**Matthew Ausitn**

**Assignment 2**

**CIS355** – Spring 2018

**Point Value**: 100 points

**Assignment Due Date**: **In class Thursday, Feb 15, 2018**

**Submission Instruction**

This assignment contains a written part and programming part. For the written part, please write the questions and your answers to those questions on a Microsoft Word document and convert it to a pdf file. The name of the file should be HW2\_YourLastname\_YourFirstname.pdf. For the programming part, please write a C++ program using pthread (POSIX) library in a C++ file. The name of the file should be HW2\_Programming\_YourLastname\_YourFirstname.cpp. Please zip both the pdf file and .cpp file into one zip file named HW2\_YourLastname\_YourFirstname.zip. Please submit the zip file on Schoology by 11:59pm and a hard copy of the pdf file to the instructor in lecture.

**Short answers**

1. What is a process (**5 points**) and what is the user address space of a process? (**5 points**)
   1. A **process** is a program in execution. Shared information among many threads in a process
   2. The **virtual/user address space** for a user-mode process is the amount of memory allocated for all possible addresses for a computational entity, such as a device, a file, a server, or a networked computer.
2. What are the 5 states of a process (**5 points**)? Please draw the process state diagram.
   1. New: the process is created
   2. Ready: the process is waiting to run
   3. Running: the process instructions are being executed
   4. Waiting: the process is waiting for some events to occur
   5. Terminated: the process has finished execution
3. What is a process context-switch **(5 points**)? Please explain what actions taken by the kernel when process 1 is replaced by process 2. (**5 points)**
   1. A **process context-switch** is when a CPU switches from process to process
   2. Saving the value of the CPU registers from the thread being switched out and restoring the CPU registers of the new thread being scheduled are the actions taken by the kernel when process 1 is replaced by process 2.
4. What is long-term scheduler **(5 points**)? What is short-term scheduler? **(5 points**)
   1. **Long-Term Scheduler:** Also known as a job scheduler, determines which programs are admitted to the system for processing. It selects processes from the queue and loads them into memory for execution. Process loads into the memory for CPU scheduling.
   2. **Short-Term Scheduler:** Also known as a CPU scheduler/ or dispatchers, make the decision of which process to execute next by *selecting a process among the processes that are ready to execute and allocates CPU to one of them.* Short-term schedulers are *faster* than long-term schedulers.
5. What are the possible reasons for a process to change from running state into the waiting state? Please list at least five reasons. **(10 points).**
   1. Process need to perform I/O operation
   2. Waiting for some event to occur such as a non busy waiting semaphore
   3. When a running process requests interaction with a device that cannot immediately respond
   4. Manually changing the process state from running to waiting, using kill commands.
   5. When the process is using too many resources for a long period of time.
6. What is a thread **(5 points**)? What are the components of program state are shared across threads in a multithreaded process? **(5 points**) What are the components that are unique to each thread in a multithreaded process **(5 points)**?
   1. A **thread** is a unit of CPU utilization.
   2. The components of program state that are shared are:
      1. Heap Memory
      2. Stack
      3. Global Variables
   3. Components that are unique:
      1. Stack
      2. Registers
      3. State
7. Is it possible to have concurrency, but not parallelism? Please explain your answer. **(10 points)**
   1. Yes, Parallelism is the act of dividing working into smaller chunks so that those smaller chunks can be solved concurrently. concurrency is a number of threads doing work simultaneously but not interacting with each other (most of the time).
8. Please design and write a C++ multithreaded program using POSIX thread library to find the number of prime numbers between 1 and 10,000,000 (10 million) and find out how many microseconds it takes in this computation process. Assume your computer has 4 CPUs and you create 4 threads from your main thread? **(30 points)**