[5 Points] Compare the performance with sse2 and avx2 extensions in regards to “vectMul.c” at ~/csds312/simd (i.e. sse2 vs avx2)

cd to right directory, check flags, sse2 and avx2 in the list

```
[fmw13@hpc6 ~]$ cd ~/csds312/simd
[fmw13@hpc6 simd]$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                12
On-line CPU(s) list:   0-11
Thread(s) per core:    1
Core(s) per socket:    12
Socket(s):             1
NUMA node(s):          1
Vendor ID:             GenuineIntel
CPU family:            6
Model:                 85
Model name:            Intel(R) Xeon(R) Silver 4116 CPU @ 2.10GHz
Stepping:              4
CPU MHz:               2377.752
CPU max MHz:           3000.0000
CPU min MHz:           800.0000
BogoMIPS:              4200.00
Virtualization:        VT-x
L1d cache:             32K
L1i cache:             32K
L2 cache:              1024K
L3 cache:              16896K
NUMA node0 CPU(s):     0-11
Flags:                 fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc aperfmperf eagerfpu pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid dca sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch epb cat_l3 cdp_l3 invpcid_single intel_ppin ssbd mba rsb_ctxsw ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms invpcid rtm cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd avx512bw avx512vl xsaveopt xsavec xgetbv1 cqm_llc cqm_occup_llc cqm_mbm_total cqm_mbm_local dtherm ida arat pln pts pku ospke md_clear spec_ctrl intel_stibp flush_l1d arch_capabilities
```

check compiler and compile with extensions and optimization flag

```
[fmw13@hpc6 simd]$ which icc
/usr/local/intel/17/compilers_and_libraries/linux/bin/intel64/icc
[fmw13@hpc6 simd]$ icc -o vectsse -O3 -xsse2 vectMul.c -lm
[fmw13@hpc6 simd]$ icc -o vectavx -O3 -xavx2 vectMul.c -lm
[fmw13@hpc6 simd]$ ll
total 528
-rwxr-xr-x 1 fmw13 sxg125_csds312 22664 Mar 20 18:38 autovect
-rwxr-x--- 1 fmw13 sxg125_csds312  8360 Jan 31 19:17 matmul
-rwxr-x--- 1 fmw13 sxg125_csds312  2080 Jan 31 19:17 matmul.c
-rwxr-x--- 1 fmw13 sxg125_csds312 13808 Mar  6 17:38 novect
-rwxr-x--- 1 fmw13 sxg125_csds312 22544 Mar 23 11:48 vectavx
-rwxr-x--- 1 fmw13 sxg125_csds312   969 Jan 31 19:17 vectMul.c
-rwxr-x--- 1 fmw13 sxg125_csds312 23248 Mar 23 11:48 vectsse
```

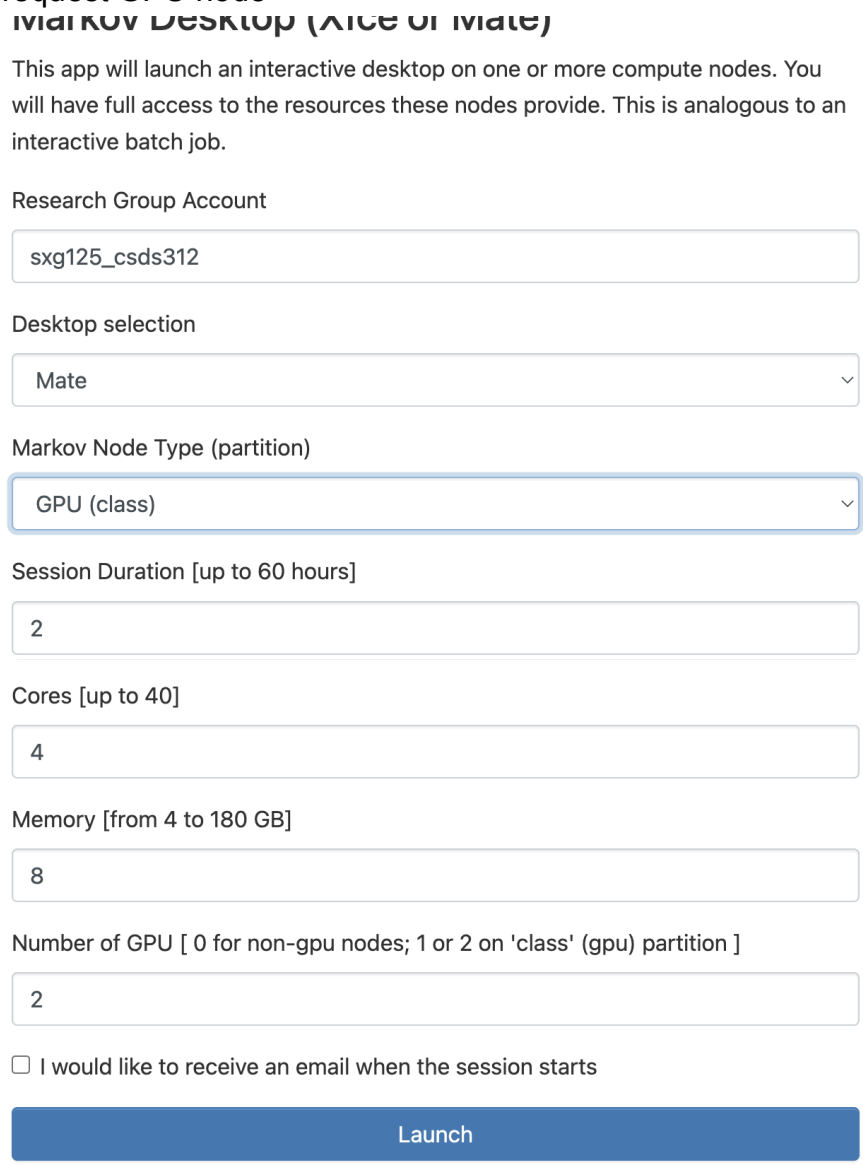
check performance

```
[fmw13@hpc6 simd]$ time ./vectavx
Multiplication vector:
74433190797631.000000

real    0m0.103s
user    0m0.032s
sys     0m0.071s
[fmw13@hpc6 simd]$ time ./vectsse
Multiplication vector:
74433190797631.000000

real    0m0.112s
user    0m0.041s
sys     0m0.070s
[fmw13@hpc6 simd]$
```

They are about the same.

[5 Points] Report GPU utilization

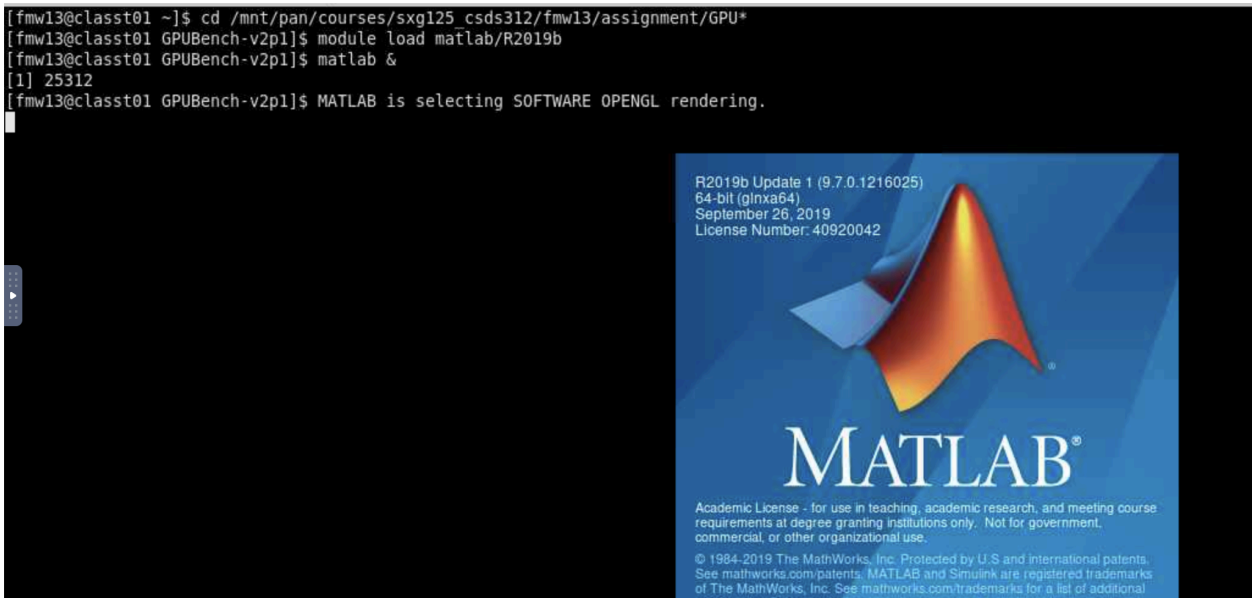
request GPU node



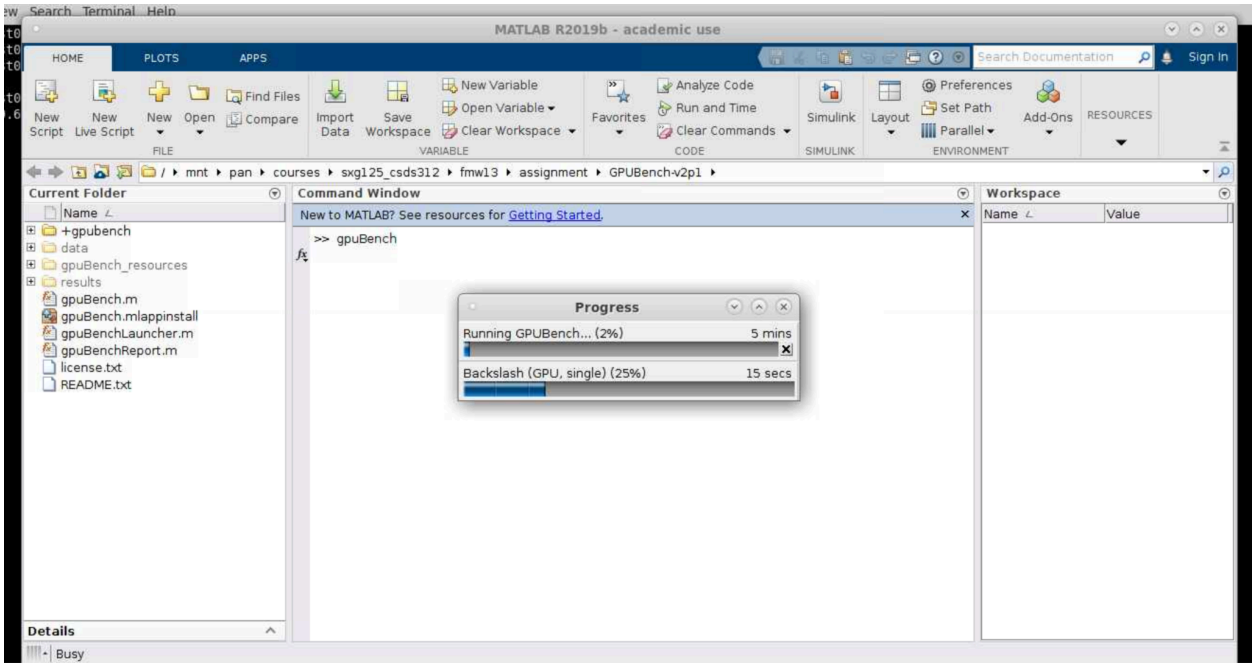
copy files

```
[fmw13@classt01 simd]$ cp -r /usr/local/doc/MATLAB/GPUBench-v2p1 /mnt/pan/courses/sxg125_csds312/fmw13/assignment
[fmw13@classt01 simd]$ cd /mnt/pan/courses/sxg125_csds312/assignment
bash: cd: /mnt/pan/courses/sxg125_csds312/assignment: Permission denied
[fmw13@classt01 simd]$ cd /mnt/pan/courses/sxg125_csds312/fmw13/assignment
[fmw13@classt01 assignment]$ ls
bootcamp  GPUBench-v2p1
[fmw13@classt01 assignment]$ cd GPUBench-v2p1
[fmw13@classt01 GPUBench-v2p1]$
```

load and run matlab



run gpuBench



Results

GPU Bench

GPU Comparison Report: NVIDIA GeForce RTX 2080 Ti

Summary of results

The table and chart below show the peak performance of various GPUs using the same version of MATLAB. Your results (if any) are highlighted in bold in the table and on the chart. All other results are from pre-stored data. The peak performance shown is usually achieved when dealing with extremely large arrays. Typical performance in day-to-day use will usually be much lower.

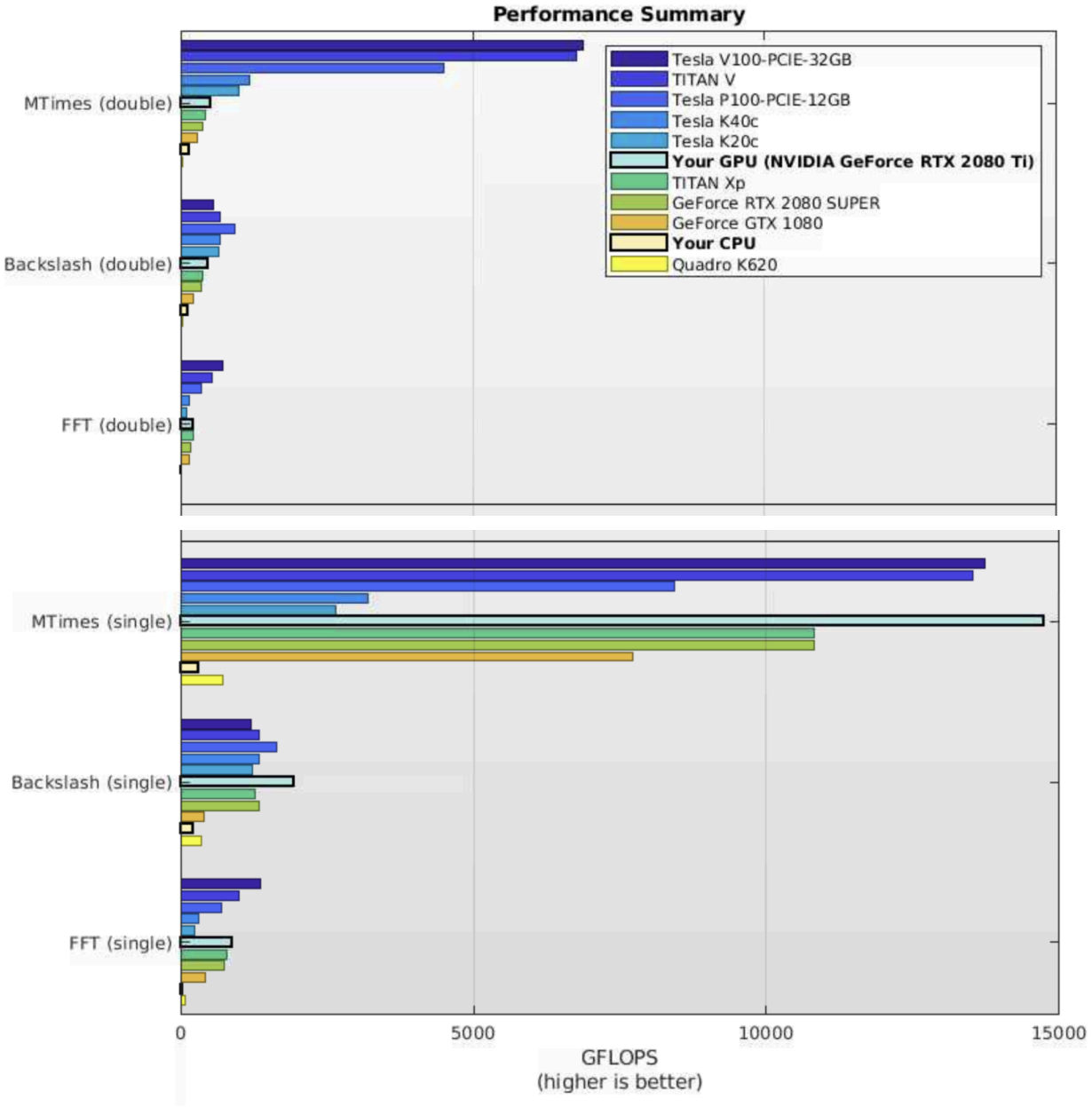
Results captured using the CPUs on the host PC (i.e., without using a GPU) are included for comparison.

Results are shown for calculations in both single and double precision. For all results, higher is better.

Shareable data files: /tmp/job.19165696.hpc/GPUBenchReport/NVIDIA_GeForce_RTX_2080_Ti.gpubench.json

	Double precision results (in GFLOPS)			Single precision results (in GFLOPS)		
	MTimes	**Backslash**	**FFT**	**MTimes**	**Backslash**	**FFT**
Tesla V100-PCIE-32GB	6884.95	563.73	728.71	13727.99	1210.42	1365.11
TITAN V	6779.73	674.40	534.65	13515.42	1336.39	985.36
Tesla P100-PCIE-12GB	4510.03	929.00	357.65	8435.34	1647.83	687.13
Tesla K40c	1189.54	677.12	135.88	3187.76	1334.17	294.86
Tesla K20c	1004.06	641.42	106.09	2657.01	1230.28	235.20
Your GPU (NVIDIA GeForce RTX 2080 Ti)	**506.79**	**472.30**	**224.25**	**14746.36**	**1943.19**	**881.96**
TITAN Xp	421.00	369.32	209.45	10823.05	1272.06	797.17
GeForce RTX 2080 SUPER	373.37	345.32	164.30	10813.12	1330.64	746.20
GeForce GTX 1080	280.84	223.05	137.66	7707.01	399.37	424.60
Your CPU	**155.81**	**111.85**	**16.49**	**313.91**	**215.92**	**26.28**
Quadro K620	25.45	22.77	12.75	716.71	350.31	75.00

(Sort the results by clicking on any column title. To see detailed performance data, click on an individual result or a device name.)



In all cases, the NVIDIA GeForce RTX 2080 Ti GPU performs better than my CPU