# Assignment 3: Semaphores

### ETH Zurich

## 1 Precedence to Implementation

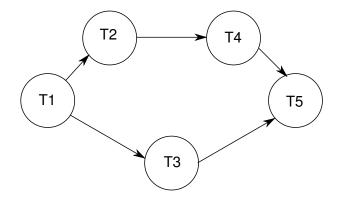
### 1.1 Background

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].

#### 2.2Task

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

s.count := 0r.count := 1Δ

$\mathbf{x} := 0$		
$P_1$	$P_2$	$P_3$
s.down	r.down	r.down
r.down	x := x * (x + 1)	x := x + 2
$\mathbf{x} := \mathbf{x} * 2$	r.up	r.up
r.up	s.up	

#### 3 Unisex bathroom

#### 3.1Background

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.

#### 3.2Task

- 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.