OS Problems

05/12/2020

Problem 1

Topic: Free space bitmaps

Reference 1: Free Space Management in Operating System
Reference 2: Modern Operating Systems (4th Edition)

The beginning of a free space bitmap looks like this after the disk partition is first formatted: **1000 0000 0000 0000** (the first block is used by the root directory).
Using a contiguous allocation approach, the system always searches for free blocks starting at the lowest-numbered block, so after writing file A, which uses six blocks, the bitmap looks like this: **1111 1110 0000 0000 0000**.
Show the bitmap after each of the following additional actions:

A. File B is written, using five blocks
B. File A is deleted
C. File C is written using 8 blocks
D. File B is deleted
E. File D is written using 3 blocks

Problem 2

Topic: Memory Management

Reference 1: Coming Soon...
Reference 2:

A computer has four page frames. The time of loading, time of last access, and the R and M bits for each page are shown below (the times are in clock ticks)

Page	Loaded	Last ref.	R	M
0	230	280	1	1
1	126	275	0	0
2	110	282	0	1
3	140	266	1	0

A. Which page will NRU replace?

B. Which page will FIFO replace?

C. Which page will LRU replace?

D. Which page will second chance replace?

Problem 3

Topic: Deadlock

Reference 1: Coming Soon...
Reference 2:

List the four conditions that must hold for a deadlock to occur in a general resource system:

Problem 4

Topic: Memory Management

Reference 1: Coming Soon...
Reference 2:

Consider a program with two segments: instructions in segment 0 and read/write data in segment 1. Segment 0 has read/execution protection and 1 has read/write protection. The system uses paged virtual memory with virtual addresses with a 4-bit page number and 10 bit offset. The page table is shown below (all values are decimal):

Segment 0		**Segment 1**	
Read/Execute		**Read/Write**	
Virtual Page	**Page Frame**	**Virtual Page**	**Page Frame**
0	2	0	On Disk
1	On Disk	1	14
2	11	2	9
3	5	3	6
4	On Disk	4	On Disk
5	On Disk	5	13
6	4	6	8
7	3	7	12

Identify the physical address (or page fault) for the following cases.

A. Fetch from segment 0, page 2, offset 5

B. Store into segment 1, page 0, offset 3

C. Fetch from segment 1, page 0, offset 21

D. Jump to segment 0, page 3, offset 31

Problem 5

Topic: Free space bitmaps

Reference 1: Free Space Management in Operating System
Reference 2: Modern Operating Systems (4th Edition)

The beginning of a free space bitmap looks like this after the disk partition is first formatted: **1000 0000 0000 0000** (the first block is used by the root directory).
Using a contiguous allocation approach, the system always searches for free blocks starting at the lowest-numbered block, so after writing file A, which uses six blocks, the bitmap looks like this: **1111 1100 0000 0000**.
Show the bitmap after each of the following additional actions:

A. File B is written, using seven blocks
B. File A is deleted
C. File C is written using 6 blocks
D. File B is deleted

Problem 6

Topic: Deadlock - Banker Algorithm

Reference 1: Coming Soon...
Reference 2:

In a computer system with 4 tape units and 2 plotters, the following resource allocation table represents the current status of five processes:

Process	Tape units	Plotters
A	1	0
B	1	1
C	1	0
D	0	1
E	0	0

The total requirements of each process are shown in the table below:

Process	Tape units	Plotters
A	2	1
B	2	1
C	2	2
D	3	1
E	2	2

Using the Banker's algorithm, show which sequences of jobs could be used to complete the execution of all processes without causing a deadlock.

Problem 7

Topic: Disk Scheduling

Reference 1: Coming Soon...
Reference 2:

Disk requests come in to the disk driver for cylinders 15, 22, 17, 3, 26, 40, and 13. Considering that the disk is already positioned in cylinder 15 and that the arm moving time between any two adjacent cylinders is 4 ms (between cylinders at distance n would be 4n ms), compute the average seek time for the following methods (Assume no other requests arrive during the execution of the given sequence):

A. First Come , First Served

B. Shortest Seek First

C. Elevator Algorithm (initially moving upward)

Problem 8

Topic: Page Table / Page Replacement

Reference 1: Coming Soon...
Reference 2:

A byte-addressable computer has a paged memory with 2048 bytes per page and 128 page frames.

A. How many bits are there in a physical address?

B. Assuming that a 1 Mbytes virtual memory system has been implemented, determine the size (number of entries) of the page table required for this system, and how many bits are used in a virtual address.

C. Name 3 possible algorithms that could be used for page replacement.

Problem 9

Topic: Virtual Memory

Reference 1: Coming Soon...
Reference 2:

Given a system with a 16 bits virtual address, consisting of pages of 256 bytes and 32 possible segments. If such system is running in a physical memory of 16 Kbytes,

A. Show the format of the physical address.

B. Show the format of the virtual address.

C. Compute the size of the virtual memory.

Given the following page and segment tables (values in the tables are decimal), compute the physical addresses (in hexadecimal) equivalent to the virtual addresses provided (in hexadecimal). If the information is not available in the memory, indicate if a segment or page fault has occurred.

Segment Descriptor Table

00	Page Table 1
01	Page Table 3
02	Page Table 2
03	On disk
04	On disk
05	On disk
...	On disk
31	On disk

Page Table 1

00	20
01	15
02	10
03	04
04	03
05	On disk
06	On disk
07	On disk

Page Table 2

00	21
01	32
02	11
03	On disk
04	On disk
05	01
06	05
07	17

Page Table 3

00	22
01	25
02	13
03	On disk
04	14
05	27
06	43
07	51

$03AB_{16}$

2102_{16}

0501_{16}

0103_{16}

$12CD_{16}$

$03A0_{16}$

1673_{16}

1721_{16}

1901_{16}

1432_{16}

Problem 10

Topic: Process States

Reference 1: Coming Soon...
Reference 2:

Processes competing for the usage of the CPU can be found to be in one of three possible states.

A. List those three states.

B. Draw the diagram showing the states and the possible transitions (make sure your arrows point in the right direction) as well as label the arrows.

Problem 11

Topic: Semaphores / Race Conditions

Reference 1: Coming Soon...
Reference 2:

Two students are eating a pizza while studying for this test. Since they are concentrated in reading the textbook, they do not look at the pizza when getting a new slice. In order to avoid an argument over the pizza rights, they developed a little procedure that controls their eating behavior as shown below:

Listing 1: Pizza Algorithm.

```
1    while (True)
2        get_pizza()
3        eat_pizza_and_read_text()
4    end while
```

It is clear that this procedure did not work because race conditions occurred when getting the pizza. Your task is:

A. Modify the procedure in order to obtain a strict alternation solution (only 2 students).

B. Some friends just arrived and want to share the pizza. Assuming that there is pizza for everybody all night, modify the procedure using semaphores in order to prevent the simultaneous access to the pizza.