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This form is a summary description of the model entitled "Parking" 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 collection of P/T nets was derived from the formal specification of a car parking control system. The parking lot is divided into several areas. The accesses to each area are controlled by a set of PLCs (*Programmable Logic Controllers*), which monitor the availability in real-time, and direct cars entering the parking to the area with the highest availability if the requested area is fully occupied. For each area, there is one *master* PLC that supervises several so-called *slave* PLCs. The PLCs communicate via a MODBUS network and the whole system can be considered as a GALS (*Globally Asynchronous, Locally Synchronous*) system.

The parking system was formally described in GRL, a specification language dedicated to PLCs and GALS. Each GRL specification was automatically translated to LNT (*LOTOS New Technology*), then to LOTOS, and then to an interpreted Petri net using the CADP toolbox. Finally, a P/T net was obtained by stripping out all dataflow-related information (variables, types, assignments, guards, etc.) from the interpreted Petri net, leading to a NUPN (*Nested-Unit Petri Net*) model translated to PNML using the CÆSAR.BDD tool.

References

Fatma Jebali, Frédéric Lang, and Radu Mateescu. *GRL: A Specification Language for Globally Asynchronous Locally Synchronous Systems.* Proceedings of the 16th International Conference on Formal Engineering Methods (ICFEM'2014), Luxembourg, November 3-5, 2014. LNCS 8829, Springer.

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
(M, S)	M: number of master PLCs, S: number of slave PLCs	$(1,4)$, $(2,8)$, $(4,16)$, $(8,32)$, $(4,32)$, $(8,64)$

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$(1,4)$	65	97	284	16	2–15–42
$(2,8)$	137	201	593	33	2–32–87
$(4,16)$	305	433	1289	73	2–72–193
$(4,32)$	529	785	2329	121	2–120–321
$(8,32)$	737	993	2993	177	2–176–449
$(8,64)$	1185	1697	5073	273	2–272–713

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]

[a] stated by CÆSAR.BDD version 2.2 on all the 6 instances.
[b] stated by CÆSAR.BDD version 2.6 on all 6 instances.

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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* ..... ✗ (s)
live — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* ..... ✗ (t)

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
$(1, 4)$	31745 (u)	?	1 (v)	15 (w)
$(2, 8)$	4.5676E+09 (x)	?	1 (y)	32 (z)
$(4, 16)$	8.44047E+21 (aa)	?	1 (ab)	72 (ac)
$(8, 32)$	$\geq$ 5.71544E+44 (ad)	?	1 (ae)	176 (af)
$(4, 32)$	3.67025E+32 (ag)	?	1 (ah)	120 (ai)
$(8, 64)$	$\geq$ 6.2771E+65 (aj)	?	1 (ak)	272 (al)

(c) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(d) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(e) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(f) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(g) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(h) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(i) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(j) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(k) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(l) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(m) stated by CÆSAR.BDD version 2.2 on all the 6 instances.
(n) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(o) safe by construction – stated by the CÆSAR compiler on all the 6 instances.
(p) stated by CÆSAR.BDD version 3.3 to be false on 3 instance(s) out of 6, and unknown on the remaining 3 instance(s).
(q) stated by CÆSAR.BDD version 2.2 to be false on 3 instances out of 6, and unknown on the remaining 3 instances.
(r) stated by CÆSAR.BDD version 2.2 to be true on 4 instances out of 6, and unknown on the remaining 2 instances.
(s) stated by CÆSAR.BDD version 2.2 to be false on 4 instances out of 6, and unknown on the remaining 2 instances.
(t) stated by CÆSAR.BDD version 2.2 to be false on 4 instances out of 6, and unknown on the remaining 2 instances.
(u) stated by CÆSAR.BDD version 2.2.
(v) stated by the CÆSAR compiler.
(w) stated by CÆSAR.BDD version 2.2.
(x) stated by CÆSAR.BDD version 2.2.
(y) stated by the CÆSAR compiler.
(z) stated by CÆSAR.BDD version 2.2.

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(aa) stated by CÆSAR.BDD version 2.2.
(ab) stated by the CÆSAR compiler.
(ac) stated by CÆSAR.BDD version 2.2.
(ad) stated by CÆSAR.BDD version 2.2.
(ae) stated by the CÆSAR compiler.
(af) stated by CÆSAR.BDD version 2.2.
(ag) stated by CÆSAR.BDD version 2.2.
(ah) stated by the CÆSAR compiler.
(ai) stated by CÆSAR.BDD version 2.2.
(aj) stated by CÆSAR.BDD version 3.3.
(ak) stated by the CÆSAR compiler.
(al) stated by CÆSAR.BDD version 3.3.