Operating Systems Project Report

To be presented to:
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Banker's Algorithm

The banker's algorithm is a resource allocation and deadlock avoidance algorithm that tests for safety by simulating the allocation for predetermined maximum possible amounts of all resources, then makes an "s-state" check to test for possible activities, before deciding whether allocation should be allowed to continue. This algorithm is used mainly in banking systems to determine whether a loan can be granted or not.

Project Description

USER PROCEDURE

- user selects maximum matrix to be input by the user or randomly generated.
- user selects the number of processes to be simulated.
- user selects the number of resource types.
- user inputs the number of iterations of the simulation
- user inputs the number of available resources for each resource type

if randomly generated, the maximum number of resources is randomly generated with values less than or equal to the available resources for each resource type.

THE SIMULATION

Random process disallocation may randomly be executed before each process requests a new allocation request. The process will request a random request whose values are less than or equal to its need for each resource type.

A simulation is then run to check for the safety of the system if the process is granted allocation. If the simulation indicated a safe state of the system, the process's request of allocation is granted, and respective matrices are updated after the request's acceptance. Else, the request is denied

These steps are repeated for each generated process for N times where N is the number of iterations input by the user.

Project Execution

TEST CASE I

THE INPUT

```
 Enter 0 for random numbers and 1 for User Input
0
Enter number of processes
2
Enter number of resources
2
Enter number of Iterations
1
Enter number of available of resources
3
4
```

THE OUTPUT

```
////////////////////// - Generated/Input Processes - //////////////////////

available
3 4

// Allocated || Max || Needed //
0 | 0 0 || 1 2 || 1 2
1 | 0 0 || 2 0 || 2 0

////////////////////// -         End         - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
3 4

// Allocated || Max || Needed //
0 | 0 0 || 1 2 || 1 2
1 | 0 0 || 2 0 || 2 0

////////////////////// -         End         - //////////////////////

disallocating P#0
0 0

randomly disallocated P#0
```

////////////////////// - System After Process Deallocation - //////////////////////

available
3 4

// Allocated || Max || Needed //
0 | 0 0 || 1 2 || 1 2
1 | 0 0 || 2 0 || 2 0

////////////////////// - End - //////////////////////

P#0 requests allocaiton

////////////////////// - Process State - //////////////////////

available
3 4

// Allocated || Max || Needed //
0 | 0 0 || 1 2 || 1 2

////////////////////// - End - //////////////////////

Request
0 2

// needed || available before || allocated || available after //

Executed P#0
1 0 || 3 2 || 0 2 || 3 4

Executed P#1
2 0 || 3 4 || 0 0 || 3 4

Safe

PROCESS GRANTED ALLOCATION

////////////////////// - After Process testing - //////////////////////

available
3 2

// Allocated || Max || Needed //
0 | 0 2 || 1 2 || 1 0
1 | 0 0 || 2 0 || 2 0

```
////////////////////// -          End         - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
3 2

// Allocated || Max || Needed //
0 | 0 2 || 1 2 || 1 0
1 | 0 0 || 2 0 || 2 0

////////////////////// -          End         - //////////////////////

disallocating P#0
0 0

randomly disallocated P#1

////////////////////// - System After Process Deallocation - //////////////////////

available
3 2

// Allocated || Max || Needed //
0 | 0 2 || 1 2 || 1 0
1 | 0 0 || 2 0 || 2 0

////////////////////// -             End             - //////////////////////

P#1 requests allocaiton

////////////////////// - Process State - //////////////////////

available
3 2

// Allocated || Max || Needed //
1 | 0 0 || 2 0 || 2 0

////////////////////// -      End      - //////////////////////

Request
1 0

// needed || available before || allocated || available after //

Executed P#0
1 0 || 2 2 || 0 2 || 2 4
```

Executed P#1
1 0 || 2 4 || 1 0 || 3 4

Safe

PROCESS GRANTED ALLOCATION

////////////////////// - After Process testing - //////////////////////

available
2 2

// Allocated || Max || Needed //
0 | 0 2 || 1 2 || 1 0
1 | 1 0 || 2 0 || 1 0

////////////////////// - End - //////////////////////

////////////////////// - Final State of the System - //////////////////////

available
2 2

// Allocated || Max || Needed //
0 | 0 2 || 1 2 || 1 0
1 | 1 0 || 2 0 || 1 0

////////////////////// - End - //////////////////////

TEST CASE II

THE INPUT
Enter 0 for random numbers and 1 for User Input
0
Enter number of processes
3
Enter number of resources
1
Enter number of Iterations
1
Enter number of available of resources
7

THE OUTPUT
////////////////////// - Generated/Input Processes - //////////////////////

available
7

// Allocated || Max || Needed //
0 | 0 || 1 || 1
1 | 0 || 3 || 3
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
7

// Allocated || Max || Needed //
0 | 0 || 1 || 1
1 | 0 || 3 || 3
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

P#0 requests allocaiton

////////////////////// - Process State - //////////////////////

available
7

// Allocated || Max || Needed //
0 | 0 || 1 || 1

////////////////////// - End - //////////////////////

Request
1

// needed || available before || allocated || available after //

Executed P#0
0 || 6 || 1 || 7

Executed P#1
3 || 7 || 0 || 7

Executed P#2
6 || 7 || 0 || 7

Safe

PROCESS GRANTED ALLOCATION

////////////////////// - After Process testing - //////////////////////

available
6

// Allocated || Max || Needed //
0 | 1 || 1 || 0
1 | 0 || 3 || 3
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
6

// Allocated || Max || Needed //
0 | 1 || 1 || 0
1 | 0 || 3 || 3
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

P#1 requests allocaiton

////////////////////// - Process State - //////////////////////

available
6

// Allocated || Max || Needed //
1 | 0 || 3 || 3

////////////////////// - End - //////////////////////

Request
2

// needed || available before || allocated || available after //

Executed P#0
0 || 4 || 1 || 5

Executed P#1
1 || 5 || 2 || 7

Executed P#2
6 || 7 || 0 || 7

Safe

PROCESS GRANTED ALLOCATION

////////////////////// - After Process testing - //////////////////////

available
4

// Allocated || Max || Needed //
0 | 1 || 1 || 0
1 | 2 || 3 || 1
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
4

// Allocated || Max || Needed //
0 | 1 || 1 || 0

1 | 2 || 3 || 1
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

P#2 requests allocaiton

////////////////////// - Process State - //////////////////////

available
4

// Allocated || Max || Needed //
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

Request
5

// needed || available before || allocated || available after //

Unsafe

PROCESS NOT GRANTED ALLOCATION, SYSTEM WOULD BE UNSAFE

////////////////////// - After Process testing - //////////////////////

available
4

// Allocated || Max || Needed //
0 | 1 || 1 || 0
1 | 2 || 3 || 1
2 | 0 || 6 || 6

////////////////////// - End - //////////////////////

////////////////////// - Final State of the System - //////////////////////

available
4

// Allocated || Max || Needed //
0 | 1 || 1 || 0
1 | 2 || 3 || 1
2 | 0 || 6 || 6
////////////////////// - End - //////////////////////

TEST CASE III

THE INPUT
Enter 0 for random numbers and 1 for User Input
0
Enter number of processes
2
Enter number of resources
4
Enter number of Iterations
2
Enter number of available of resources
2
5
3
1

THE OUTPUT

////////////////////// - Generated/Input Processes - //////////////////////

available
2 5 3 1

// Allocated || Max || Needed //
0 | 0 0 0 0 || 2 5 2 0 || 2 5 2 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
2 5 3 1

// Allocated || Max || Needed //
0 | 0 0 0 0 || 2 5 2 0 || 2 5 2 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

P#0 requests allocaiton

////////////////////// - Process State - //////////////////////

available
2 5 3 1

// Allocated || Max || Needed //
0 | 0 0 0 0 || 2 5 2 0 || 2 5 2 0

////////////////////// - End - //////////////////////

Request
2 5 2 0

// needed || available before || allocated || available after //

Executed P#0
0 0 0 0 || 0 0 1 1 || 2 5 2 0 || 2 5 3 1

Executed P#1
2 4 2 0 || 2 5 3 1 || 0 0 0 0 || 2 5 3 1

Safe

PROCESS GRANTED ALLOCATION

////////////////////// - After Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

disallocating P#0
0 0 0 0

randomly disallocated P#1

////////////////////// - System After Process Deallocation - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

P#1 requests allocaiton

////////////////////// - Process State - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

Request
0 1 0 0

// needed || available before || allocated || available after //

Unsafe

PROCESS NOT GRANTED ALLOCATION, SYSTEM WOULD BE UNSAFE

////////////////////// - After Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available

0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

disallocating P#0
1 3 2 0

randomly disallocated P#0

////////////////////// - System After Process Deallocation - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

P#0 requests allocaiton

////////////////////// - Process State - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0

////////////////////// - End - //////////////////////

Request
0 0 0 0

PROCESS NEEDS ZERO RESOURCES

////////////////////// - After Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0

1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

////////////////////// - Before Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

P#1 requests allocaiton

////////////////////// - Process State - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

Request
0 2 2 0

// needed || available before || allocated || available after //

Unsafe

PROCESS NOT GRANTED ALLOCATION, SYSTEM WOULD BE UNSAFE

////////////////////// - After Process testing - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////

////////////////////// - Final State of the System - //////////////////////

available
0 0 1 1

// Allocated || Max || Needed //
0 | 2 5 2 0 || 2 5 2 0 || 0 0 0 0
1 | 0 0 0 0 || 2 4 2 0 || 2 4 2 0

////////////////////// - End - //////////////////////