Examination 1

COP 4600 Operating Systems
February 13, 1997

Instructions

1. This is a closed-book examination.
2. You are permitted on 8.5 by 11 inch sheet of notes, both sides, that you have prepared.
3. **Answer any three (3) questions, and no more.** All questions are of equal value.
4. **Leave sufficient room in the upper lefthand corner for the staple.**
5. Use exactly one page of paper (both sides is OK) to hold the answer to each question, and please write legibly.
6. Start the answer to each question on a new page (i.e., do **not** put the answer to more than one question on the same page).
7. Assemble your answers in numerical order of the questions when you submit them.
8. **Read and sign the following statement.** You may write this on your exam and sign it there if you wish to take the exam questions home with you today.

On my honor, I have neither given nor received unauthorized aid on this examination.
Signed:

1. (a) What are the major components of an operating system, and why are they necessary (or are they?)?
   (b) Describe and compare batch systems and time-sharing systems. Include all salient distinctions, including how their characteristics affect the design of the major components. Be specific.
   (c) What forces and observations drove the development of batch systems, and why was this development critical in the history of operating systems?

2. (a) What are the primary goals of computer security, and how do they relate to the major system components?
   (b) What mechanisms are used to enforce security policies, and how do they work? List as many as you can with brief descriptions, and describe two mechanisms in detail.
   (c) How are systems calls related to computer security?
   (d) How do interrupts relate to computer security?

3. (a) Compare memory-mapped I/O and channel-based I/O. Which is more commonly used, and why? How can each be protected from misuse?
   (b) Describe the typical hardware and software components of an I/O system. Describe the type of communication that occurs at each interface, and indicate where in the system hardware independence is achieved.
   (c) What is DMA? Describe it and compare it to its alternative. What does it have to do with buffering? When is it applicable, and how does it help when it is? What is cycle-stealing?

4. (a) What are threads? How do they differ from processes?
   (b) What are two different ways in which threads may be implemented? What are their pros and cons?
   (c) Distinguish synchronous and asynchronous IPC. How can asynchronous IPC be used to achieve synchronization when it is needed?
   (d) Relate RPC to synchronous IPC. In what ways is it similar? How does it differ?
   (e) What is the capacity of a link in Minix? Are sends blocking or not?

5. (a) Draw and label a complete process state diagram. Include labels for states and for transitions.
   (b) For each transition, what parts of the operating system are involved, and how? If the process participates in the transition, include how. Include key terms in your discussion.
   (c) What is the "degree of multiprogramming?" How is it determined? For the element(s) of the OS that determine the degree of multiprogramming, what do they do to adjust it, and what criteria do they typically use?

6. Consider the following set of process CPU bursts.

Process Number	Priority (1=high)	Arrival Time	Burst Time
1	3	0	7
2	2	1	8
3	4	3	3
4	1	4	2

(a) Give Gantt charts for this set for FCFS, SJF, SRTF, RR(2), RR(3) and preemptive Priority. Show the ready queue at "interesting" times.

(b) What is the average turnaround time for each of those scheduling policies? Compare and explain.