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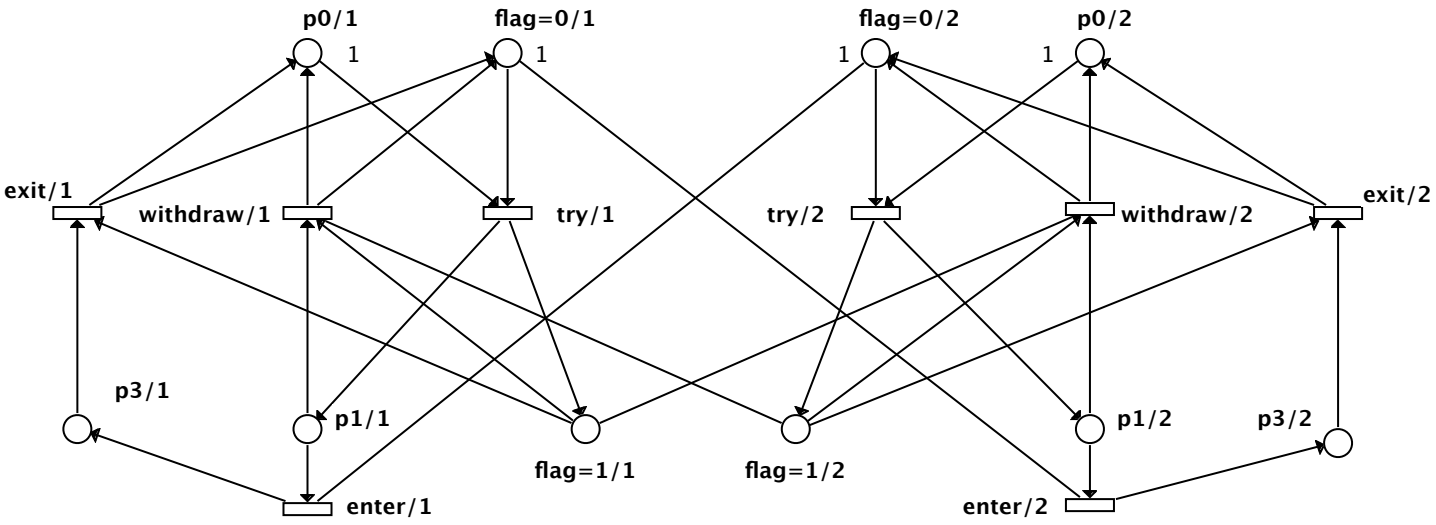
This form is a summary description of the model entitled "A variant of Dekker's algorithm for mutual exclusion" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, 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

ordinary — *all arcs have multiplicity one* ..... ✔
simple free choice — *all transitions sharing a common input place have no other input place* ..... ✘ [(a)]
extended free choice — *all transitions sharing a common input place have the same input places* ..... ✘ [(b)]
state machine — *every transition has exactly one input place and exactly one output place* ..... ✘ [(c)]
marked graph — *every place has exactly one input transition and exactly one output transition* ..... ✘ [(d)]
connected — *there is an undirected path between every two nodes (places or transitions)* ..... ✔ [(e)]
strongly connected — *there is a directed path between every two nodes (places or transitions)* ..... ✔ [(f)]
source place(s) — *one or more places have no input transitions* ..... ✘ [(g)]
sink place(s) — *one or more places have no output transitions* ..... ✘ [(h)]
source transition(s) — *one or more transitions have no input places* ..... ✘ [(i)]
sink transitions(s) — *one or more transitions have no output places* ..... ✘ [(j)]
loop-free — *no transition has an input place that is also an output place* ..... ✘ [(k)]
conservative — *for each transition, the number of input arcs equals the number of output arcs* ..... ✔ [(l)]
subconservative — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ..... ✔ [(m)]
nested units — *places are structured into hierarchically nested sequential units* [(n)] ..... ✘

Behavioural properties

safe — *in every reachable marking, there is no more than one token on a place* ..... ✔ [(o)]
deadlock — *there exists a reachable marking from which no transition can be fired* ..... ✘ [(p)]
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* ..... ? [(q)]
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)] transitions "enter_2" and "try_0" share a common input place "flag_0_0", but only the former transition has input place "flag_0_1".
[(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 1.7 on all 6 instances (10, 15, 20, 50, 100, and 200).
[(n)] the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
[(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).
[(p)] 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); confirmed at MCC'2014 by Tapaal, GreatSPN, and Lola on the 2, 3, and 4 smallest instances, respectively.
[(q)] 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
$N = 10$	6144 [r]	171 530 [s]	1 [t]	20 [u]
$N = 15$	278 528 [v]	1.6835E+7 [w]	1 [x]	30 [y]
$N = 20$	1.1534E+7 [z]	1.2164E+9 [aa]	1 [ab]	40 [ac]
$N = 50$	2.9273E+16 [ad]	?	1 [ae]	100 [af]
$N = 100$	6.4650E+31 [ag]	?	1 [ah]	200 [ai]
$N = 200$	1.6230E+62 [aj]	?	1 [ak]	400 [al]

Other properties

Mutual exclusion is guaranteed: 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.

[r] computed at MCC'2013 by ITS-Tools, Marcie, Neco, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.
[s] computed at MCC'2014 by Marcie.
[t] confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
[u] number of initial tokens, because the net is conservative.
[v] computed at MCC'2013 by ITS-Tools, Marcie, Neco, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.
[w] computed at MCC'2014 by Marcie.
[x] confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
[y] number of initial tokens, because the net is conservative.
[z] computed at MCC'2013 by Marcie, Neco, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and PNXDD.
[aa] computed at MCC'2014 by Marcie.
[ab] confirmed at MCC'2014 by GreatSPN, Marcie, and PNMC.
[ac] number of initial tokens, because the net is conservative.
[ad] computed at MCC'2014 by PNMC.
[ae] computed at MCC'2014 by PNMC.
[af] number of initial tokens, because the net is conservative.
[ag] computed at MCC'2014 by PNMC.
[ah] computed at MCC'2014 by PNMC.
[ai] number of initial tokens, because the net is conservative.
[aj] computed at MCC'2014 by PNMC.
[ak] computed at MCC'2014 by PNMC.
[al] number of initial tokens, because the net is conservative.