

**Addis Ababa University**  
**Addis Ababa Institute of Technology**  
**School of Electrical and Computer Engineering**

**ECEG-6518: Parallel Computing**  
**Assignment V: OpenCL Optimization**

Follow the lecture notes posted on the course page to do this assignment

**Part I - Benefit of memory coalescing**

1. write a kernel that accepts two arrays of size  $N = (64 * 1024 * 1024)$  chars and also an offset. What the kernel does is shown below

```
kernelA(char * A, char * B, int offset)
{
    i=get_global_id(0)
    A[i]=B[i+offset]
}
```

measure the time it takes to complete running this kernel. You are supposed to vary the offset from 0,1,2,...,16 and repeat the measurement.

2. Also do the same kind of measurement for the following kernel.

```
kernelB(char *A, char *B, int stride)
{
    i=get_global_id(0)
    A[i]=B[i*stride]
}
```

here also vary stride from 1,2,...16. But you will need to limit the global work item number to  $N/16$ .

**Part II - Benefit of caching on local memory**

1. Implement a naive matrix multiplication using OpenCL. Measure the time it takes to complete a multiplication of two floating point (Real) matrices with dimensions of  $1024 \times 1024$  (if this does not take long and if you feel you want to see a more relevant result change it to  $2048 \times 2048$ ). Also vary the work group size from  $4 \times 4$ ,  $8 \times 8$ , ..., until the MAX workgroup size can accommodate.

2. Improve the naïve implementation by transposing the second matrix for data locality in the cache. Do this for the CPU implementation as well. When measuring the runtime include the transpose operation as well.
  
3. Implement a local memory cached version of the Matrix multiplication and do the same measurements asked in 1. To do this experiment and appreciate the results you need to do it on a GPU. I advise you to write you opencl code and test it on your own machine (can be a computer that does not have a GPU). Then you can do your experiments on a computer with a dedicated GPU in our lab. The operating system on this machine is Ubuntu. Please make arrangements with me if you want to test your code on this machine.

Due Date: \_\_\_\_\_