

Name – Raunak  
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# Assignment3- CSE- 520

## OpenCL

### **CPU Model:**

Platform Name: Inter® CPU Runtime for OpenCL  
Model name: Intel® Core™ i9-9820X CPU @3.30 GHz  
Device Vendor: Intel® Corporation  
Architecture: x86\_64  
CPU op-mode: 32 bit, 64-bit  
Byte order: Little Endian  
CPUs: 20  
Threads per core: 2  
Max compute units: 20  
Max Clock frequency: 3300 MHz  
Max work item sizes: 8192x8192x8192  
Global Memory size: 62.62 GB

### **GPU Model:**

Platform name: NVIDIA CUDA  
Model name: Quadro RTX 5000  
Device Vendor: NVIDIA Corporation  
Memory: 160686 MB  
Power capacity: 230W  
Address bits: 64, Little Endian  
Max compute units: 48  
Max Clock frequency: 1815 Mhz  
Max work item sizes: 1024x1024x64  
Global Memory size: 15.71 GB

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## Screenshots:

```
rraunak@en6169322-217: ~/assignment3/ca_assignment$ ./run.sh
Reference C 512x512 matrix multiplication: 0.339575 sec
Size:512 Platform:CPU Tile Size:8
OpenCL normal kernel matrix multiplication: 0.00217455 sec
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.30375 sec
Size:512 Platform:CPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.019141 sec
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.293025 sec
Size:512 Platform:CPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.00128495 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 2.97432 sec
Size:1024 Platform:CPU
OpenCL normal kernel matrix multiplication: 0.0356848 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 2.9275 sec
Size:1024 Platform:CPU Tile Size:8
OpenCL tiled kernel matrix multiplication: 0.0830187 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 2.96459 sec
Size:1024 Platform:CPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.0102522 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 64.9847 sec
Size:2048 Platform:CPU
OpenCL normal kernel matrix multiplication: 0.290544 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 61.304 sec
Size:2048 Platform:CPU Tile Size:8
OpenCL tiled kernel matrix multiplication: 0.6875 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 59.7251 sec
Size:2048 Platform:CPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.083699 sec
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.262464 sec
Size:512 Platform:GPU
OpenCL normal kernel matrix multiplication: 0.000370784 sec
Press Enter to finish...
```

```
rraunak@en6169322-217: ~/assignment3/ca_assignment$ 
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.262464 sec
Size:512 Platform:GPU
OpenCL normal kernel matrix multiplication: 0.000370784 sec
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.245639 sec
Size:512 Platform:GPU Tile Size:8
OpenCL tiled kernel matrix multiplication: 0.000375872 sec
Press Enter to finish...

Reference C 512x512 matrix multiplication: 0.252546 sec
Size:512 Platform:GPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.000247424 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 3.02942 sec
Size:1024 Platform:GPU
OpenCL normal kernel matrix multiplication: 0.00282733 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 3.05884 sec
Size:1024 Platform:GPU Tile Size:8
OpenCL tiled kernel matrix multiplication: 0.00288256 sec
Press Enter to finish...

Reference C 1024x1024 matrix multiplication: 3.0633 sec
Size:1024 Platform:GPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.0018312 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 56.7119 sec
Size:2048 Platform:GPU
OpenCL normal kernel matrix multiplication: 0.0230894 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 55.5611 sec
Size:2048 Platform:GPU Tile Size:8
OpenCL tiled kernel matrix multiplication: 0.022995 sec
Press Enter to finish...

Reference C 2048x2048 matrix multiplication: 57.3394 sec
Size:2048 Platform:GPU Tile Size:16
OpenCL tiled kernel matrix multiplication: 0.0145673 sec
Press Enter to finish...
rraunak@en6169322-217:~/assignment3/ca_assignment$ 
rraunak@en6169322-217:~/assignment3/ca_assignment$
```

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**Data Collected:**

Matrix size	Reference C implementation (single thread)	OpenCL on CPU			OpenCL on GPU		
		Normal kernel	Tiled kernel (tile_size=8)	Tiled kernel (tile_size=16)	Normal kernel	Tiled kernel (tile_size=8)	Tiled kernel (tile_size=16)
512x512	0.30375	0.00217455	0.019141	0.00128495	0.000370784	0.000375872	0.000247424
1024x1024	2.9275	0.0356848	0.0830187	0.0102522	0.00282733	0.00288256	0.0018312
2048x2048	61.304	0.290544	0.6875	0.083699	0.0230894	0.022995	0.0145673