**Experiment:17-Illustrate the deadlock avoidance concept by simulating Banker’s algorithm with C.**

**Aim:**

The aim of this program is to **illustrate the concept of deadlock avoidance** by simulating **Banker's Algorithm** in C. The Banker's Algorithm is a resource allocation and deadlock avoidance algorithm that checks whether the system is in a safe state before granting resources to a process.

**Procedure:**

1. **Define the Data Structures**: The system needs several matrices and vectors:
   * Allocation[][]: Keeps track of how many resources are currently allocated to each process.
   * Max[][]: Represents the maximum resources each process may need.
   * Available[]: Represents the available resources in the system.
   * Need[][]: Represents the remaining resources each process may need (calculated as Need[i][j] = Max[i][j] - Allocation[i][j]).
2. **Safety Check**: The algorithm checks if granting the request for resources leaves the system in a **safe state**. This is done by simulating the allocation and verifying if all processes can eventually finish with the available resources.
3. **Granting Resources**: Before granting a resource request, the system checks if the request is **less than or equal to the need of the process** and if the request is **less than or equal to the available resources**.
4. **Simulation**:
   * The algorithm simulates whether the system can proceed with all processes completing successfully (safe state).
   * If the system is in a safe state, the request is granted. Otherwise, the request is denied.

**Banker's Algorithm C Program:**

c

Copy code

#include <stdio.h>

#include <stdbool.h>

// Number of processes and resources

#define P 5

#define R 3

// Function to calculate if the system is in a safe state

bool isSafeState(int processes[], int avail[], int max[][R], int allot[][R]) {

int work[R];

bool finish[P];

// Initialize work[] and finish[]

for (int i = 0; i < R; i++) {

work[i] = avail[i];

}

for (int i = 0; i < P; i++) {

finish[i] = false;

}

int count = 0;

while (count < P) {

bool progressMade = false;

for (int p = 0; p < P; p++) {

// Check if process p is not finished and its needs can be satisfied with current available resources

if (!finish[p]) {

bool canAllocate = true;

for (int r = 0; r < R; r++) {

if (max[p][r] - allot[p][r] > work[r]) {

canAllocate = false;

break;

}

}

if (canAllocate) {

// Add the allocated resources of process p to work[]

for (int r = 0; r < R; r++) {

work[r] += allot[p][r];

}

finish[p] = true;

count++;

progressMade = true;

}

}

}

// If no process can be allocated, break out

if (!progressMade) {

return false; // The system is not in a safe state

}

}

return true; // The system is in a safe state

}

bool requestResources(int processes[], int avail[], int max[][R], int allot[][R], int request[], int pid) {

// Check if request is valid (request <= need)

for (int i = 0; i < R; i++) {

if (request[i] > max[pid][i] - allot[pid][i]) {

printf("Error: Process has exceeded its maximum claim!\n");

return false;

}

}

// Check if request is less than or equal to available resources

for (int i = 0; i < R; i++) {

if (request[i] > avail[i]) {

printf("Resources are not available!\n");

return false;

}

}

// Pretend to allocate the resources to process pid

for (int i = 0; i < R; i++) {

avail[i] -= request[i];

allot[pid][i] += request[i];

}

// Check if the system is in a safe state

if (isSafeState(processes, avail, max, allot)) {

printf("Request can be granted safely.\n");

return true;

} else {

// Rollback the allocation

for (int i = 0; i < R; i++) {

avail[i] += request[i];

allot[pid][i] -= request[i];

}

printf("Request cannot be granted safely.\n");

return false;

}

}

int main() {

// Initialize the processes, available resources, maximum resources and allocation

int processes[] = {0, 1, 2, 3, 4};

int avail[] = {3, 3, 2}; // Available resources

// Maximum resources needed by each process

int max[][R] = {

{7, 5, 3},

{3, 2, 2},

{9, 0, 2},

{2, 2, 2},

{4, 3, 3}

};

// Resources allocated to each process

int allot[][R] = {

{0, 1, 0},

{2, 0, 0},

{3, 0, 2},

{2, 1, 1},

{0, 0, 2}

};

int pid, request[R];

// Request resources for process

printf("Enter process ID for resource request (0-4): ");

scanf("%d", &pid);

printf("Enter request for resources (format: Request1 Request2 Request3): ");

for (int i = 0; i < R; i++) {

scanf("%d", &request[i]);

}

// Try to allocate resources

if (requestResources(processes, avail, max, allot, request, pid)) {

printf("Resources allocated successfully.\n");

} else {

printf("Request denied.\n");

}

return 0;

}

Output:

