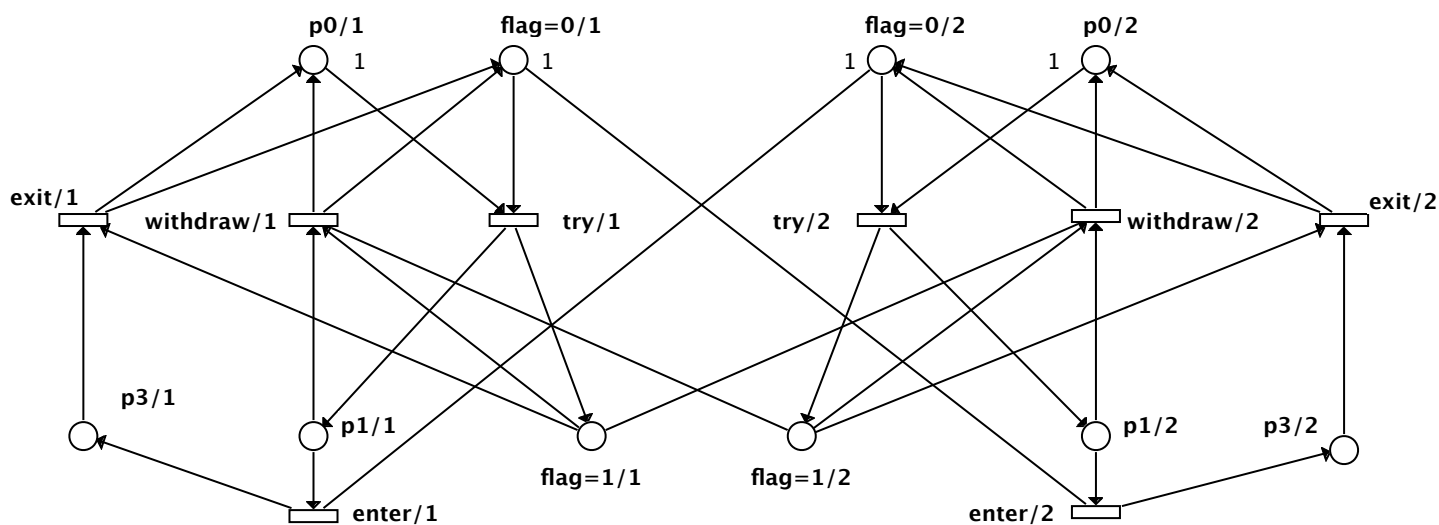


This form is a summary description of the model entitled "A variant of Dekker's algorithm for mutual exclusion" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, 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 **withdraws** its intent and goes back to **p0**. In **p1**, it **enters** 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

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).

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 $i, j \in \{1, \dots, N\}$.
 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.