Assignment 3: Semaphores

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1 Precedence to Implementation

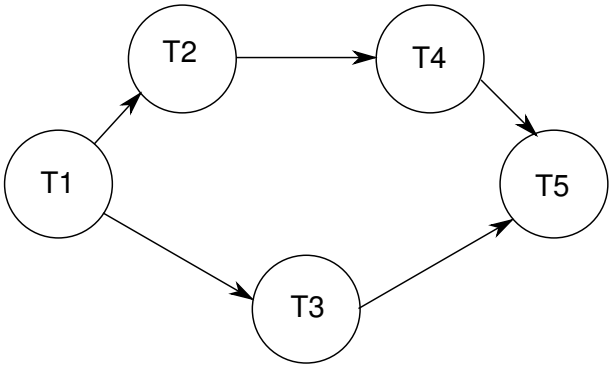
1.1 Background

This task is taken from *Foundations of Multithreaded, Parallel, and Distributed Programming* [1].

1.2 Task

A precedence graph is a DAG. Nodes represent tasks and edges indicate the order in which tasks are to be completed. In particular, a task can execute as soon as all of its predecessors have been completed.

1. Given the following precedence graph,



   give an implementation in Java that satisfies the order restrictions, using a minimum of semaphores.

2. Devise a general scheme that given any DAG, can assign semaphores to edges or processes. Do not worry about minimizing the number of semaphores, as this is an NP-hard problem (for an arbitrary DAG).

2 Interleaving with Semaphores

2.1 Background

This task is also taken from *Foundations of Multithreaded, Parallel, and Distributed Programming* [1].

2.2 Task

Given the following processes and code, give the possible outputs of the interleavings:

s.count := 0 r.count := 1 x := 0		
P_1	P_2	P_3
s.down	r.down	r.down
r.down	x := x * (x + 1)	x := x + 2
x := x * 2	r.up	r.up
r.up	s.up	

3 Unisex bathroom

3.1 Background

This task has been adapted from *Foundations of Multithreaded, Parallel, and Distributed Programming* [1]. In an office there is a unisex bathroom with n toilets. The bathroom is open to both men and women, but it cannot be used by men and women at the same time.

3.2 Task

1. Develop a Java program that simulates the above scenario using semaphores from the Java concurrency library. Your solution should be deadlock free, but it does not have to be starvation free.

2. Justify why your solution is deadlock free.

References

[1] Gregory R. Andrews. Foundations of Multithreaded, Parallel, and Distributed Programming. Addison Wesley, 1999.