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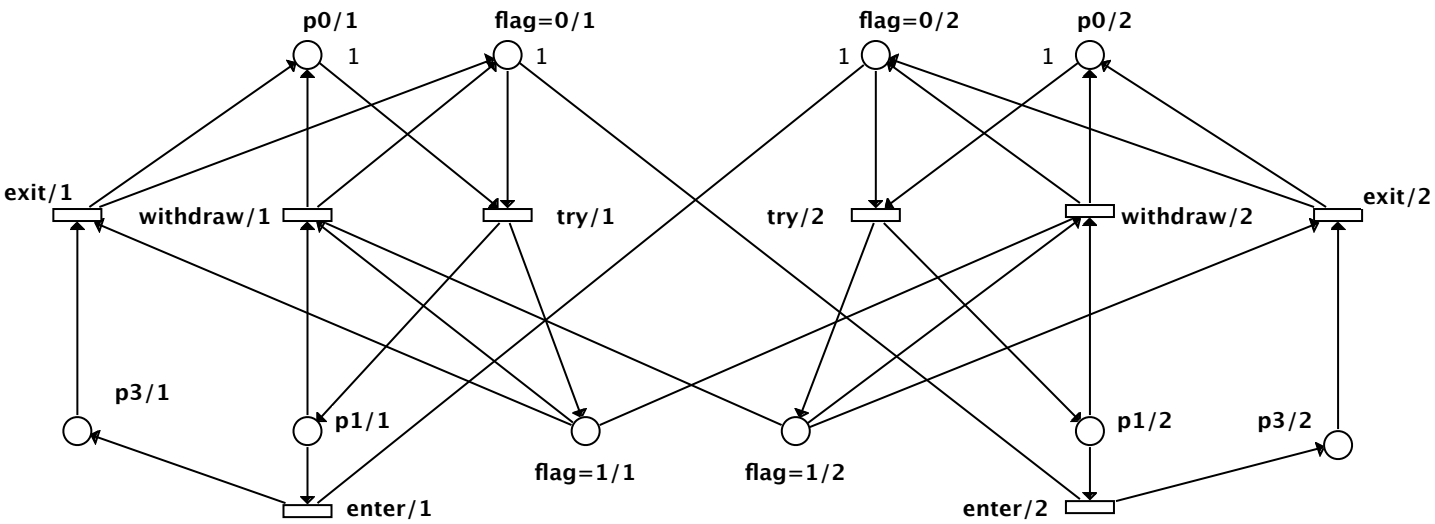
This form is a summary description of the model entitled "A variant of Dekker's algorithm for mutual exclusion" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.

Description

A Place-Transition net representing a variant of the Dekker's mutual exclusion algorithm for $N > 2$ processes. Each process has three states, **p0**, **p1**, and **p3**. **p0** is initial. From there, the process executes **try** and raises its **flag**, reaching **p1**. In **p1**, if at least one of the other process has a high **flag**, it **withdraw**s its intent and goes back to **p0**. In **p1**, it **enter**s the critical section if all other process' **flag** is zero. From **p3**, the process can only **exit** the critical section.



Graphical representation for $N = 2$

References

https://code.google.com/p/cunf/source/browse/tools/mkdekker.py

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	Number of processes	10, 15, 20, 50, 100, 200

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Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
N	$5N$	$N^2 + 2N$	$O(N^2)$
$N = 10$	50	120	820
$N = 15$	75	255	1830
$N = 20$	100	440	3240
$N = 50$	250	2600	20100
$N = 100$	500	10200	80200
$N = 200$	1000	40400	320400

Structural properties

free choice — *all (different) transitions with a shared input place have no other input place* ✗ [a]
state machine — *every transition has exactly one input place and exactly one output place* ✗ [b]
marked graph — *every place has exactly one input transition and exactly one output transition* ✗ [c]
connected — *there is a undirected path between every two nodes (places or transitions)* ✓ [d]
strongly connected — *there is a directed path between every two nodes (places or transitions)* ✓ [e]
source place(s) — *one or more places have no input transitions* ✗ [f]
sink place(s) — *one or more places have no output transitions* ✗ [g]
source transition(s) — *one or more transitions have no input places* ✗ [h]
sink transitions(s) — *one or more transitions have no output places* ✗ [i]
loop-free — *no transition has an input place that is also an output place* ✗ [j]
conservative — *for each transition, the number of input arcs equals the number of output arcs* ✓ [k]
subconservative — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ✓ [l]

Behavioural properties

safe — *in every reachable marking, there is no more than one token on a place* ✓ [m]
deadlock — *there exists a reachable marking from which no transition can be fired* ✗ [n]
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ✓
quasi-live — *for every transition t, there exists a reachable marking in which t can fire* ? [o]
live — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* ?

[a] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[b] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[c] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[d] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[e] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[f] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[g] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[h] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[i] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[j] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[k] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[l] stated by CÆSAR.BDD version 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[m] stated by CÆSAR.BDD version 2.0 to be true on 3 instance(s) out of 6, and unknown on the remaining 3 instance(s).
[n] stated by CÆSAR.BDD version 2.0 to be false on 3 instance(s) out of 6, and unknown on the remaining 3 instance(s).
[o] stated by CÆSAR.BDD version 2.0 to be true on 3 instance(s) out of 6, and unknown on the remaining 3 instance(s).

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Size of the marking graphs

Parameter	Number of reachable markings	Number of transition firings	Max. number of tokens per place	Max. number of tokens per marking
$N = 10$	6 144 [p]	?	1	$\in [20, 50]$ [q]
$N = 15$	278 528 [r]	?	1	$\in [30, 75]$
$N = 20$	1.153×10^7 [s]	?	1	$\in [40, 100]$
$N = 50$	?	?	?	≥ 100 [t]
$N = 100$	?	?	?	≥ 200
$N = 200$	?	?	?	≥ 400

Other properties

Mutual exclusion is guaranted: no reachable marking covers any two places `p3/i`, `p3/j` with $i \neq j$ and $i, j \in \{1, \ldots, N\}$. Unfair runs are however possible.

[p] computed by ITS-Tools, marcie, neco, and pnxdd at MCC'2013; confirmed by CÆSAR.BDD version 1.8.
[q] lower and upper bounds given by the number of initial tokens and the number of places.
[r] computed by ITS-Tools, marcie, neco, and pnxdd at MCC'2013; confirmed by CÆSAR.BDD version 1.8.
[s] computed by marcie, neco, and pnxdd at MCC'2013; confirmed by CÆSAR.BDD version 1.8.
[t] lower bound given by the number of initial tokens.