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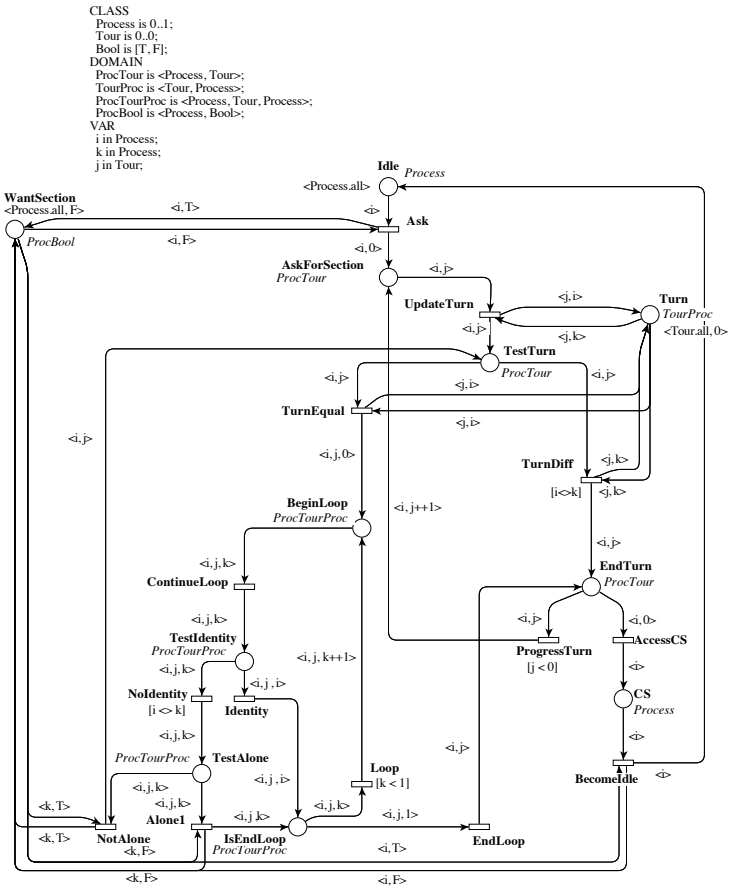
This form is a summary description of the model entitled "Peterson" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together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

Description

This is a model of the Peterson's algorithm for the mutual exclusion problem, in its generalized version for N processes. This algorithm is based on shared memory communication and uses a loop with N-1 iterations, each iteration is in charge of stopping one of the competing processes.

In March 2020, Pierre Bouvier and Hubert Garavel provided a decomposition of three 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. In April 2021, Pierre Bouvier decomposed all the remaining instances of this model.



Graphical representation for $N = 1$ (2 processes)

References

http://dblp.uni-trier.de/rec/bibtex/journals/ipl/Peterson81

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Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	N is the number of processes (numbered 0 to N). It has an impact on the initial marking of places Idle, Turn and WantSection. It has, also, an impact on the guards of transitions ProgressTurn and Loop. The color functions between EndTurn and AccessCS, as well as the one between IsEndLoop and EndLoop are impacted.	2, 3, 4, 5, 6, 7

Size of the colored net model

number of places: 11
number of transitions: 14
number of arcs: 42

Size of the derived P/T model instances

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$N = 2$	102	126	384	10	1–9–28
$N = 3$	244	332	1016	13	1–12–40
$N = 4$	480	690	2120	16	1–15–55
$N = 5$	834	1242	3828	19	1–18–73
$N = 6$	1330	2030	6272	23	1–22–91
$N = 7$	1992	3096	9584	26	1–25–105

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]

[a] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[b] stated by CÆSAR.BDD version 2.6 on all 6 instances (2, 3, 4, 5, 6, and 7).
[c] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[d] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[e] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[f] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[g] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[h] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[i] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[j] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[k] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
[l] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).

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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* ..... ✔
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
$N = 2$	20 754 (s)	62 262 (t)	1 (u)	8 (v)
$N = 3$	3.40795×10^6 (w)	1.363×10^7 (x)	1 (y)	11 (z)
$N = 4$	6.299×10^8 (aa)	?	1 (ab)	14 (ac)
$N = 5$	1.366×10^{11} (ad)	?	1 (ae)	17 (af)
$N = 6$	$\geq$ 4.3116e+08 (ag)	?	1 (ah)	20 (ai)
$N = 7$	$\geq$ 1.44298e+08 (aj)	?	1 (ak)	23 (al)

(m) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 6, and 7).
(n) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(o) stated by CÆSAR.BDD version 3.5 on all 6 instances (2, 3, 4, 5, 6, and 7).
(p) stated by CÆSAR.BDD version 3.3 to be false on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s).
(q) stated by CÆSAR.BDD version 3.3 to be false on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s).
(r) stated by CÆSAR.BDD version 3.3 to be false on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s); confirmed at MCC'2014 by Helena on 3 colored instances ($N = 2$, $N = 3$, and $N = 4$), and by GreatSPN, Lola, and/or Tapaal on the 3 corresponding P/T instances.
(s) computed at MCC'2013 by Alpina, ITS-Tools, Marcie, Neco, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal on the P/T net instance.
(t) computed at MCC'2014 by Helena on the colored net instance and by Marcie on the P/T net instance.
(u) confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal on the P/T net instance.
(v) number of initial tokens, because the net is conservative.
(w) computed at MCC'2013 by Alpina, ITS-Tools, Marcie, and PNXDD; confirmed by CÆSAR.BDD version 3.3; confirmed at MCC'2014 by Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, and PNXDD on the P/T net instance.
(x) computed at MCC'2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.
(y) computed at MCC'2014 by GreatSPN, Marcie, and PNMC on the P/T net instance.
(z) number of initial tokens, because the net is conservative.
(aa) computed at MCC'2013 by ITS-Tools, and PNXDD.
(ab) stated by CÆSAR.BDD version 3.3.
(ac) number of initial tokens, because the net is conservative.
(ad) computed at MCC'2013 by ITS-Tools.
(ae) the P/T instance is safe.
(af) number of initial tokens, because the net is conservative.
(ag) stated by CÆSAR.BDD version 3.5.
(ah) the P/T instance is safe.
(ai) number of initial tokens, because the net is conservative.
(aj) stated by CÆSAR.BDD version 3.5.
(ak) the P/T instance is safe.
(al) number of initial tokens, because the net is conservative.