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Department of Computer Technology B. Tech in Computer Science and Engineering (IOT)

Vision of the Department

To be a well-known centre for pursuing computer education through innovative pedagogy, value-based education and industry collaboration.

Mission of the Department

To establish learning ambience for ushering in computer engineering professionals in core and multidisciplinary area by developing Problem-solving skills through emerging technologies.

Session 2025-2026

Vision: Dream of Where you want	**Mission:** Means to achieve vision

Program Educational Objectives of the program (PEO): (broad statements that describe the professional and career accomplishments)

PEO1	**Preparation**	**P: Preparation**	**Pep-CL abbreviation pronounce as Pep-si-lL easy to recall**
PEO2	**Core Competence**	**E: Environment (Learning Environment)**	
PEO3	**Breadth**	**P: Professionalism**	
PEO4	**Professionalism**	**C: Core Competence**	
PEO5	**Learning Environment**	**L: Breadth (Learning in diverse areas)**	

Program Outcomes (PO): (statements that describe what a student should be able to do and know by the end of a program)

Keywords of POs:
Engineering knowledge, Problem analysis, Design/development of solutions, Conduct Investigations of Complex Problems, Engineering Tool Usage, The Engineer and The World, Ethics, Individual and Collaborative Team work, Communication, Project Management and Finance, Life-Long Learning

PSO Keywords: Cutting edge technologies, Research

"I am an engineer, and I know how to apply engineering knowledge to investigate, analyse and design solutions to complex problems using tools for entire world following all ethics in a collaborative way with proper management skills throughout my life." *to contribute to the development of cutting-edge technologies and Research*.

Integrity: I will adhere to the Laboratory Code of Conduct and ethics in its entirety.

Name and Signature of Student and Date
(Signature and Date in Handwritten)

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Session	**2025-26 (ODD)**	**Course Name**	**Operating System**
Semester	**5**	**Course Code**	**23IOT1504**
Roll No	**58**	**Name of Student**	**Puneet Raut**

Practical Number	**5**
Course Outcome	1. Understand Computer System Configuration and Simulate system resources efficiently using Linux Commands (CO1) 2. Analyse operating system functionalities utilizing system calls, thread programming and process scheduling algorithms (CO2) 3. Apply Synchronization primitives to implement a Deadlock-free solution(CO3) 4. Simulate Disk scheduling, Memory allocation, File allocation, page replacement algorithms (CO4)
Aim	Stimulate banks deadlock algorithm
Problem Definition	Design and implement a simulation of the **Banker's Algorithm** for deadlock avoidance. The system should safely allocate resources to multiple processes without entering a deadlock state. The program must check whether a requested resource allocation can be granted without compromising system safety and display the safe sequence if it exists.
Theory (100 words)	Introduction: • Page replacement algorithms are used in operating systems to manage memory when a page fault occurs. • When all memory frames are full and a new page needs to be loaded, the system decides which existing page to replace. Objective: • To reduce the number of page faults and improve overall CPU performance. • Efficient page replacement ensures better utilization of physical memory. First In First Out (FIFO): • This is the simplest page replacement technique. • Pages are replaced in the order they were loaded into memory — the oldest page is replaced first. • It uses a queue to track the order of pages. • Although easy to implement, it may lead to *Belady's anomaly*

<table>
<tr><td></td><td>(more frames causing more faults).
□ Least Recently Used (LRU):
• Replaces the page that has not been used for the longest time.
• It assumes pages used recently are likely to be used again soon.
• Implemented using counters or stacks to track recent usage.
• It gives better performance than FIFO but is more complex.
□ Optimal Page Replacement:
• Replaces the page that will not be used for the longest period in the future.
• It gives the minimum possible page faults but is theoretical as future references are unknown.</td></tr>
<tr><td>Procedure and Execution

(100 Words)</td><td>Step for Implementation:

🎬 Input the number of processes and resource types.
🎬 Input the Allocation matrix (resources currently allocated to each process).
🎬 Input the Maximum matrix (maximum resources each process may need).
🎬 Calculate the Need matrix = Maximum - Allocation.
🎬 Input the Available resources.
🎬 Run the Banker's safety algorithm:
1. Find a process whose needs can be met with available resources.
○ Pretend to allocate those resources and mark the process as finished.
○ Release its resources back to available.
○ Repeat until all processes are finished or no further progress is possible.
🎬 If all processes finish, the system is in a safe state and the safe sequence is printed.
🎬 If not, the system is in an unsafe state (potential deadlock).</td></tr>
</table>

Code:

```
#include <stdio.h> #include
<stdbool.h>

 int main() { int n,
    m;

    printf("Enter number of processes: "); scanf("%d",
    &n);
    printf("Enter number of resource types: ");
    scanf("%d", &m);

    int alloc[n][m], max[n][m], need[n][m], avail[m];

    // Input Allocation Matrix printf("\nEnter
    Allocation Matrix:\n"); for (int i = 0; i < n;
    i++)
        for (int j = 0; j < m; j++)
            scanf("%d", &alloc[i][j]);

    // Input Maximum Matrix printf("\nEnter
    Maximum Matrix:\n"); for (int i = 0; i < n;
    i++)
        for (int j = 0; j < m; j++)
            scanf("%d", &max[i][j]);

    // Input Available Resources printf("\nEnter
    Available Resources:\n"); for (int j = 0; j < m;
    j++)
        scanf("%d", &avail[j]);

    // Calculate Need Matrix = Max - Allocation for
    (int i = 0; i < n; i++)
        for (int j = 0; j < m; j++)
            need[i][j] = max[i][j] - alloc[i][j];

    bool finish[n];
    for (int i = 0; i < n; i++) finish[i] =
        false;

    int safeSequence[n]; int
    work[m];
```

	<pre>for (int i = 0; i < m; i++) work[i] = avail[i];
	    int count = 0;
	
	    while (count < n) { bool
	      found = false;
	      for (int i = 0; i < n; i++) { if
	        (!finish[i]) {
	          bool canRun = true;
	          for (int j = 0; j < m; j++) { if
	            (need[i][j] > work[j]) {
	              canRun = false; break;
	            }
	          }
	          if (canRun) {
	            for (int k = 0; k < m; k++) work[k]
	              += alloc[i][k];
	
	            safeSequence[count++] = i; finish[i] =
	            true;
	            found = true;
	          }
	        }
	      }
	      if (!found) {
	        printf("\nSystem is in UNSAFE state (deadlock may occur).\n");
	        return 1;
	      }
	    }
	
	    // If system is in a safe state
	    printf("\nSystem is in SAFE state.\nSafe sequence is: "); for (int
	    i = 0; i < n; i++)
	      printf("P%d ", safeSequence[i]); printf("\n");
	
	    return 0;
	}</pre>

<table>
<tr><td></td><td>Output:<pre>
Enter number of processes: 5
Enter number of resource types: 3

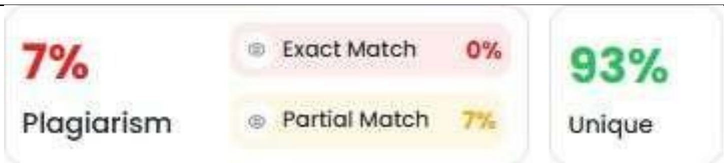
Enter Allocation Matrix:
2 3 5
1 4 3
2 4 6
1 4 6
1 3 2

Enter Maximum Matrix:
7 5 2
 4 3
2 4 6
6 8 9
2 5 2
3 6 3

Enter Available Resources:
3 3 2

System is in SAFE state.
Safe sequence is: P0 P1 P2 P3 P4

...Program finished with exit code 0
Press ENTER to exit console.
</pre></td></tr>
<tr><td>Output Analysis</td><td>🎬 The system receives input for 5 processes (P0 to P4) and 3 resource types.
🎬 Each process provides its Allocation (resources currently held) and Maximum
(maximum resources it may need).
🎬 The program calculates the Need matrix by subtracting Allocation from Maximum for each resource per process.
🎬 The system starts with the given Available resources: A = 3, B = 3, C</td></tr>
</table>

	= 2. 🎬 Using the Banker's Algorithm, it checks if any process's **Need** can be satisfied with the current **Available** resources. 🎬 It successfully finds a **safe sequence** in which all processes can execute without causing a deadlock. 🎬 The safe sequence found is: **P1 → P3 → P4 → P0 → P2**. 🎬 This means the system is in a **SAFE state**, and all processes can complete by sequentially allocating and releasing resources. 🎬 No deadlock will occur if processes request resources as declared in their **Maximum matrix**.
Link of student Github profile where lab assignment has been uploaded	https://github.com/Puneet4382/Operating-System-Practicals
Conclusion	The implementation and simulation of the **Banker's Algorithm** successfully demonstrate how a system can avoid deadlocks by carefully analyzing resource allocation and ensuring it remains in a **safe state**. By calculating the **Need**, **Available**, and using a safety check, the algorithm ensures that all processes can complete without waiting indefinitely for resources. The safe sequence output confirms that resource allocation can proceed without causing a deadlock. This algorithm is crucial in multi-processing environments where resource management and system stability are priorities. Therefore, **Banker's Algorithm serves as an effective strategy for deadlock avoidance** in operating systems
Plag Report (Similarity index < 12%)	
Date	29/10/2025