The George Washington University
School of Engineering & Applied Science
Electrical & Computer Engineering Department

Instructor: Prof. Tarek El Ghazawi
Semester: Fall 2019
Course: ECE-6105 Introduction to HPC
Homework 3

Deadline: 12:00pm (Noon) 10/07/2019

1. List two unique features in each of the four parallel programming models: message passing, data parallel, shared memory, and distributed shared memory.

2. How many shared and remote accesses will be done by each thread in the following code snippet, if shared array is declared as:

```
// N is an integer larger than and divisible by THREADS
shared [X] double image[N][N];

upc_forall(i=0; i<N; i++; i/TRHEADS)
      for(j=0; j<N; j++)
            image[i][j] == image[i][j] + 1.0;
```

   For the following cases of blocking factor X, assuming N = 64 and THREADS = 4:
   a) X == N
   b) X == ((N*N) / THREADS) // Row block distribution
   c) X == (N / THREADS) // Column block distribution

3. Write a UPC program that computes the mean and variance of all elements in a shared array of a general size, larger or smaller than the number of threads. You can use another shared array of size equal to the number of threads to hold partial sums from each thread. At the end, thread 0 will need to sum up all partial sums, compute the mean and variance, and print the result.

4. Write a program that generates the image histogram using UPC. Imagine that the image is an n×n matrix filled with random integers that have values ranging from 0 to 255. Your programs should give each thread part of image to work on. When all threads finish their part of work, one of them needs to consolidate the results generated by all of them.