



**United International University**  
**Department of Computer Science and Engineering**

CSE 4509/CSI 309: Operating System Concepts/Operating Systems

Final Examination: Spring 2023

Total Marks: 40 Time: 2 hours

Any examinee found adopting unfair means will be expelled from  
the trimester / program as per UIU disciplinary rules.

Answer all 8 questions. Numbers to the right of the questions denote their marks.

1. (a) Mention **two** primary differences between the Windows file system and the Linux file system. [ 1 ]  
(b) The following commands were run in a Linux system. Answer the following questions. [ 2.5 + 1.5 ]

```
$ mkdir OS/  
$ mkdir -p OS/Scheduling/  
$ mkdir -p OS/page_replacement/LRU  
$ mkdir -p OS/Page_replacement/LFU  
$ cd OS  
$ cd Scheduling  
$ touch fcfs.cpp  
$ cd ../..  
$ touch OS/page_replacement/sjf.cpp  
$ cp OS/page_replacement/sjf.cpp OS/Scheduling/  
$ ln -s OS/page_replacement/ OS/Page_replacement/  
$ ln -s OS/page_replacement/sjf.cpp OS/Scheduling/sjf_2.cpp
```

Table 1: The table shows action of all the commands along with the action of the flags used in the scenario above.

Command	Action	Flag	Action
mkdir	creates a directory	p	creates directory along with parent
cd	changes to a directory	-	-
touch	creates a file	-	-
ln	creates a link	s	creates symbolic link
cp	copies a file	-	-

- i. Draw a directed graph representation of the directory OS.  
ii. Is it acyclic?
2. (a) The diagram in figure-1 shows the linked list allocation of 3 different files. Convert the linked list allocation to a FAT. Assume that the file system consists of 16 blocks. [2]

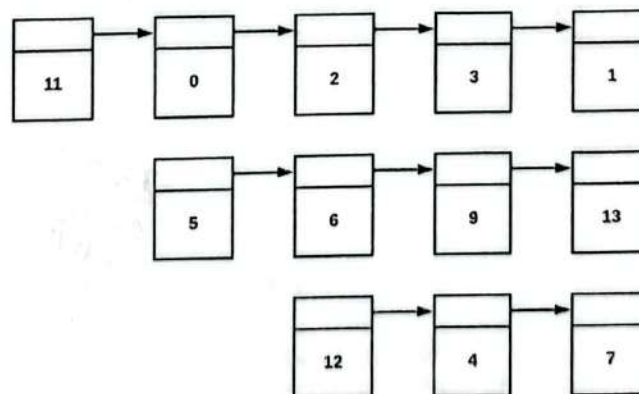
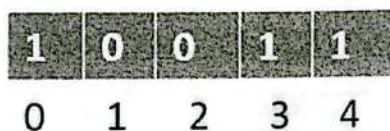


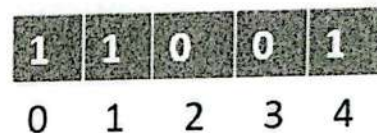
Figure 1: Linked list allocation of 3 files

[ Note: all the files reside in the same file system. ]

- (b) Suppose, the size of a disk is 2TB. Each block in the file system is 8KB. We want to use a bitmap to manage the free space. [ 1.5 + 1.5 ]
- How many blocks are there in the file system? How much memory do we need to address all the blocks?
  - If we use a clustering system where the cluster size is 16KB, how much memory will we need then?
3. (a) Show the relation between per-process and system-wide open file table with a diagram. [ 2 ]
- (b) In a Unix File System (UFS), there are 12 direct blocks, one single-indirect block, and one double-indirect block. Data blocks are each 4 KB. L1 blocks are of size 8 KB and L2 blocks are 1 KB. What is the size of this file system? The address space of the file system is 32 bits. [ 3 ]
4. "LFU is more optimal than second chance algorithm at handling page fault in the given scenario."- Justify the statement for the number of frame 4 and reference string as: [5]
- 0, 1, 2, 3, 4, 3, 1, 9, 3, 7, 0, 7, 9, 7, 6, 3, 0, 7, 0, 7
5. (a) Draw a diagram for the steps that an operating system takes when a page fault occurs. [2]  
[ Note: only the diagram is required. ]
- (b) Design an LRU (Least Recently Used) approximation algorithm for 5 frames numbered 0 to 4. Given the status of the reference bit at two different points in time (t1 and t2). Assume that the initial reference bits of the prime numbered frames are 1 and the remaining are 0. Determine the status of each frame for this time step. [3]



(a) time t1



(b) time t2

Figure 2: Status of the reference bit

6. Consider the Table-2 snapshot of a system:

Table 2: Processes, its allocated resources, and maximum resources required if each process wants to execute.

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2
P1	1	0	0	0	1	7	5	0
✓ P2	1	3	5	4	2	3	5	6
✓ P3	0	6	3	2	0	6	5	2
P4	0	0	1	4	0	6	5	6

Assume that available resources are {1,5,2,0}

- (a) Calculate the Need matrix

- (b) Determine the system is in safe state or not?

- (c) "If a request from process P1 arrives for (0,4,2,0), request will be granted immediately."-Justify the statement. [2]

7. Consider a system with five processes and four resources, each with a specific number of instances. Resource R1 has two instances, R2 has one instance, R3 has four instances, and R4 has two instances. Among the processes, P1 holds one instance of R1 and R3 and requests an additional instance of R2. P2 holds one instance of R4 and requests an additional instance of R2. P3 holds one instance of R2 and R3. P4 holds one instance of R3 and R4 and requests an additional instance of R1. Finally, P5 holds one instance of R1 and R3.

- (a) Draw Resource Allocation Graph (RAG) for the above scenario. [1.5]

- (b) Draw wait-for graph from RAG. [1.5]
- (c) Using the resource allocation graph (RAG) from (a), determine if a deadlock exists. [2]
8. (a) Mr. Shaun is a manager in a bank that has multiple ATMs available for customers to withdraw money. He needs to ensure that only one customer can access an ATM at a time to prevent issues with conflicting transactions. Mr. Strange suggests the use of binary semaphores while Mr. Stark suggests the use of mutex to manage access to ATMs. Whose suggestion would be better for this situation, and why? [ 4 ]
- (b) What is a semaphore? What is the atomic action property of semaphore? [ 1 ]