Concurrency theory	
Exercise sheet 7	TU Braunschweig
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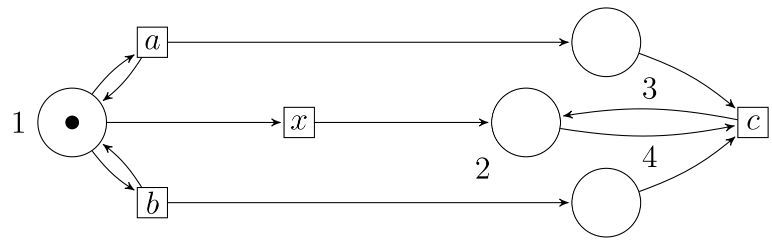
Out: December 12 Due: December 19

Submit your solutions until Wednesday, December 19, 12:00 am. You may submit in groups up to three persons.

Exercise 1: Rackoff's bound

Consider the Petri net $N = (\{1,2,3,4\}, \{a,b,c,x\}, \mathfrak{i}, \mathfrak{o})$ with multiplicities as depicted below. The initial marking of interest is $M_0 = (1,0,0,0)^T$ and the final marking is $M_f = (1,0,10,100)^T$.



Compute the values $m(3, M_0)$ and $f(3)$ and argue why they are correct.

Exercise 2: Counter programs

You may use additional counter variables to solve these problems. In each part of this exercise, you may use the previous parts as subroutines.

Let n be some fixed number.

a) Present a counter program $\texttt{Set}_n(x_j)$ that sets the value of counter variable x_j to n.

b) Present a counter program $\texttt{Double}(x_j)$ that doubles the current value of counter variable x_j.

c) Present a counter program $\texttt{Power}_n(x_j)$ that sets the value of counter variable x_j to 2^n.

d) Present a counter program $\texttt{Square}(x_j)$ that squares the value of counter variable x_j, i.e. the new value is v^2, where v is the old value.

In each part of this exercise, argue briefly that your program is correct.

Exercise 3: Communication-free Petri nets and SAT

A **communication-free Petri net** (or **BPP net**) is a Petri net in which each transition consumes at most one token, i.e. we have $\forall t \in T\colon \sum_{p \in P} \mathfrak{i}(t,p) \in \{0,1\}$.

Show that the coverability problem for communication-free Petri nets is NP-hard by reducing SAT. To this end, show how to construct in polynomial time from a given Boolean formula φ in conjunctive normal form communication-free Petri net (N, M_0, M_f) such that M_f is coverable if and only if φ is satisfiable.