Model: HirschbergSinclair
Type: P/T Net
Origin: Academic

since
MCC 2021

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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 alorithm (leader election in a synchronous ring network). This was one of the Tra My Nguyen's exercices during her bachelor.
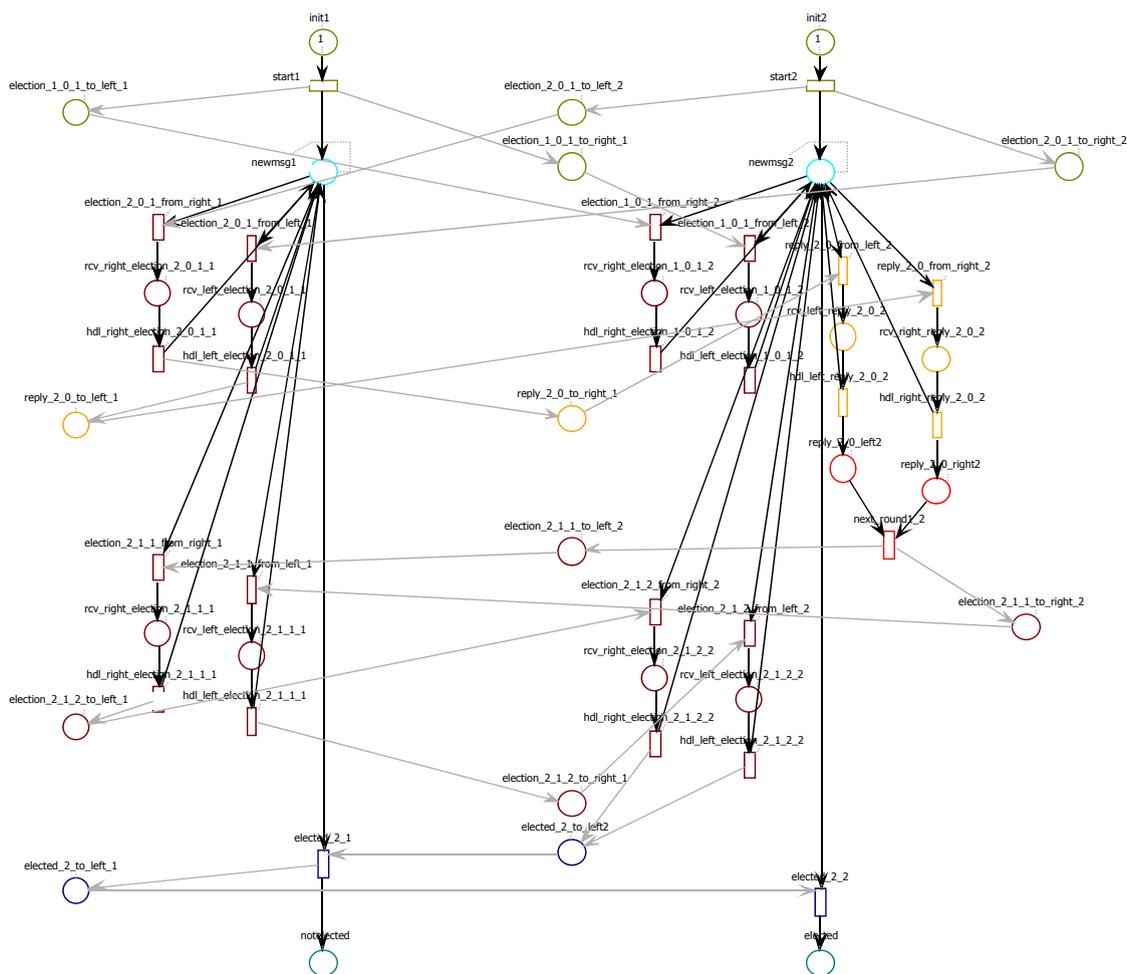
Graphical representation for n = 2

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

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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* .... yes

simple free choice — *all transitions sharing a common input place have no other input place* .... no [a]

extended free choice — *all transitions sharing a common input place have the same input places* .... no [b]

state machine — *every transition has exactly one input place and exactly one output place* .... no [c]

marked graph — *every place has exactly one input transition and exactly one output transition* .... no [d]

connected — *there is an undirected path between every two nodes (places or transitions)* .... yes [e]

strongly connected — *there is a directed path between every two nodes (places or transitions)* .... no [f]

source place(s) — *one or more places have no input transitions* .... yes [g]

sink place(s) — *one or more places have no output transitions* .... yes [h]

source transition(s) — *one or more transitions have no input places* .... no [i]

sink transitions(s) — *one or more transitions have no output places* .... no [j]

loop-free — *no transition has an input place that is also an output place* .... yes [k]

conservative — *for each transition, the number of input arcs equals the number of output arcs* .... no [l]

subconservative — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ...... no [m]

nested units — *places are structured into hierarchically nested sequential units* [n] .... no

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* .... no

dead transition(s) — *one or more transitions cannot fire from any reachable marking* .... no

deadlock — *there exists a reachable marking from which no transition can be fired* .... yes [p]

reversible — *from every reachable marking, there is a transition path going back to the initial marking* .... no [q]

live — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* .... no [r]

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[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.

[r] Stated by PROD on March 2021.

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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
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

[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.