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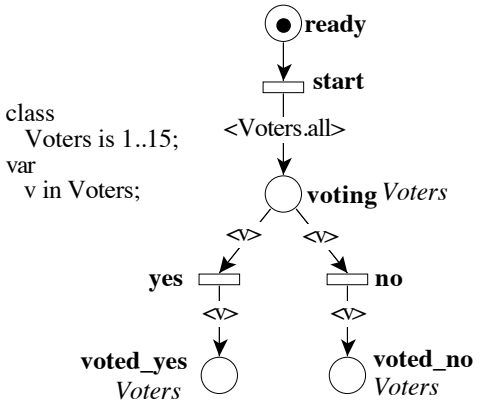
This form is a summary description of the model entitled "Referendum" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together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

Description

This simple Petri net models a referendum system where a population is asked to accept a given proposal by votin "yes" or "no". It was introduced in [1] as an example of combinatorial explosion that could be contained by using Symmetric Nets with Bags (SNB).

In March 2020, Pierre Bouvier and Hubert Garavel provided a decomposition of all 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.



Graphical representation of the Referendum model for V=15.

References

1 S. Haddad, F. Kordon, L. Petrucci, J-F. Pradat-Peyre, and N. Trèves. Efficient State-Based Analysis by Introducing Bags in Petri Net Color Domains. 28th American Control Conference (ACC), pages 5018-5025, Omnipress IEEE Catalog, June 2009

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
V	the maximum number of voters (in the color domain)	10, 15, 20, 50, 100, 200, 500, 1000

Size of the colored net model

number of places: 4
number of transitions: 3
number of arcs: 6

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Size of the derived P/T model instances

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$V = 10$	31	21	51	11	1–10–20
$V = 15$	46	31	76	16	1–15–30
$V = 20$	61	41	101	21	1–20–40
$V = 50$	151	101	251	51	1–50–100
$V = 100$	301	201	501	101	1–100–200
$V = 200$	601	401	1001	201	1–200–400
$V = 500$	1501	1001	2501	501	1–500–1000
$V = 1000$	3001	2001	5001	1001	1–1000–2000

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)
deadlock — *there exists a reachable marking from which no transition can be fired* ..... ✔ (r)

(a) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(b) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(c) transition "start_0" is not of a state machine.
(d) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(e) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(f) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(g) place "ready" is a source place.
(h) stated by CÆSAR.BDD version 3.3 on all 8 instances (see all aforementioned parameter values).
(i) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(j) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(k) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).
(l) transition "start_0" is not conservative.
(m) transition "start_0" is not subconservative.
(n) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(o) there is only one token of a given color at most in each colored place; stated by CÆSAR.BDD version 3.3 to be true on all 8 instances.
(p) stated by CÆSAR.BDD version 3.3 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).
(q) each transition is reachable from the initial state; stated by CÆSAR.BDD version 3.3 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).
(r) tokens accumulate in "vote_yes" or in "voted_no"; stated by CÆSAR.BDD version 2.7 to be true on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).

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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
$V = 10$	59 050 [u]	393 661 [v]	1	10
$V = 15$	14 348 908 [w]	143 489 071 [x]	1	15
$V = 20$	3.48678e+09 [y]	?	1	20
$V = 50$	7.17898e+23 [z]	?	1	50
$V = 100$	5.15378e+47 [aa]	?	1	100
$V = 200$	2.65614e+95 [ab]	?	1	200
$V = 500$	3.63603e+238 [ac]	?	1	500
$V = 1000$	?	?	1	1000

[s] the marking graph has deadlocks and contains more than one reachable marking; stated by CÆSAR.BDD version 2.7 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).
[t] the net has at least one transition and its marking graph has deadlocks; stated by CÆSAR.BDD version 2.7 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).
[u] computed by Prod in March 2017; confirmed by CÆSAR.BDD version 2.7.
[v] computed by Prod in March 2017.
[w] computed by Prod in March 2017; confirmed by CÆSAR.BDD version 2.7.
[x] computed by Prod in March 2017.
[y] stated by CÆSAR.BDD version 2.7.
[z] stated by CÆSAR.BDD version 2.7.
[aa] stated by CÆSAR.BDD version 2.7.
[ab] stated by CÆSAR.BDD version 3.3.
[ac] stated by CÆSAR.BDD version 3.3.