Parallel Homework #4 刘康来

2021年5月25日

图 1: Here is the hardware's information

CPU: Intel i7-8565U (8) @ 4.600GH GPU: Intel UHD Graphics 620 PU: NVIDIA GeForce MX250 emory: 2936MiB / 7708MiB

图 2: About the GPU and CUDA

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→ Latex git:(master) × nvidia-smi
Mon May 24 21:02:59 2021
Uriver Version: 465.31 CUDA Version: 11.3
| NVIDIA-SMI 465.31
Default |
| Processes:
 GPU GI CI
ID ID
                          Usage
.
|------|
 No running processes found
```

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Matrix A has a sparsity of 10.192%
((a) GEMM_OpenMP)(row-col, A and B are in row-major) used 0.40963 ms, 0.15624 gflops ((a) GEMM_OpenMP)(row-col, A and B are in row-major) PASS!
((b) GEMM_OpenBLAS)(row-col, A and B are in row-major) used 8.01651 ms, 3.87573 gflops ((b) GEMM_OpenBLAS)(row-col, A and B are in row-major) PASS!
((c) GEMM_CUDA_global_memory)(row-col, A and B are in row-major) used 0.01913 ms, 3.34606 gflops ((c) GEMM_CUDA_global_memory)(row-col, A and B are in row-major) PASS!
((d) GEMM_CUDA_shared_memory)(row-col, A and B are in row-major) used 0.02847 ms, 2.24782 gflops ((d) GEMM_CUDA_shared_memory)(row-col, A and B are in row-major) PASS!
((e) GEMM_cuBLAS)(row-col, A and B are in row-major) used 8.83768 ms, 1.69833 gflops ((e) GEMM_cuBLAS)(row-col, A and B are in row-major) PASS!
((f) csrSpMM_serial)(row-col, A and B are in row-major) used 0.00118 ms, 5.52032 gflops ((f) csrSpMM_serial)(row-col, A and B are in row-major) PASS!
((g) csrSpMH_OpenMP)(row-col, A and B are in row-major) used 0.00126 ms, 5.17725 gflops ((g) csrSpMH_OpenMP)(row-col, A and B are in row-major) PASS!
((h) csrSpMM_CUDA_scalar)(row-col, A and B are in row-major) used 0.80569 ms, 1.14671 gflops ((h) csrSpMM_CUDA_scalar)(row-col, A and B are in row-major) PASS!
((i) csrSpMM_CUDA_vector)(row-col, A and B are in row-major) used 8.88898 ms, 6.64599 gflops ((i) csrSpMM_CUDA_vector)(row-col, A and B are in row-major) PASS!
((j) csrSpMM_cuSPARSE)(row-col, A and B are in row-major) used 0.00064 ms, 10.17600 gflops
((j) csrSpMM_cuSPARSE)(row-col, A and B are in row-major) PASS!
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	GEMM_OpenMP (in used/s)																			
16 -	0.00224	0.00893	0.01994	0.03673	0.05159	0.08035	0.08753	0.10628	0.13136	0.16462	0.19861	0.23799	0.30179	0.33589	0.39248	0.43842	0.50213	0.57545	0.66707	0.85283
32 -	0.00504	0.02004	0.04578	0.08037	0.08731	0.14333	0.17453	0.24616	0.31204	0.3559	0.45129	0.56933	0.76516	0.89728	1.10283	1.19134	1.3428	1.70434	1.857	1.93911
64 -	0.01056	0.04147	0.07072	0.13466	0.19457	0.30878	0.43072	0.59574	0.7976	0.97855	1.20508	1.459	1.72403	2.06175	2.40824	2.67166	3.1069	3.63395	3.81517	4.31107
	200	200	300	200	400	600	700	*00°	°00	200°	2100	2200	1300	2400	-500	2600	7100	2800	2900	2000
_									GEM	M_OpenBL	AS (in use	d/s)								
16 -	0.00051	0.00035	0.00103	0.00179	0.00244	0.0033	0.00683	0.00784	0.0093	0.01136	0.01439	0.01581	0.0241	0.02407	0.02752	0.03318	0.04221	0.04522	0.05049	0.04758
32 -	0.00019	0.00047	0.00113	0.00376	0.01417	0.01926	0.00648	0.01116	0.01132	0.01404	0.01696	0.02124	0.0263	0.03596	0.0335	0.04154	0.05751	0.06004		0.07931
64 -	0.00026	0.0017	0.00153	0.00288	0.00399	0.00604	0.00759	0.01134	0.01575	0.01973	0.0207	0.02747	0.03315	0.03889	0.10491	0.0544	0.06489		0.079	0.08732
•	200	200	300	¹ 00	500	600	700	800	°oo	2000	2200	2200	1300	2400	7500	2600	2700	2800	2900	2000
										プ JDA_globa				У	Y	y	У	y	Y	· v
16 -	0.0002	0.00046	0.00101	0.00194	0.00284	0.00384	0.00483	0.0068	0.00867	0.01032	0.01175	0.0148	0.01752	0.01942	0.02172	0.02606	0.02927	0.03157	0.0341	0.03947
32 -	0.00027	0.00091	0.00188	0.00331	0.00497	0.0071	0.00928	0.01237	0.01507	0.01894	0.02234	0.02724	0.03089	0.03672	0.04107	0.04765	0.05262	0.05987	0.06583	0.07331
64 -	0.00049	0.00167	0.0036	0.00624	0.00968	0.01382	0.01873	0.02417	0.0305	0.03743	0.04475	0.05274	0.06192	0.07134	0.07908		0.09924	0.11083	0.12192	0.13411
	200	200	300	_{ko} o	500	600	100	800	900	2000	2700	2200	-30°	2400	2500	2000	z100	2800	2900	2000
									GEMM_CU	DA_shared	l_memory	(in used/s))							
16 -	0.0003	0.00075	0.00147	0.00253	0.00376	0.00531	0.00706	0.00933	0.01178	0.01432	0.01665	0.0204	0.02409	0.0277	0.0315	0.03565	0.03972	0.0438	0.04666	0.05182
32 -	0.00044	0.00134	0.00265	0.0046	0.00744	0.01047	0.01384	0.01794	0.02284	0.02816	0.03358	0.04063	0.04723	0.05442	0.0584	0.068	0.07729	0.08116	0.08964	0.09991
64 -	0.00081	0.00253	0.00524	0.00899	0.01456	0.02062	0.02728	0.03517	0.04575	0.05536	0.06352	0.07565	0.0855	0.09771	0.10997	0.12384	0.13908	0.15408	0.17012	0.18775
	200	200	300	200	400	600	100	800	₈ 0	1000	1100	2200	2300	2400	2500	2600	2700	2800	2900	2000
									G	EMM_cuBL	AS (in use	d/s)								
16	0.00027	0.00073	0.0014	0.00236	0.00327	0.00487	0.00616	0.00793	0.00957	0.01215	0.01403	0.0171	0.01746	0.02092	0.02293	0.02719	0.02973	0.03404	0.03674	0.04182
32 -	- 0.00048	0.00109	0.0024	0.00395	0.00599	0.01793	0.0208	0.03544	0.03747	0.04408	0.05302	0.06334	0.06884	0.04148	0.04782	0.05275	0.06083	0.06462	0.07172	0.0795
64 -	0.00068	0.00208	0.00467	0.00752	0.01173	0.01748	0.01879	0.02685	0.03715	0.04231	0.05541	0.06334	0.06573	0.07055	0.07578	0.10074	0.11364	0.12912	0.14128	0.15082
	200	200	300	200	400	600	700	*00°	%00	2000	2100	2200	1300	2400	500	2600	2700	1800	2900	2000

	csrSpMM_serial (in used/s)																			
16 -	1e-05	2e-05	6e-05	0.0001	0.00016	0.00024	0.00031	0.00041	0.00053	0.00065	0.00076	0.00099	0.00125	0.00136	0.00153	0.00177	0.00203	0.00227	0.00281	0.00304
32 -	1e-05	4e-05	0.0001	0.00019	0.00031	0.00041	0.00053	0.00071	0.00096	0.00116	0.00142	0.00178	0.00208	0.00242	0.0029	0.00322	0.00385	0.00432	0.00494	0.00563
64 -	3e-05	0.0001	0.00023	0.00044	0.00066	0.00101	0.00124	0.00176	0.00231	0.00263	0.00329	0.00414	0.00452	0.0054	0.00637	0.00668		0.00883	0.00951	0.0115
	200	200	300	MOO	400	600	700	800	300	2000	2200	2200	230°	2400	2500	2600	₂ 700	2800	2900	2000
	csrSpMM_OpenMP (in used/s)																			
16 -	1e-05	2e-05	5e-05	0.0001	0.00016	0.00023	0.0003	0.00041	0.00053	0.00066	0.00076	0.00096	0.00127	0.00138	0.00155	0.00175	0.00205	0.00218	0.00257	0.00322
32 -	1e-05	4e-05	0.0001	0.00021	0.00031	0.00042	0.00057	0.00072	0.00093	0.00119	0.00135	0.00169	0.0021	0.00241	0.00312	0.00323	0.0041	0.00459	0.00522	0.00579
64 -	3e-05	0.0001	0.00024	0.00046	0.00066	0.00104	0.00123	0.0018	0.00234	0.00264	0.00333	0.00419	0.00455	0.00555	0.00644	0.00665				0.01157
	200	200	300	200	400	600	100	800	300	2000	2200	2200	2300	2400	2500	2600	2700	2800	2900	2000
	csrSpMM_CUDA_scalar (in used/s)																			
16 -	4e-05	0.00013	0.00028	0.00051	0.00077	0.00119	0.00154	0.002	0.00262	0.0032	0.00372	0.00443	0.00499	0.00581	0.00656	0.00734	0.0084	0.00937	0.0104	0.01155
32 -	8e-05	0.00024	0.00055	0.001	0.00154	0.00235	0.00306	0.00398	0.00488	0.00597	0.0069	0.00832	0.00961	0.01122	0.0129	0.01472	0.01621	0.01817	0.02038	0.02285
64 -	0.00015	0.00048	0.0011	0.002	0.00307	0.00461	0.00569	0.00739	0.00961	0.01153	0.01366	0.01666	0.01933	0.02254	0.02542					0.04569
	200	200	300	200	400	600	100	800	900	2000	2100	200	1300	2400	50°	2600	2700	1800	2900	2000
									csrSpM	1M_CUDA_	vector (in	used/s)								
16 -	1e-05	3e-05	5e-05	9e-05	0.00013	0.00022	0.00026	0.00034	0.00047	0.00057	0.00063	0.00075	0.00091	0.00103	0.00109	0.00125	0.00153	0.00166	0.00176	0.002
32 -	2e-05	4e-05	9e-05	0.00016	0.00025	0.00039	0.0005	0.00067	0.00082	0.00104	0.00113	0.00141	0.00164	0.00194	0.00216	0.00251	0.00279	0.00319	0.00352	0.00397
64 -	3e-05	8e-05	0.00018	0.00032	0.00051	0.00074	0.00092	0.00121	0.00155	0.00191	0.00224	0.00277	0.00325	0.0038	0.00429	0.00494				0.00786
	200	200	300	100	500	600	100	800	300	2000	2700	2200	2300	2400	2500	2600	2700	2800	2900	2000
									csrS	pMM_cuSi	PARSE (in u	ısed/s)								
16	1e-05	2e-05	4e-05	5e-05	8e-05	0.00011	0.00013	0.00021	0.00032	0.00039	0.00037	0.00046	0.00048	0.00053	0.00059	0.00064	0.0007	0.00077	0.00084	0.00091
32	2e-05	4e-05	7e-05	0.0001	0.00015	0.00018	0.00025	0.00033	0.00057	0.00065	0.00072	0.00083	0.00093	0.00103	0.00114	0.00127	0.00142	0.00164	0.00189	0.00221
64	4e-05	8e-05	0.00013	0.0002	0.00028	0.00032	0.00041	0.00066	0.00114	0.00137	0.00164	0.00222	0.00294	0.00355	0.00431	0.00526				0.0098
	200	200	300	200	400	600	100	*00	900	2000	1100	2200	1300	2400	2500	2600	2700	1800	2900	2000