

CS 692 Systems Exam – Spring 2023

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.