1) (20pts) Producer Consumer – Critical Sections

a) (3pts) What is the critical section problem? Why is it important?

b) (2pts) What can be done if two processes are deadlocked waiting for a particular resource?

c) (3pts) Explain “bounded waiting.” What can be done to be sure that “bounded waiting” is satisfied?

d) (12pts) Below is a semaphore solution for the producer/consumer problem. The buffer can hold n items. Semaphores are A, B, and C.

// The buffer is initialized to be empty and is processed as a first-in, first-out queue.

// Producer Code
while (true)
{
  1. getItem();
  2. wait(A);
  3. wait(C);
  4. addItemToBuffer();
  5. signal(C);
  6. signal(B);
}

// Consumer Code
while(true)
{
  1. wait(B);
  2. wait(C);
  3. readItemFromBuffer();
  4. signal(C);
  5. signal(A);
  6. processItem();
}

For each, give a sequence of statements showing if or how an error might occur. Show your work for credit, no credit will be given for guessing.

i. A = 0, B = n, C = 1
ii. A = n, B = 0, C = 2
iii. A = n, B = n, C = 1
2. (20pts Total) Memory

a) (2pts) Describe two (2) benefits of using virtual memory.

b) (3pts) What is the Translation Look Ahead Buffer (TLB). Specifically, what is stored in it, and how is it used?

c) (12pts) Given memory partitions of 200KB, 400KB, 600KB, 300KB (in this order). How would each of the algorithms below place the following processes P1-250KB, P2-110KB, P3-300KB, P4-280KB, P5-210KB (in this order). Assume dynamic partitioning. Show your work for full credit.

   i. First Fit
   ii. Best Fit
   iii. Worst Fit

d) (3pt) Which algorithm makes the most efficient use of memory in this case? Explain your answer.

3) (20pts) Paging

a) (4pts) There are multiple techniques for structuring page tables in large address spaces. Choose one and describe how it works.

b) (2pts) When discussing page replacement, what is the “working set?”

c) (12pts) Assume 4 page frames have been allocated to a process. For each of the algorithms below, show the contents of the page frames for the requests: 1,2,3,4,2,1,5,6,2,1,2,3,7. Indicate whenever a page fault occurs.

   i. First in First Out
   ii. Least Recently Used
   iii. Optimal

d) (2pts) For this particular set of pages, which paging method is best and why? Describe any disadvantage of the “best” method if there is one.