



Parallel & Distributed Computing

CSE525

Assignment #7 - to be submitted to **Dr. Masroor Hussain**

**Comparison of GPU's vs. CPU's performance with OpenCL based
Matrix Multiplication Code**

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OpenCL - Matrix Multiplication

Install OpenCL and compare its results on CPU and GPU, submit a report

In this assignment, we are required to setup OpenCL on our system and run Matrix Multiplication code on CPU and GPU to compare the two of them. Remember that the performance may vary significantly from system to system and different hardware specs. Therefore, it is important to notice the details of hardware we are using. Following snapshot shows the DXDIAG results on my Core i3, Windows laptop PC.

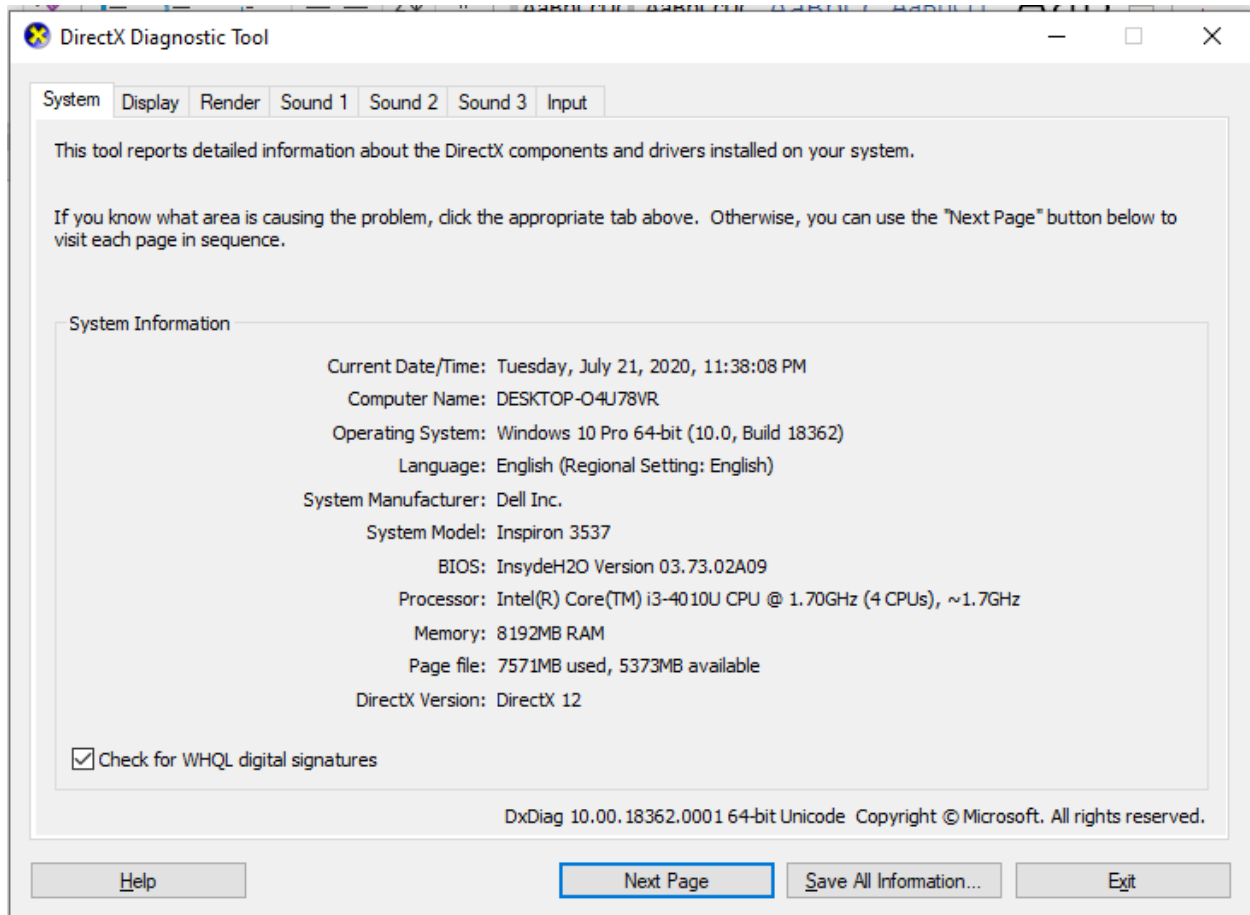


Figure 1. processor specs

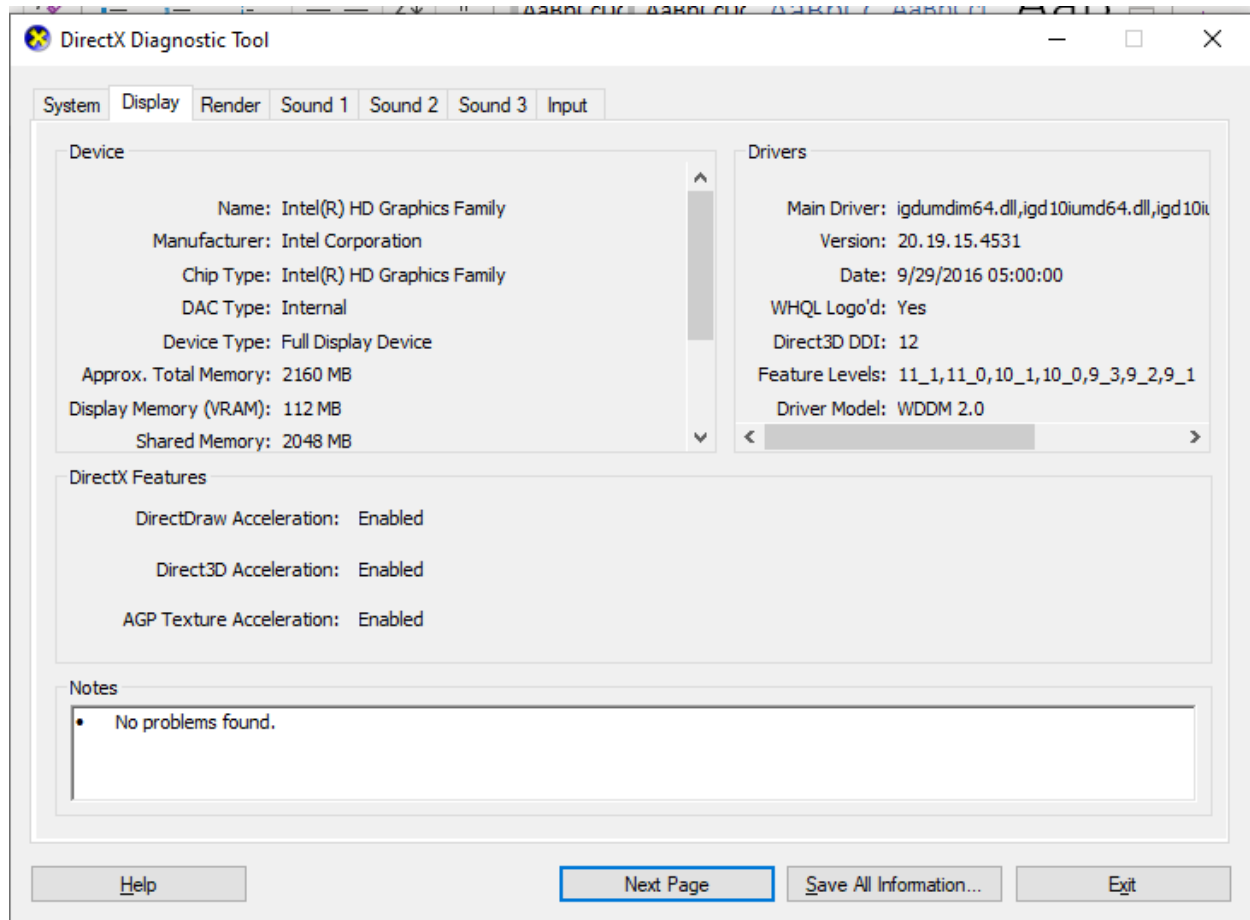


Figure 2. graphics card specs

The code I have chosen is sourced from a freely published [gist on GitHub by Tanay Prabhu Desai](#). A fork of it is available on [my GitHub](#). This code contains a matrix multiplication code for a pre-filled matrix of size 3x3. Navigate to the folder containing codes, and compile with this command in CMD:

```
gcc -I. mat_mul.c C:\Windows\System32\OpenCL.dll -o main.exe
```

```

C:\Windows\System32\cmd.exe
C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication>gcc -I. mat_mul.c C:\Windows\System32\OpenCL.dll -o mat_mul.exe
In file included from ./CL/cl.h:20,
      from mat_mul.c:10:
./CL/cl_version.h:22:9: note: #pragma message: cl_version.h: CL_TARGET_OPENCL_VERSION is not defined. Defaulting to 220 (OpenCL 2.2)
 22 | #pragma message("cl_version.h: CL_TARGET_OPENCL_VERSION is not defined. Defaulting to 220 (OpenCL 2.2)")
      |
mat_mul.c: In function 'main':
mat_mul.c:170:3: warning: 'clCreateCommandQueue' is deprecated [-Wdeprecated-declarations]
 170 |     command_queue = clCreateCommandQueue(context, device_id, 0, &err);
      |
In file included from mat_mul.c:10:
./CL/cl.h:1887:1: note: declared here
1887 | clCreateCommandQueue(cl_context
      |
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clGetPlatformIDs@12 by linking to _clGetPlatformIDs
Use --enable-stdcall-fixup to disable these warnings
Use --disable-stdcall-fixup to disable these fixups
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clGetDeviceIDs@24 by linking to _clGetDeviceIDs
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clCreateContext@24 by linking to _clCreateContext
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clCreateCommandQueue@20 by linking to _clCreateCommandQueue
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clCreateBuffer@24 by linking to _clCreateBuffer
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clEnqueueWriteBuffer@36 by linking to _clEnqueueWriteBuffer
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clCreateProgramWithSource@20 by linking to _clCreateProgramWithSource
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clBuildProgram@24 by linking to _clBuildProgram
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clCreateKernel@12 by linking to _clCreateKernel
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clSetKernelArg@16 by linking to _clSetKernelArg
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clEnqueueNDRangeKernel@36 by linking to _clEnqueueNDRangeKernel
c:/mingw/bin/../lib/gcc/mingw32/9.2.0/../../../../mingw32/bin/ld.exe: warning: resolving _clEnqueueReadBuffer@36 by linking to _clEnqueueReadBuffer

C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication>mat_mul.exe
1 2 5
4 2 5
5 2 6

5 2 7
3 6 2
6 2 6

41 24 41
56 30 62
67 34 75

Activate Windows
Go to Settings to activate Windows.

C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication>

```

Figure 3. compiling it with OpenCL dynamic linking library from system

Note the time using PowerShell with this:

Measure-Command {start-process mat_mul.exe -wait}

To run on CPU, go to line 157, change **CL_DEVICE_TYPE_***** to **CL_DEVICE_TYPE_CPU**, recompile and re-run. Now change the device type to GPU and recompile.

To run on GPU, go to line 157, change **CL_DEVICE_TYPE_***** to **CL_DEVICE_TYPE_GPU**, recompile and re-run. Notice the time taken by two in following figure.

```
Windows PowerShell
PS C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication> Measure-Command {start-process mat_mul.exe -wait}

Days           : 0
Hours          : 0
Minutes        : 0
Seconds        : 12
Milliseconds    : 334
Ticks          : 123347391
TotalDays      : 0.000142763184027778
TotalHours     : 0.00342631641666667
TotalMinutes   : 0.205578985
TotalSeconds   : 12.3347391
TotalMilliseconds : 12334.7391

PS C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication> Measure-Command {start-process mat_mul.exe -wait}

Days           : 0
Hours          : 0
Minutes        : 0
Seconds        : 2
Milliseconds    : 288
Ticks          : 22888545
TotalDays      : 2.64913715277778E-05
TotalHours     : 0.000635792916666667
TotalMinutes   : 0.038147575
TotalSeconds   : 2.2888545
TotalMilliseconds : 2288.8545

PS C:\Users\Quswar Abid\Downloads\7. OpenCL - Multiplication>
```

Figure 4. time taken by CPU vs. GPU based OpenCL

As you can see that there is a clear difference between the running time of two. Running time of CPU is 4x as compared to GPU.

- Time taken by CPU is **12334.7391 ms**
- Time taken by GPU is **2288.8545 ms**

Code files are attached with this report.