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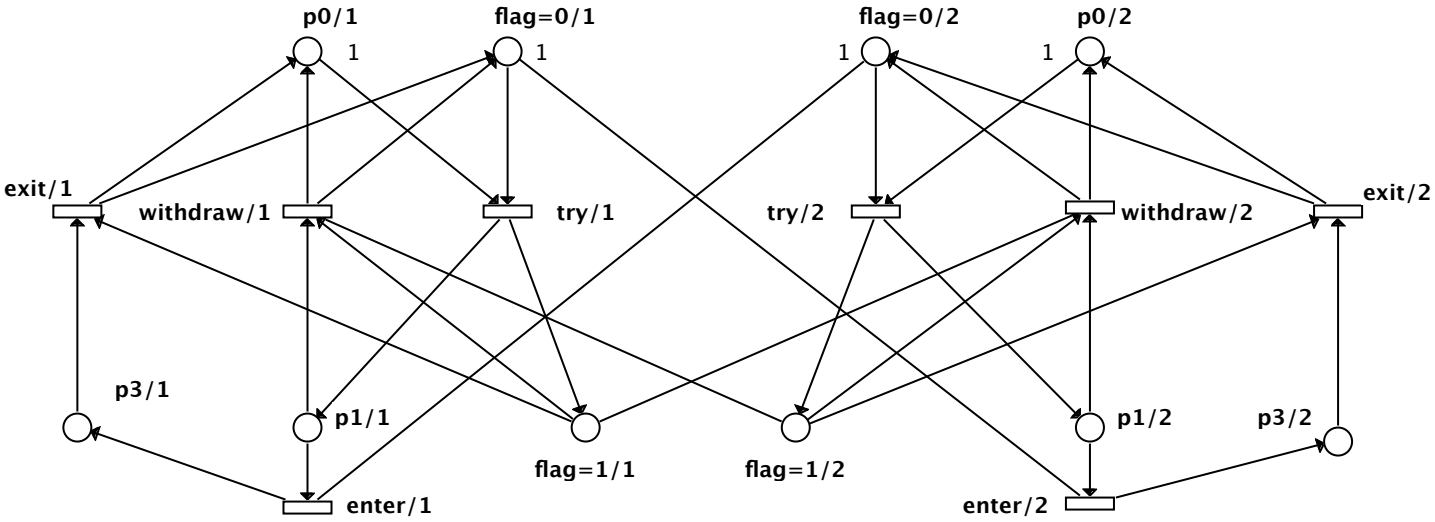
This form is a summary description of the model entitled "A variant of Dekker's algorithm for mutual exclusion" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent,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