# CIS*3110 Operating Systems

# Assignment 4

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## Question 1

The program contains two threads which request for a semaphore to access the variable *cnt*. Once the value has been incremented the resource is released. Each thread requests for only one resource, the counter semaphore, and request no additional resources. This means that the hold and wait condition required for a deadlock to arise is not satisfied. Thus, it is not possible for the program to encounter a deadlock. This can also be observed from the resource allocation graph present in Figure 1. The resource allocation graph contains no cycles indicating that no deadlocks are possible.

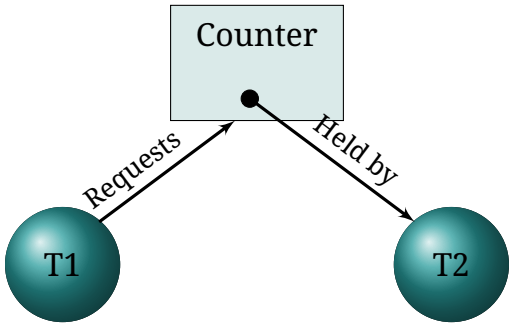


Figure 1: Resource allocation graph for program igoodcnt.c

# Question 2

| | Allocation | Max | Available |
|---|---|---|---|
| | *A B C D* | *A B C D* | *A B C D* |
| $P_0$ | 0 0 1 2 | 0 0 1 2 | 1 5 2 0 |
| $P_1$ | 1 0 0 0 | 1 7 5 0 | |
| $P_2$ | 1 3 5 4 | 2 3 5 6 | |
| $P_3$ | 0 6 3 2 | 0 6 5 2 | |
| $P_4$ | 0 0 1 4 | 0 6 5 6 | |

Figure 2: Snapshot of a system.

The content of the matrix ***Need*** is shown below. It is obtained by calculating ***Max*** - ***Allocation***.

| Process | Need |
|---|---|
| - | *A B C D* |
| $p_0$ | 0 0 0 0 |
| $p_1$ | 0 7 5 0 |
| $p_2$ | 1 0 0 2 |
| $p_3$ | 0 0 2 0 |
| $p_4$ | 0 6 4 2 |

The system is in a safe state and can be verified using the safety criteria for in the Banker's algorithm. Initially the Work vector is <1, 5, 2, 0>. This allows either $p_0$ or $p_3$ to satisfy the condition $Need_i \leq Work$. Using $p_3$ as the first process to satisfy the condition, the Work vector becomes <1, 11, 5, 2>. The new Work vector satisfies the needs of all the other processes, making the system safe.