ECE30021-02 / ITP30002-02 Operating Systems, Spring 2019

Final Exam

Your Name and Student Number: _____

- You have **90 minutes** to answer to **6 problems** (100 points).
- Check you have total **5 pages** including this cover page.
- Write answers **only in given boxes**. Words outside the boxes will not be counted.
- Write answers **clearly**. No points for illegible writings.
- Read the following quoted from Handong CSEE Standard and write your signature below.

> Examination
>
> 1. Examination is an educational act necessary for evaluation of the students' achievement and for encouraging the students to absorb the material in the process of preparation.
> 2. Student should do their best to prepare for exams in order to improve her/his own knowledge and skill and should fully engage in the test during examination hour.
> 3. Accessing or providing unauthorized information, including other students' answer sheets, is regarded as cheating. The use of electronic devices, including cell phones and computers, without permission is strictly prohibited.
> 4. Entering or leaving the classroom during the examination before the finish time without permission is regarded as cheating.

I agree to uphold Handong Honor Code and Handong CSEE Standard in taking this exam.

Signature: _____

1. Discuss the benefits (advantages) and the drawback (disadvantages) to a virtual memory system of having a smaller page size (15 points)

2. Discuss inverted page table (16 points)

3. Answer to the following two sub problems on page replacement algorithm

(a) Suppose that OS allocates 3 frames to a process which has six pages, **A** to **F**. Show how the second-change algorithm (aka. clock algorithm), one of an approximated LRU, brings pages into frames for the following reference string (12 points):

F B C A B C F A C D

(b) Explain the advantage of the second-chance algorithm over the exact (original) LRU algorithm (9 points)

4. You are writing a multithreaded program to find the maximum value of a given array of *S* integers using *N* threads.

```
typedef struct {
  int * partition ;
  int size ;   // the size of partition
  int max ;
} task_t ;

task_t * tasks ;

void * run(void * p) {
  /* TO-DO */
}

int find_max(int * arr, int S, int N) { // S is the size of arr
  int max ;
  tasks = (task_t *) calloc(N, sizeof(task_t)) ;
  /* TO-DO */
  return max ;
}
```

Complete the program by filling out `TO-DO` in `run` and `TO-DO` in `find_max`, such that function `run` is used as the start routine of *N* threads and the structure `task_t` is for giving a task to each of *N* threads (16 points).

5. Suppose that you are asked to extend a file system with Tree-structure directory to a file system with Acyclic-graph structure directory. Explain what you need to add and/or modify? (14 points)

6. Fill out the blanks to complete a Semaphore implementation using Pthread conditional variable and mutex (18 points)

```
#include <pthread.h>
typedef struct {
        int counter ;
        pthread_mutex_t m ;
        pthread_cond_t cv ;
} Semaphore_t ;

void Semaphore_Init(Semaphore_t *s, int init_counter) {
        s->counter = init_counter ;
        pthread_mutex_init(&(s->m), 0x0) ;
        pthread_cond_init(&(s->cv), 0x0) ;
}

void Wait(Semaphore_t * s) {
    pthread_mutex_lock(&(s->m)) ;
```

```
    pthread_mutex_unlock(&(s->m)) ;
}

void Signal(Semaphore_t *s) {
    pthread_mutex_lock(&(s->m)) ;
```

```
    pthread_mutex_unlock(&(s->m)) ;
}
```