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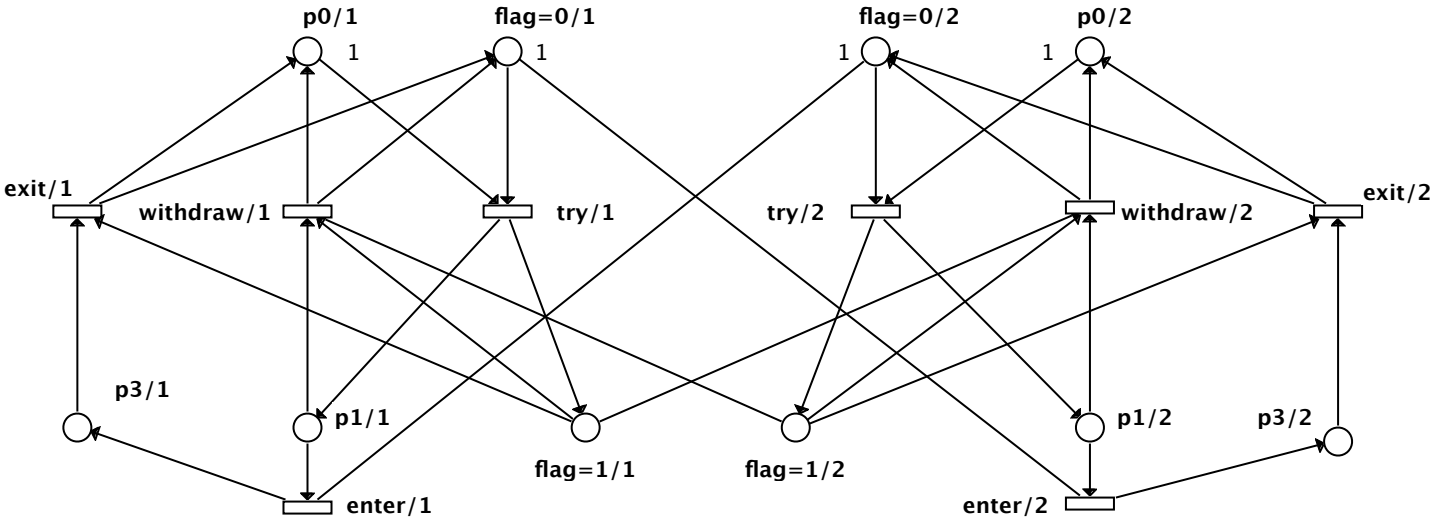
This form is a summary description of the model entitled "A variant of Dekker's algorithm for mutual exclusion" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent,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

In March 2020, Pierre Bouvier and Hubert Garavel provided a decomposition of all instances of this model into networks of communicating automata. Each network is expressed as a Nested-Unit Petri Net (NUPN) that can be found, for each instance, in the "toolspecific" section of the corresponding PNML file.



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	Number of units	HWB code
N	$5N$	$N^2 + 2N$	$O(N^2)$	?	1–?–?
$N = 10$	50	120	820	23	1–22–35
$N = 15$	75	255	1830	32	1–31–49
$N = 20$	100	440	3240	42	1–41–65
$N = 50$	250	2600	20100	102	1–101–156
$N = 100$	500	10200	80200	203	1–202–308
$N = 200$	1000	40400	320400	402	1–401–608

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)
dead place(s) — *one or more places have no token in any reachable marking* ..... ✘ (p)
dead transition(s) — *one or more transitions cannot fire from any reachable marking* ..... ? (q)
deadlock — *there exists a reachable marking from which no transition can be fired* ..... ✘ (r)
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ..... ✔

(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 3.3 on all 6 instances (10, 15, 20, 50, 100, and 200).
(p) stated by CÆSAR.BDD version 3.3 on all 6 instances (10, 15, 20, 50, 100, and 200).
(q) stated by CÆSAR.BDD version 3.3 to be false on 4 instance(s) out of 6, and unknown on the remaining 2 instance(s).
(r) stated by CÆSAR.BDD version 2.0 to be false on 4 instance(s) out of 6, and unknown on the remaining 4 instance(s); confirmed at MCC'2014 by Tapaal, GreatSPN, and Lola on the 2, 3, and 4 smallest instances, respectively.

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live — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* ..... ?

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 [s]	171 530 [t]	1 [u]	20 [v]
$N = 15$	278 528 [w]	1.6835E+7 [x]	1 [y]	30 [z]
$N = 20$	1.1534E+7 [aa]	1.2164E+9 [ab]	1 [ac]	40 [ad]
$N = 50$	2.9273E+16 [ae]	?	1 [af]	100 [ag]
$N = 100$	6.4650E+31 [ah]	?	1 [ai]	200 [aj]
$N = 200$	1.6230E+62 [ak]	?	1 [al]	400 [am]

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.

[s] 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.
[t] computed at MCC'2014 by Marcie.
[u] confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
[v] number of initial tokens, because the net is conservative.
[w] 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.
[x] computed at MCC'2014 by Marcie.
[y] confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
[z] number of initial tokens, because the net is conservative.
[aa] 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.
[ab] computed at MCC'2014 by Marcie.
[ac] confirmed at MCC'2014 by GreatSPN, Marcie, and PNMC.
[ad] number of initial tokens, because the net is conservative.
[ae] computed at MCC'2014 by PNMC; confirmed by CÆSAR.BDD version 3.3.
[af] computed at MCC'2014 by PNMC.
[ag] number of initial tokens, because the net is conservative.
[ah] computed at MCC'2014 by PNMC.
[ai] computed at MCC'2014 by PNMC.
[aj] number of initial tokens, because the net is conservative.
[ak] computed at MCC'2014 by PNMC.
[al] computed at MCC'2014 by PNMC.
[am] number of initial tokens, because the net is conservative.