

COMP 322/L—Introduction to Operating Systems and System Architecture

Assignment #3—Banker's Algorithm

Objective:

To implement resource allocation and demonstrate deadlock avoidance using the Banker's algorithm.

Specification:

The program simulates resource allocation to requesting processes and demonstrates deadlock avoidance with the Banker's algorithm. A menu controls the operations, and each choice calls the appropriate procedure, where the choices are:

- 1) Enter parameters
- 2) Run the Banker's algorithm to determine a safe sequence
- 3) Quit program and free memory

Assignment:

- The program uses a claim graph consisting of processes, multi-unit resources, request edges, allocation edges, and claim edges to represent the state of allocated resources to processes.
- The graph can be represented by a set of arrays/vectors:
 - **Resource vector:** an m -element vector, where m is the number of resources and each entry **resource** $[j]$ records the total number of units of resource j .
 - **Available vector:** an m -element vector, where m is the number of resources and each entry **available** $[j]$ records the number of units of resource j that are available.
 - **Max claims array:** an $n \times m$ -element array, where m is the number of resources and n is the number of processes, and each entry **maxclaim** $[i][j]$ contains an integer that records the maximum number of units of resource j that process i may ever request.
 - **Allocation array:** an $n \times m$ -element array, where m is the number of resources and n is the number of processes, and each entry **allocation** $[i][j]$ contains an integer that records the number of units of resource j that process i has actually been allocated.
 - **Need array:** an $n \times m$ array, where m is the number of resources and n is the number of processes, and each entry **need** $[i][j]$ contains an integer that records the number of units of resource j that process i may need in the future.

What NOT to do (any violation will result in an automatic score of 0 on the assignment):

- Do NOT modify the choice values (1,2,3) or input characters and then try to convert them to integers--the test script used for grading your assignment will not work correctly.
- Do NOT turn in an alternate version of the assignment downloaded from the Internet (coursehero, chegg, reddit, github, etc.) or submitted from you or another student from a previous semester.
- Do NOT turn in your assignment coded in another programming language (C++, C#, Java).

What to turn in:

- The source code as a C file uploaded to Canvas by the deadline of 11:59pm PST (-20% per consecutive day for late submissions, up to the 4th day—note 1 minute late counts as a day late, 1 day and 1 minute late counts as 2 days late, etc.)
- Make sure your code compiles with the online C compiler before submitting:
https://www.onlinegdb.com/online_c_compiler

Sample output

Banker's Algorithm

- 1) Enter parameters
- 2) Determine safe sequence
- 3) Quit program

Enter selection: 1

Enter number of processes: 5

Enter number of resources: 3

Enter number of units for resources (r0 to r2): 10 5 7

Enter maximum number of units process p0 will request from each resource (r0 to r2) 7 5 3

Enter maximum number of units process p1 will request from each resource (r0 to r2) 3 2 2

Enter maximum number of units process p2 will request from each resource (r0 to r2) 9 0 2

Enter maximum number of units process p3 will request from each resource (r0 to r2) 2 2 2

Enter maximum number of units process p4 will request from each resource (r0 to r2) 4 3 3

Enter number of units of each resource (r0 to r2) allocated to process p0: 0 1 0

Enter number of units of each resource (r0 to r2) allocated to process p1: 2 0 0

Enter number of units of each resource (r0 to r2) allocated to process p2: 3 0 2

Enter number of units of each resource (r0 to r2) allocated to process p3: 2 1 1

Enter number of units of each resource (r0 to r2) allocated to process p4: 0 0 2

	Units			Available		
	-----			-----		
r0	10			3		
r1	5			3		
r2	7			2		

	Max claim			Current			Potential		
	r0	r1	r2	r0	r1	r2	r0	r1	r2

p0	7	5	3	0	1	0	7	4	3
p1	3	2	2	2	0	0	1	2	2
p2	9	0	2	3	0	2	6	0	0
p3	2	2	2	2	1	1	0	1	1
p4	4	3	3	0	0	2	4	3	1

Banker's Algorithm

- 1) Enter parameters
- 2) Determine safe sequence
- 3) Quit program

Enter selection: 2

Checking: < 7 4 3 > <= < 3 3 2 > :p0 could not be sequenced

Checking: < 1 2 2 > <= < 3 3 2 > :p1 safely sequenced

Checking: < 6 0 0 > <= < 5 3 2 > :p2 could not be sequenced

Checking: < 0 1 1 > <= < 5 3 2 > :p3 safely sequenced

Checking: < 4 3 1 > <= < 7 4 3 > :p4 safely sequenced

Checking: < 7 4 3 > <= < 7 4 5 > :p0 safely sequenced

Checking: < 6 0 0 > <= < 7 5 5 > :p2 safely sequenced

Deadlock reached!

Banker's Algorithm

- 1) Enter parameters
- 2) Determine safe sequence
- 3) Quit program

Enter selection: 3

Quitting program...