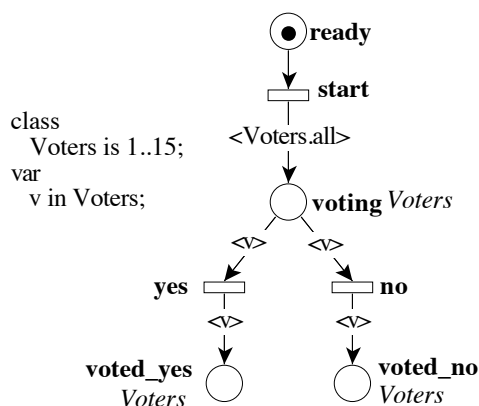


This form is a summary description of the model entitled “Referendum” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together 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 Bowier 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

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).

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.