, simmedium, simlarge e native.

Os testes realizados no experimento utilizaram todas as entradas nos benchmarks executados, cujos comandos de execução a indicação dos resultados são apresentados na que segue.

Núm. da Execução	Pacote	Entrada	Comando de execução do pacote de Benchmark
001	blackscholes	test	parsecmgmt -a run -p blackscholes -i test > result/exec-001-blackscholes-test.txt
002	blackscholes	simdev	parsecmgmt -a run -p blackscholes -i simdev > result/exec-002-blackscholes-simdev.txt
003	blackscholes	simsml	parsecmgmt -a run -p blackscholes -i simsmall > result/exec-003-blackscholes-simsmall.txt
004	blackscholes	simlarge	parsecmgmt -a run -p blackscholes -i simlarge > result/exec-004-blackscholes-simlarge.txt
005	blackscholes	native	parsecmgmt -a run -p blackscholes -i native > result/exec-005-blackscholes-native.txt
006	vips	test	parsecmgmt -a run -p vips -i test > result/exec-006-vips-test.txt
007	vips	simdev	parsecmgmt -a run -p vips -i simdev > result/exec-007-vips-simdev.txt
008	vips	simsml	parsecmgmt -a run -p vips -i simsmall > result/exec-008-vips-simsmall.txt
009	vips	simlarge	parsecmgmt -a run -p vips -i simlarge > result/exec-009-vips-simlarge.txt
010	vips	native	parsecmgmt -a run -p vips -i native > result/exec-010-vips-native.txt
011	bodytrack	test	parsecmgmt -a run -p bodytrack -i test > result/exec-011-bodytrack-test.txt
012	bodytrack	simdev	parsecmgmt -a run -p bodytrack -i simdev > result/exec-012-bodytrack-simdev.txt
013	bodytrack	simsml	parsecmgmt -a run -p bodytrack -i simsmall > result/exec-013-bodytrack-simsmall.txt
014	bodytrack	simlarge	parsecmgmt -a run -p bodytrack -i simlarge > result/exec-014-bodytrack-simlarge.txt
015	bodytrack	native	parsecmgmt -a run -p bodytrack -i native > result/exec-015-bodytrack-native.txt
016	fluidanimate	test	parsecmgmt -a run -p fluidanimate -i test > result/exec-016-fluidanimate-test.txt
017	fluidanimate	simdev	parsecmgmt -a run -p fluidanimate -i simdev > result/exec-017-fluidanimate-simdev.txt
018	fluidanimate	simsml	parsecmgmt -a run -p fluidanimate -i simsmall > result/exec-018-fluidanimate-simsmall.txt
019	fluidanimate	simlarge	parsecmgmt -a run -p fluidanimate -i simlarge > result/exec-019-fluidanimate-simlarge.txt

020	fluidanimate	native	parsecmgmt -a run -p fluidanimate -i native > result/exec-020-fluidanimate-native.txt
021	freqmine	test	parsecmgmt -a run -p freqmine -i test > result/exec-021-freqmine-test.txt
022	freqmine	simdev	parsecmgmt -a run -p freqmine -i simdev > result/exec-022-freqmine-simdev.txt
023	freqmine	simsmall	parsecmgmt -a run -p freqmine -i simsmall > result/exec-023-freqmine-simsmall.txt
024	freqmine	simlarge	parsecmgmt -a run -p freqmine -i simlarge > result/exec-024-freqmine-simlarge.txt
025	freqmine	native	parsecmgmt -a run -p freqmine -i native > result/exec-025-freqmine-native.txt
026	splash2	test	parsecmgmt -a run -p splash2 -i test > result/exec-026-splash2-test.txt
027	splash2	simdev	parsecmgmt -a run -p splash2 -i simdev > result/exec-027-splash2-simdev.txt
028	splash2	simsmall	parsecmgmt -a run -p splash2 -i simsmall > result/exec-028-splash2-simsmall.txt
029	splash2	simlarge	parsecmgmt -a run -p splash2 -i simlarge > result/exec-029-splash2-simlarge.txt
030	splash2	native	parsecmgmt -a run -p splash2 -i native > result/exec-030-splash2-native.txt
031	splash2x	test	parsecmgmt -a run -p splash2x -i test > result/exec-031-splash2x-test.txt
032	splash2x	simdev	parsecmgmt -a run -p splash2x -i simdev > result/exec-032-splash2x-simdev.txt
033	splash2x	simsmall	parsecmgmt -a run -p splash2x -i simsmall > result/exec-033-splash2x-simsmall.txt
034	splash2x	simlarge	parsecmgmt -a run -p splash2x -i simlarge > result/exec-034-splash2x-simlarge.txt
035	splash2x	native	parsecmgmt -a run -p splash2x -i native > result/exec-035-splash2x-native.txt

Tabela 6. Comandos PARSEC para execução dos benchmarks com as entradas possíveis.

3.5 Rodinia benchmark *

O Rodinia Benchmark é uma ferramenta destinada a infraestrutura de computação heterogênea com implementações com OpenMP, OpenCL e CUDA.

A Tabela 7 apresenta a lista dos programas que foram compilados com sucesso em cada implementação.

CUDA (make CUDA)	OPENMP (make OMP)	OPENCL (make OPENCL)
<u>backprop</u>	backprop	OCL_particlefilter_double
<u>bfs</u>	bfs	OCL_particlefilter_naive
<u>dwt2d</u>	euler3d_cpu	OCL_particlefilter_single
<u>gaussian</u>	euler3d_cpu_double	backprop
<u>heartwall</u>	heartwall	gaussian
<u>hotspot</u>	hotspot	heartwall
<u>kmeans</u>	kmeans	hotspot
<u>leukocyte</u>	lavaMD	kmeans
<u>needle</u>	leukocyte	lavaMD

<u>nn</u>	lud_omp	leukocyte
<u>pathfinder</u>	needle	lud
<u>sc_gpu</u>	nn	nn
<u>srad_v1</u>	particle_filter	nw
<u>srad_v2</u>	pathfinder	srad
	pre_euler3d_cpu	
	pre_euler3d_cpu_double	
	sc_omp	
	srad_v1	
	srad_v2	

Tabela 7. Lista de programas que foram compilados com sucesso no ambiente da ferramenta Rodinia Benchmark.

A Tabela 8 apresenta a execução de benchmarks com alguns resultados detalhados ou o nome do arquivo de resultado devido ao seu tamanho excessivo.

Implementação	Benchmark	Resultado
OPENMP	bfs	result.txt
OPENMP	cfid (euler3d)	409.637 segundos root@NotebookRubens:/usr/local/rodinia_3.1/openmp/cfid# ./run Starting... Compute time: 409.637 Saving solution... Saved solution... Cleaning up... Done...
OPENMP	heartwall	result.txt
OPENMP	hotspot	output.out
OPENMP	kmeans	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/kmeans# ./run ./run: line 1: ./kmeans_serial/kmeans: No such file or directory I/O completed num of threads = 4 number of Clusters 5 number of Attributes 34 Time for process: 4.266001
OPENMP	lavaMD	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/lavaMD# ./run Configuration used: cores = 4, boxes1d = 10 Time spent in different stages of CPU/MCPU KERNEL: 0.000000000000 s, 0.000000000000 % : CPU/MCPU: VARIABLES 0.000014000000 s, 0.000279933040 % : MCPU: SET DEVICE 0.000000000000 s, 0.000000000000 % : CPU/MCPU: INPUTS 5.001182079315 s, 99.999717712402 % : CPU/MCPU: KERNEL Total time: 5.001195907593 s
OPENMP	leukocyte	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/leukocyte# ./run Num of threads: 4 Detecting cells in frame 0 Cells detected: 36 Detection runtime ----- GICOV computation: 0.52551 seconds GICOV dilation: 0.21413 seconds Total: 0.79247 seconds Tracking cells across 5 frames

		Processing frame 5 / 5 Tracking runtime (average per frame): ----- MGVF computation: 14.68158 seconds Snake evolution: 0.02456 seconds Total: 4.09308 seconds Total application run time: 21.25787 seconds
OPENMP	nn	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/nn# ./run The 5 nearest neighbors are: 1974 12 22 18 24 JOYCE 30.6 89.9 80 593 --> 0.608276 2003 8 27 12 10 TONY 29.9 89.4 160 286 --> 0.608275 1997 11 14 12 24 HELENE 30.5 89.8 134 529 --> 0.538515 1980 10 22 18 3 ISAAC 30.1 90.4 110 778 --> 0.412312 1988 12 27 0 18 TONY 30.0 89.8 113 39 --> 0.199997 total time : 0.527607023716 s
OPENMP	particle_filter	Result.txt
OPENMP	pathfinder	o.out
OPENMP	srad_v1	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/srad/srad_v1# ./run Time spent in different stages of the application: 0.000000000000 s, 0.000000000000 % : SETUP VARIABLES 0.000021000000 s, 0.001276622177 % : READ COMMAND LINE PARAMETERS 0.131821006536 s, 8.013600349426 % : READ IMAGE FROM FILE 0.002430000110 s, 0.147723421454 % : RESIZE IMAGE 0.000082999999 s, 0.005045697093 % : SETUP, MEMORY ALLOCATION 0.016366999596 s, 0.994974911213 % : EXTRACT IMAGE 1.328287959099 s, 80.748657226562 % : COMPUTE 0.005131000187 s, 0.311921358109 % : COMPRESS IMAGE 0.160110995173 s, 9.733392715454 % : SAVE IMAGE INTO FILE 0.000714000023 s, 0.043405152857 % : FREE MEMORY Total time: 1.644966006279 s
OPENMP	srad_v2	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/srad/srad_v2# ./run Randomizing the input matrix Start the SRAD main loop Computation Done

Tabela 8. Benchmarks executados com os resultados.

A Tabela 9 apresenta comparações de alguns benchmarks que foram executados nas três implementações CUDA, OpenMP e OpenCL.

Comparação de Benchmarks entre as Implementações CUDA, OpenMP e OpenCL		
Hotspot		
CUDA	OpenMP	OpenCL
root@NotebookRubens:/usr/local/rodinia_3.1/cuda/hotspot# ./run WG size of kernel = 16 X 16 pyramidHeight: 2 gridSize: [512, 512] border:[2, 2] blockGrid:[43, 43] targetBlock:[12, 12]	root@NotebookRubens:/usr/local/rodinia_3.1/openmp/hotspot# ./run Start computing the transient temperature Ending simulation Total time: 0.045 seconds	Erro de execução

Start computing the transient temperature Ending simulation		
BFS		
CUDA	OpenMP	OpenCL
root@NotebookRubens:/usr/local/rocinia_3 .1/cuda/bfs# ./run Reading File Read File Copied Everything to GPU memory Start traversing the tree Kernel Executed 1 times Result stored in result.txt >> 1.000.000 lines	root@NotebookRubens:/usr/local/rocinia_3.1 /openmp/bfs# ./run Reading File Start traversing the tree Compute time: 0.633491 Result stored in result.txt >> 1.000.000 lines	Erro de compilação
HeartWall		
CUDA	OpenMP	OpenCL
root@NotebookRubens:/usr/local/rocinia_3 .1/cuda/heartwall# ./run WG size of kernel = 256 frame progress: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 Resultados no arquivo result.txt	root@NotebookRubens:/usr/local/rocinia_3.1 /openmp/heartwall# ./run num of threads: 4 frame progress: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 Resultados no arquivo result.txt	Erro de execução
particlefilter		
CUDA	OpenMP	OpenCL
Erro de compilação	video sequence took 0.043539 time to get neighbors took: 0.000005 time to get weightstook: 0.014813 time to set arrays took: 0.000106 time to set error took: 0.000682 time to get likelihoods took: 0.002394 time to get exp took: 0.000109 time to sum weights took: 0.000008 time to normalize weights took: 0.000004 time to move object took: 0.000008 xe: 64.523185 ye: 64.469547 0.702991 ... time to calc cum sum took: 0.000033 time to calc u took: 0.011697 time to calc new array x and y took: 0.061382 time to reset weights took: 0.000047 time to set error took: 0.006374 time to get likelihoods took: 0.008245 time to get exp took: 0.011114 time to sum weights took: 0.011051 time to normalize weights took: 0.008430 time to move object took: 0.016451 xe: 48.546698 ye: 72.385056 17.581630 time to calc cum sum took: 0.000034 time to calc u took: 0.013806 time to calc new array x and y took: 0.053608 time to reset weights took: 0.000045 particle filter took 0.937339 entire program took 0.980878	root@notebookrubens:/usr/local/rocinia_3.1/ opencl/particlefilter# ./run video sequence took 0.063222 error: clgetplatformids(1,*,0) failed particle filter took 0.694592 entire program took 0.757814 video sequence took 0.031961 error: clgetplatformids(1,*,0) failed particle filter took 0.632983 entire program took 0.664944

Tabela 9. Comparação de benchmarks nas três implementações CUDA, OpenMP e OpenCL.

3.6 Intel Pin

→ Aguardando definição dos 3 programas para experimentos posteriores

3.7 Dinero cache simulator

A ferramenta Dinero é um simulador de cache de 4ª geração de simuladores.

Comando de execução:

```
/dineroIV -l1-dsize 2K -l1-isize 2K -l1-ibsize 16 -l1-dbsize 8 < test.din
```


4 Considerações sobre o aprendizado nesse projeto

5 Conclusões