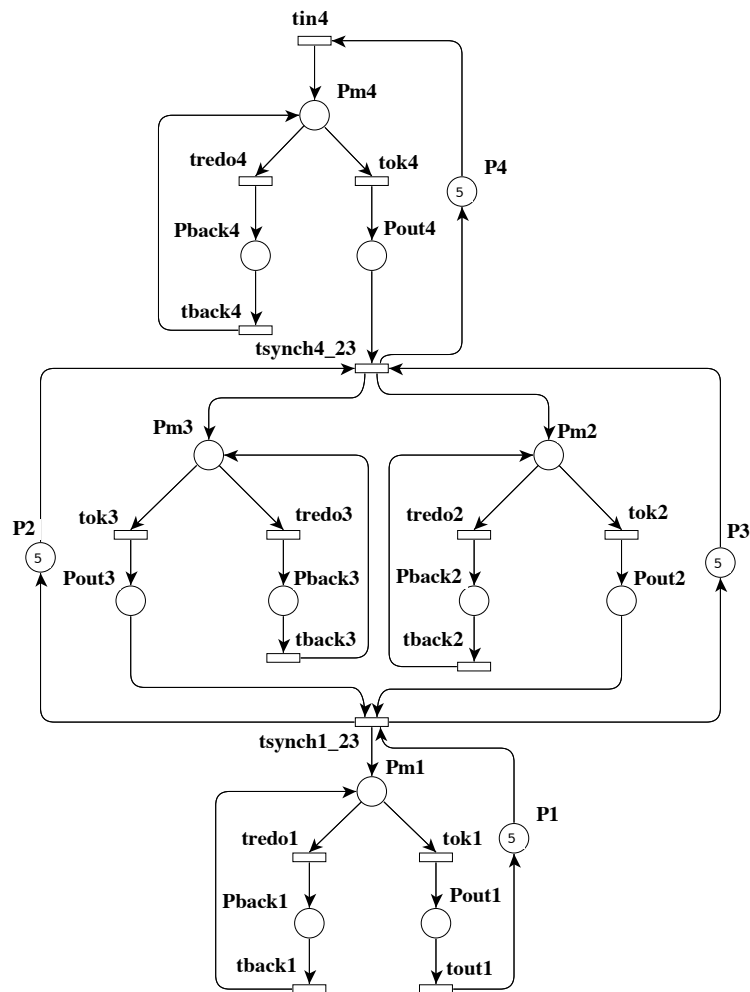


This form is a summary description of the model entitled “Kanban” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.

Description

This Petri net is extracted a benchmark used for SMART. It models a Kanban system.

The five largest instances have been added in 2019.



Graphical representation for $N = 5$

References

<http://www.cs.ucr.edu/~ciardo/SMART/>

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	The scale factor is a value N that determines the initial marking of the places P_1 , P_2 , P_3 , and P_4 ($M(P_1) = M(P_2) = M(P_3) = M(P_4) = N$)	5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000

Size of the model

Although the model is parameterized, its size does not depend on parameter values.

number of places: 16
 number of transitions: 16
 number of arcs: 40

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)

(a) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (b) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (c) 2 transitions are not of a state machine, e.g., transition “tsynch1.23”.
 (d) 4 places are not of a marked graph, e.g., place “Pm3”.
 (e) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (f) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (g) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (h) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (i) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (j) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (k) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (l) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (m) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (n) the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>
 (o) in the initial marking, some places have several tokens (the number of which depends on N); confirmed by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (p) stated by [CÆSAR.BDD](#) version 3.3 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
 (q) stated by [CÆSAR.BDD](#) version 2.8 on all 13 instances (5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

deadlock — there exists a reachable marking from which no transition can be fired $\times^{(r)}$
reversible — from every reachable marking, there is a transition path going back to the initial marking ?
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
$N = 5$	$2.5464E+6^{(s)}$	$2.4460E+7^{(t)}$	$5^{(u)}$	$20^{(v)}$
$N = 10$	$1.006E+9^{(w)}$	$1.2032E+10^{(x)}$	$10^{(y)}$	$40^{(z)}$
$N = 20$	$8.0542E+11^{(aa)}$	$1.1012E+13^{(ab)}$	$20^{(ac)}$	$80^{(ad)}$
$N = 50$	$1.0426E+16^{(ae)}$	$1.5612E+17^{(af)}$	$50^{(ag)}$	$200^{(ah)}$
$N = 100$	$1.7263E+19^{(ai)}$	$2.6705E+20^{(aj)}$	$100^{(ak)}$	$400^{(al)}$
$N = 200$	$3.1732E+22^{(am)}$; confirmed at MCC'2014 by GreatSPN and PNMC	?	$200^{(an)}$	$800^{(ao)}$
$N = 500$	$7.0860E+26^{(ap)}$?	$500^{(aq)}$	$2000^{(ar)}$
$N = 1000$?	?	?	$4000^{(as)}$
$N = 2000$?	?	?	$8000^{(at)}$
$N = 5000$?	?	?	$20000^{(au)}$
$N = 10000$?	?	?	$40000^{(av)}$
$N = 20000$?	?	?	$80000^{(aw)}$
$N = 50000$?	?	?	$200000^{(ax)}$

^(r) confirmed at MCC'2014 by GreatSPN on 6 instances, by Lola on 4 instances, and by Tapaal on 3 instances.
^(s) computed at MCC'2013 by Alpina, GreatSPN, ITS-Tools, Marcie, Neco, and PNXDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.
^(t) computed at MCC'2014 by Marcie.
^(u) computed 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 Alpina, GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.
^(x) computed at MCC'2014 by Marcie.
^(y) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(z) number of initial tokens, because the net is conservative.
^(aa) computed at MCC'2013 by GreatSPN, ITS-Tools, Marcie, and PNXDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.
^(ab) computed at MCC'2014 by Marcie.
^(ac) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ad) number of initial tokens, because the net is conservative.
^(ae) computed at MCC'2013 by GreatSPN, ITS-Tools, and Marcie; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Stratagem.
^(af) computed at MCC'2014 by Marcie.
^(ag) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ah) number of initial tokens, because the net is conservative.
^(ai) computed at MCC'2013 by GreatSPN, ITS-Tools, and Marcie; computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(aj) computed at MCC'2014 by Marcie.
^(ak) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(al) number of initial tokens, because the net is conservative.
^(am) computed at MCC'2013 by ITS-Tools.
^(an) computed at MCC'2014 by GreatSPN and Marcie.
^(ao) number of initial tokens, because the net is conservative.
^(ap) computed at MCC'2014 by PNMC.
^(aq) computed at MCC'2014 by PNMC.
^(ar) number of initial tokens, because the net is conservative.
^(as) number of initial tokens, because the net is conservative.
^(at) number of initial tokens, because the net is conservative.
^(au) number of initial tokens, because the net is conservative.
^(av) number of initial tokens, because the net is conservative.
^(aw) number of initial tokens, because the net is conservative.
^(ax) number of initial tokens, because the net is conservative.

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