Project Two

CSCE 4600 – Operating Systems
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Report

Main Issue

The issue we are tackling in this project is the issue of deadlock detection. We are given a set of processes and resources, a resource vector, and an adjacency matrix. Using these parameters, we can build a resource allocation graph to analyze the state of these sets. The key to solving this kind of problem is knot detection, as we are told we can assume the system is expedient. Based on this assumption, we can acknowledge that if a deadlock is present in the system, it will be represented by a knot in the resource allocation graph.

This is the exact approach that we took in solving this problem. Since we could not search the hypothetical system for a deadlock, we decided to use the contrapositive to prove a deadlock-free system. We used a depth-first traversal to find all reachable nodes for each starting process, then checked if any of the nodes did not reach all other nodes. If we found a case in which a node could not reach all other nodes, then we have by definition found a sink, as well as guaranteed the lack of a knot, proving our contrapositive.

Results

We used three different test cases in our testing, one of which is deadlock free and the other two containing deadlocks. We chose this variety to ensure that our system was robust enough to detect deadlocks in different situations. We chose an adjacency graph in test 1 that contained an unequal number of processes and resources, to test the program for resiliency in this type of inputs. In test 2 we chose one that we knew would deadlock to make sure the system would recognize, and in test 3 we chose a graph that didn't contain a knot, so we would know the system could recognize a deadlock free system.

Test 1
Adjacency matrix:

1	0	0	0	0	1
0	1	1	1	0	0
1	0	1	0	0	0
0	0	0	1	0	0
0	0	0	0	1	0
0	0	0	0	0	1

Result: no knot detected; graph is deadlock free.

Test 2
Adjacency matrix:

$$
\left[
\begin{array}{ccc|ccc}
1 & 0 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 1 & 0 & 1 \\
\hline
0 & 1 & 0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 & 1 & 0 \\
1 & 0 & 0 & 0 & 0 & 1 \\
\end{array}
\right]
$$

Result: knot detected, deadlock in graph.

Test 3
Adjacency matrix:

$$
\left[
\begin{array}{ccc|ccc}
1 & 0 & 0 & 0 & 1 & 0 \\
0 & 1 & 0 & 1 & 0 & 1 \\
0 & 0 & 1 & 0 & 0 & 0 \\
\hline
1 & 0 & 1 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 0 & 1 \\
\end{array}
\right]
$$

Result: no knot detected; graph is deadlock free.

References

Silberschatz, A., Galvin, P. B., & Gagne, G. (2012). *Operating system concepts essentials*. Hoboken, NJ: Wiley.