

CSCI-GA.3033-009
Multicore Processors: Architecture & Programming
Homework Assignment # 2

1. Suppose that you have the following array of structure.

```
struct info{  
    float a;  
    float b;  
    floact c;  
    int d;  
}A[8];
```

We know that 8 threads will be accessing the different 8 elements of the array simultaneously (i.e. thread 1 accesses A[0], thread 2 accesses A[1], and so on).

- a. [2] Draw a simple figure that shows how this array structure is stored in memory. Do not worry about exact addresses or element sizes.
- b. [2] Based on your figure, will there be a lot of cache misses or not when the 8 threads access the array (assume we have one shared cache)? Justify
- c. [3] If you say that the number of cache misses will be small, justify. If you say that we will have a lot of cache misses, how do we deal with that (from a programmer perspective, so don't mention a hardware technique)?

2. [3] Having too many threads in an application may not be a good idea. State all the reasons can think of.

3. Assume we have p hardware threads (i.e. p cores or n cores with v -way hyperthreading where $v \cdot n = p$). For each of the following problems, specify how you are going to divide the problem among threads. Do not write code.

- a) [3] Find all prime numbers between 1 and n .
- b) [3] Find whether a number x is a prime number.

4. [2] Suppose a processor has to wait 10 cycles for its memory system to provide a 64-bit word. What can we do to reduce this delay when we have several loads coming from the processor to the memory?

5. [2] Suppose we have a system with three level of caches: L1 is close to the processor, level 2 is below it, and level 3 is the last level before accessing the main memory. We know that two main characteristics of a cache performance are: cache access latency (How long does the cache take before responding with hit or miss?) and cache hit rate (how many of the cache accesses are hits?). As we go from L1 to L2 to L3, which of the two characteristics become more important? and why?