# CST 352 – Final

Wilsonville, Spring 2018

This is a take home final. You must turn in your completed final on **Blackboard** by mid-night on **Thursday 6/14/2018**. You may use any and all resources available to you to complete the final. You will be expected to turn in your own work. Do not copy/paste from a source (for example from the internet), instead read the source, understand the material and then put your answer into your own words.

## Section 1 – Terminology and Concepts (60 points)

Answer each question in this section with enough detail that the instructor understands that *you* understand the term or concept.

1. (10 points) Contrast the following terms in your own words:
   1. Process vs Thread

Both processes and threads are abstractions of physical space on some kind of memory (CPU, Main Memory). A process is the space that code can function in. A program that declares an array and does something to it is an example. A thread, on the other hand is needed to actually execute this process. The act of actually putting a variable in a process in the heap is an example of a task for the thread. The process is like a record, while the thread is like the head of the record player actually reading each note.

* 1. Principle vs Subject
  2. Device Controller vs Device Driver
  3. Internal vs External Fragmentation

Fragmentation occurs when memory segments are allocated by different programs in such a way that leaves gaps in memory. This is the same for both internal and external fragmentation. External fragmentation occurs when leftover chunks of memory are too small to be used by another process. Internal fragmentation occurs when the end of a page doesn’t get fully used. Internal refers to the fragmentation relative to the process itself. External refers to a new process trying to fit in memory.

* 1. CHS vs LBA Addressing

1. (5 points) What is virtual memory and why do operating systems include it?

Virtual memory is address space given to a program. Operating systems map this memory to physical storage. This gives the operating system a chance to catch the program if it reaches out of the allocated space. A page fault is generated by the CPU if a program tries to reach out of its bounds. This could definitely be seen as a safety precaution as well as a crash precaution.

1. (5 points) What is a deadlock? Describe a scenario where one could happen. What is an operating system technique for allowing programmers to avoid deadlocks?

A deadlock is when two threads are waiting on each other. This results in neither thread doing anything and an infinite loop of waiting. An example would be if Thread A is waiting for mutex 1 to become available before releasing mutex 2. Meanwhile Thread B is waiting mutex 2 to release mutex 1. Since neither mutex will ever become available, both threads sit idle. A quick fix for a situation like this is to give threads timeouts when waiting for another mutex. General careful design is another technique.

1. (10 points) Describe the producer/consumer pattern. Use at least the following terms in your description: ~~thread~~, ~~synchronization, mutex~~, ~~event~~, ~~queue~~. Include a diagram to illustrate your explanation.

The producer/consumer pattern is used for threads to communicate with each other without possible deadlocks. Synchronization of two different kinds of threads results in efficient operations happening in tandem. Producers are only allowed insert data or requests into a queue. Consumers have access to this same queue but can only remove data or process requests. Events must be added to the queue to make sure a consumer doesn’t take something that’s not there or a producer place something into a full queue. A mutex is used to make sure that nothing is being done to the queue while its attributes are changing. An example of this process is below.

Queue

Event Capacity;

Event Items;

The queue will lock the mutex whenever updating the Capacity or Items Events. These are updated as things are put into the queue or removed.

1. (10 points) Describe the 3 layers of a modern file system. What is the role of each layer?

Physical File System – This is the system that is responsible for writing data to the physical drive. This is system that takes care of writing blocks of data to cache, which then is translated to main memory, and some non-volatile disk. This is the layer that actually saves things to a place that will exist after power off.

Logical File System - This is the place where applications interact with the file system. An example here would be when I save this document in Microsoft Word. This system abstracts away the physical storage, and makes a common system for applications to use. I could save the same file from Notepad++ and things would work the same (except for Microsoft’s pesky .docx format).

Virtual File System – This system is where different physical file systems come together into one common ground. Mount points of different disks come into play here when operating systems have to read from a physical disk. An example here is how Windows mounts drives with a letter, such as the C: drive.

1. (5 points) Contrast the First-Fit and Best-Fit algorithms. What is the significant difference? What are the pros/cons of each?
2. (5 points) What are the potential consequences to data storage when a computer crashes. Describe an operating system technique for mitigating these risks.
3. (5 points) What is a security context? When and how is it established? How is it used by the operating system?
4. (5 points) Describe how session management combines various components of the operating system together to provide a secure and usable experience.

## Section 2 – Problem Solving (40 points)

For each of the questions in this section, read the challenge and describe the operating system techniques that are used to solve the challenge. Imagine that the visionary OS designer had anticipated the challenges and built the OS to solve them before the computer was set up. Be specific in your answer and use examples whenever possible.

1. (10 points) A person wants to run multiple applications at the same time. Each application needs to be able to share a single processor. Bugs in one application should not impact the other applications.
2. (10 points) A system administrator needs to add more storage capacity to a computer, without downtime. Since the computer was originally purchased, new types of hard disks have come out with much greater capacity per disk (more and larger sectors).
3. (10 points) A computer is accessed by many people at a time and over time. The computer is used to stored and edit confidential documents in a number of formats. Each person expects to share their documents only with other people of their choice.
4. (10 points) A person has purchased a new laptop after their previous one suffered catastrophic failure at a local coffee shop. They bring their new equipment home and are greatly relieved to discover that their wireless mouse, keyboard, 45” screen and printer work seamlessly with their new laptop. Within 10 minutes they are leaving a positive review on the laptop vendor’s website.