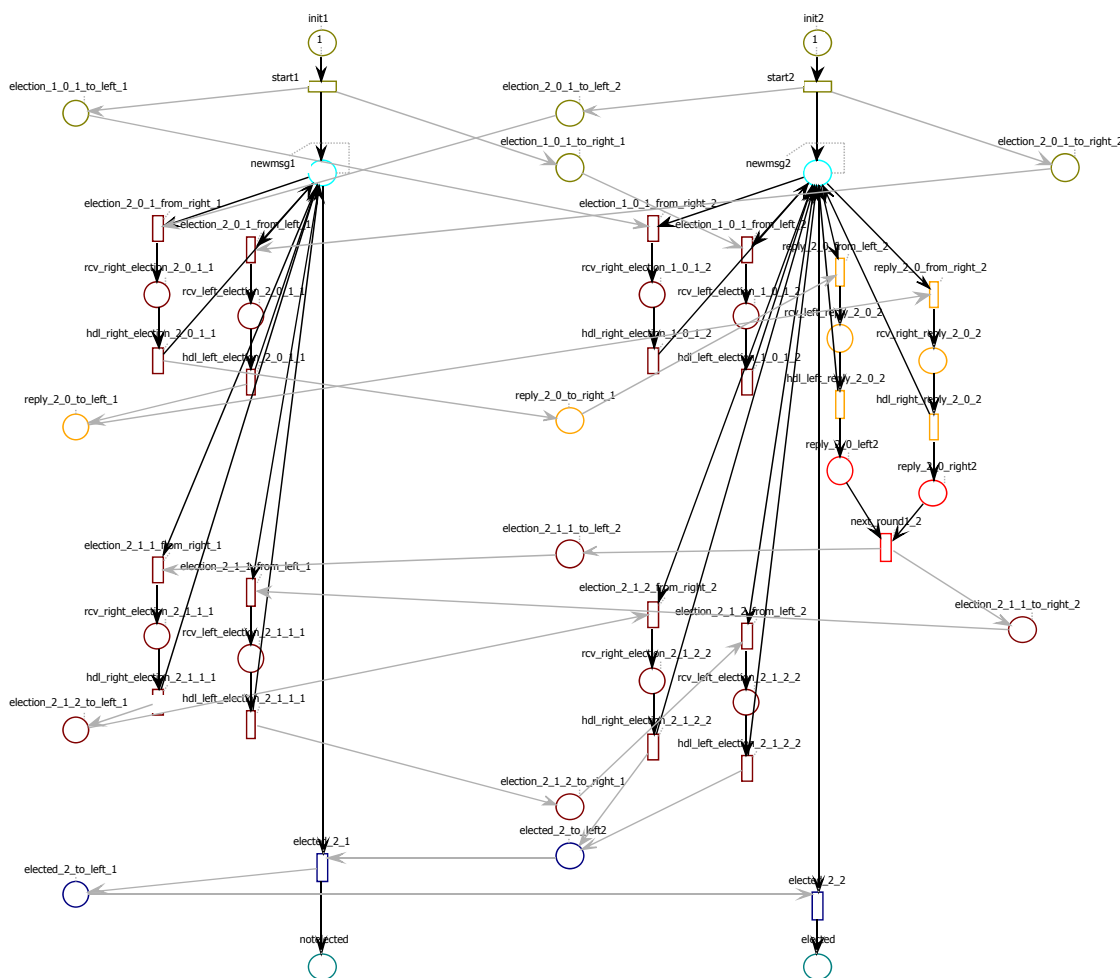


This form is a summary description of the model entitled “HirschbergSinclair” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given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

Description

This Petri net models a simplified version of the Hirschberg and Sinclair algorithm (leader election in a synchronous ring network). This was one of the Tra My Nguyen’s exercices during her bachelor.



Graphical representation for $n = 2$

References

Daniel S. Hirschberg, James B. Sinclair: Decentralized Extrema-Finding in Circular Configurations of Processors. Communications of the ACM 23(11): 627-628 (1980)

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
n	n is the number of processes in the ring	5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
5	124	111	340
10	260	236	721
15	330	296	906
20	530	485	1 479
25	600	545	1 664
30	670	605	1 849
35	998	922	2 806
40	1 068	982	2 991
45	1 138	1 042	3 176
50	1 208	1 102	3 361

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	✗
dead transition(s) — one or more transitions cannot fire from any reachable marking	✗
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	✗ (q)

(a) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(b) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(c) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(d) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(e) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(f) from place “init1” one cannot reach place “init2”.

(g) at least place “init1”; confirmed by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(h) at least place “notelected”; confirmed by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(i) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(j) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(k) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(l) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(m) stated by CÆSAR.BDD version 3.5 on all 10 instances (5, 10, 15, 20, 25, 30, 35, 40, 45, 50).

(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 to be false on 4 instance(s) out of 10, and unknown on the remaining 6 instance(s).

(p) Stated by PROD on March 2021.

(q) By construction, since the model ends.

live — for every transition t , from every reachable marking, one can reach a marking in which t can fire \times ^(r)

Size of the marking graphs

Parameter	Number of reach-able markings	Number of tran-sition firings	Max. number of tokens per place	Max. number of tokens per marking
5	$\geq 6.17794e+06$ ^(s)	?	?	≥ 15
10	$\geq 6.96577e+12$ ^(t)	?	?	≥ 30
15	$\geq 2.93539e+18$ ^(u)	?	?	≥ 45
20	$\geq 1.20319e+20$ ^(v)	?	?	≥ 60
25	?	?	?	≥ 75
30	?	?	?	≥ 90
35	?	?	?	≥ 105
40	?	?	?	≥ 120
45	?	?	?	≥ 135
50	?	?	?	≥ 150

^(r) Stated by PROD on March 2021.

^(s) stated by [CÆSAR.BDD](#) version 3.5.

^(t) stated by [CÆSAR.BDD](#) version 3.5.

^(u) stated by [CÆSAR.BDD](#) version 3.5.

^(v) stated by [CÆSAR.BDD](#) version 3.5.