Name: _____

CS 4/53201 **Exam #2** **Operating Systems**

Wednesday 8 November 2000

1. Fill in the table below, writing “yes” or “no” (the whole word) in the second and third columns to describe each of the four CPU scheduling algorithms. (20 points)

Algorithm Name	Pre-emptive?	Starvation Possible?
First-Come First-Served		
Shortest Job First		
Round Robin		
Shortest Remaining Time		

2. In the children’s game of "Cootie," each player is supposed to roll the dice, and based on the values received, eventually collect enough body parts (1 head, 1 body, 2 antennae, and 6 legs) to build a complete “cootie” (a cootie is a type of insect). When you buy the box, it comes with enough parts for four players to complete the game.

   However, in this particular case, some parts have been lost and there are more than four people who want to play. Therefore, the rules are changed slightly — players still roll dice to request parts, but if the parts aren't available, they have to wait until they are. When a player makes a complete Cootie, she takes it apart and returns its pieces to the pile.

   Suppose that the box has 3 heads, 2 bodies, 11 legs, and 5 antennae. There are 3 players.

   Player 1 has 1 head, 1 body, and 3 legs;
   player 2 has 1 body , 2 antennae, and 2 legs; and
   player 3 has 5 legs, 1 head, and 2 antennae.

   Player 1 is currently waiting for an antenna,
   player 2 is currently waiting for a head, and
   player 3 is currently waiting for a body.

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a. Draw a resource allocation diagram that describes the situation. (Hint: body parts are resources) (10 points)

b. List the four conditions of deadlock and explain why each of them does or does not hold in this situation. (10 points)

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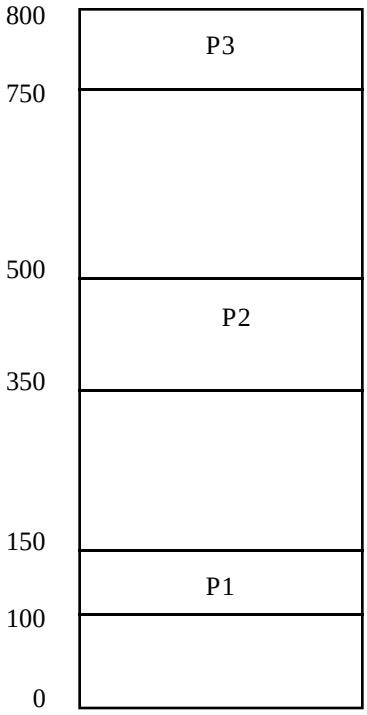
3. Assume that memory has been allocated among 3 processes (P1, P2, and P3) as shown in the diagram below. Now suppose three new processes request memory, in this order: P4 — size 180, P5 — size 95, and P6 — size 220. Draw two additional diagrams, one showing the result of the Next Fit algorithm, and the second showing the result of the Best Fit algorithm, after these new processes have been added. Be sure to label which diagram is which. (20 points)



4. In a system that uses paging, each virtual address is 16 bits long, of which the 10 most significant bits specify the page number, and the remaining 6 bits specify the offset. Each entry in the page table specifies an 8-bit base address in physical memory. Answer the following questions (answers specified as powers of two are fine).

   a. What is the maximum number of pages of virtual memory available to each process? (3 points)

   b. What is the maximum number of frames of physical memory? (3 points)

c. How many words are in a page or frame? (4 points)

d. Suppose the page table for a given process is as given below. What is the physical address that corresponds to the virtual address 0000 0000 1100 1001? (Spaces are given only to help you count bits). (10 points)

0: 1010 1111
1: 0000 0000
2: 1110 1000
3: 1111 0000
4: 0011 0011
5: 0100 1001

5. Suppose you have a memory with 4 frames, and the reference string:

7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 7 4 6 5 4 6 (these numbers refer to page numbers)

For each of the following algorithms, what is the total number of page faults? Show your work! (20 points)

a. FIFO

b. LRU