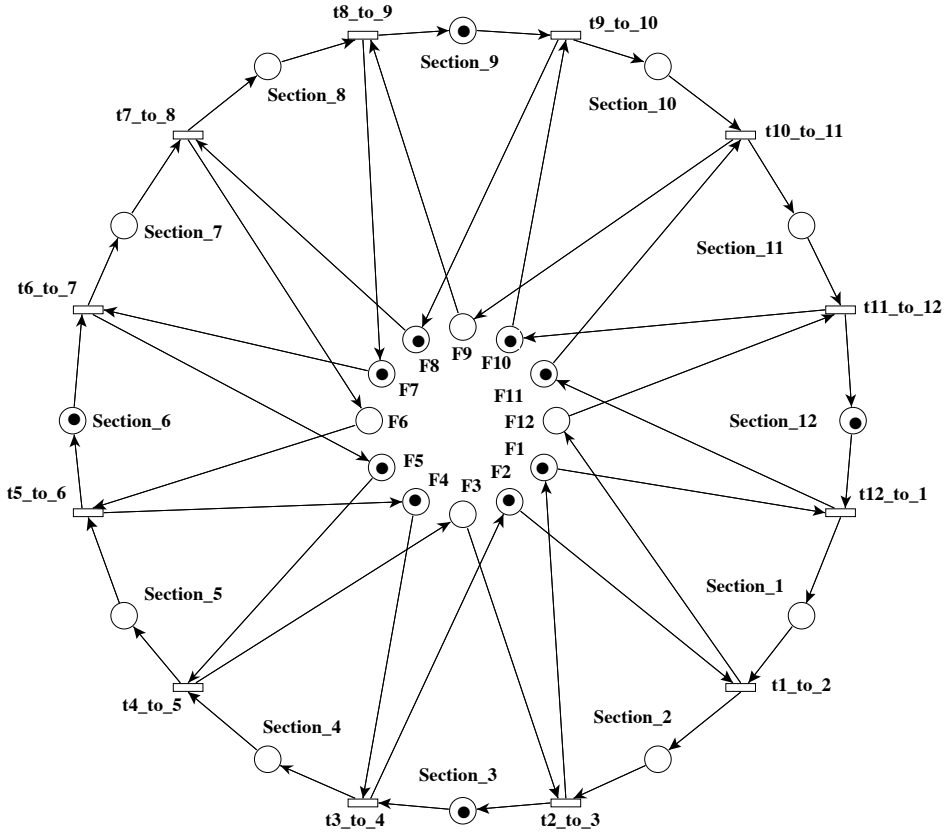
Fabrice Kordon
Fabrice.Kordon@lip6.fr

This form is a summary description of the model entitled "Circular Trains" 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

On a circular railroad divided in S sections, $\frac{S}{3}$ trains circulate in the same direction. For security reasons, a segment may never contains more than one train at a time [(a)]. Traffic lights manage the access to each sections. In the figure below, sections are represented by places Section_$\langle i \rangle$. The presence of a marking in such places means that a train is there. Traffic lights are modeled by places F$\langle i \rangle$, they are marked when they are green. The passage from section $\langle i \rangle$ to $\langle j \rangle$ is done when firing transition t$\langle i \rangle$_to_$\langle j \rangle$.



References

The model was originally presented in [1], it was reused as an example in the PetriScript documentation [2].

1. Hartmann Genrich, "Predicate/Transition nets", in Petri Nets: Central Models and their Properties, Advances in PetriNets 1986, Part 1, roc on an advanced course, Bad Honnef, 1986, Springer Verlag, L.N.C.S. 254. pp 207-247
2. A. Hamez and X. Renault, "PetriScript Reference Manual (1.0)", http://www.lip6.fr/cpn-ami-doc/PetriScript_Reference_Manual.pdf, 2005

[(a)] this is an adaptation of the original problem where these trains could never be located on two contiguous segments (change of the initial marking).

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Scaling parameter

Parameter name	Parameter description	Chosen parameter values
S	The number of sections in the railway	12, 24, 48, 96, 192, 384, 768

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
S	$2 \times S$	S	$4 \times S$
$S = 12$	24	12	48
$S = 24$	48	24	96
$S = 48$	96	48	192
$S = 96$	192	96	384
$S = 192$	384	192	768
$S = 384$	768	384	1536
$S = 768$	1536	768	3072

Structural properties

ordinary — *all arcs have multiplicity one* ..... ✔
simple free choice — *all transitions sharing a common input place have no other input place* ..... ✔ (b)
extended free choice — *all transitions sharing a common input place have the same input places* ..... ✔ (c)
state machine — *every transition has exactly one input place and exactly one output place* ..... ✘ (d)
marked graph — *every place has exactly one input transition and exactly one output transition* ..... ✔ (e)
connected — *there is an undirected path between every two nodes (places or transitions)* ..... ✔ (f)
strongly connected — *there is a directed path between every two nodes (places or transitions)* ..... ✔ (g)
source place(s) — *one or more places have no input transitions* ..... ✘ (h)
sink place(s) — *one or more places have no output transitions* ..... ✘ (i)
source transition(s) — *one or more transitions have no input places* ..... ✘ (j)
sink transitions(s) — *one or more transitions have no output places* ..... ✘ (k)
loop-free — *no transition has an input place that is also an output place* ..... ✔ (l)
conservative — *for each transition, the number of input arcs equals the number of output arcs* ..... ✔ (m)
subconservative — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ..... ✔ (n)
nested units — *places are structured into hierarchically nested sequential units* (o) ..... ✘

Behavioural properties

safe — *in every reachable marking, there is no more than one token on a place* ..... ✘ (p)
dead place(s) — *one or more places have no token in any reachable marking* ..... ? (q)

(b) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(c) stated by CÆSAR.BDD version 2.6 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(d) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(e) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(f) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(g) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(h) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(i) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(j) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(k) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(l) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(m) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(n) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(o) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(p) stated by CÆSAR.BDD version 2.0 on all 7 instances (12, 24, 48, 96, 192, 384, and 768).
(q) stated by CÆSAR.BDD version 3.3 to be false on 4 instance(s) out of 7, and unknown on the remaining 3 instance(s).

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dead transition(s) — *one or more transitions cannot fire from any reachable marking* ..... ✗ (r)
deadlock — *there exists a reachable marking from which no transition can be fired* ..... ✗ (s)
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
$S = 12$	195 (t)	496 (u)	2 (v)	12 (w)
$S = 24$	86 515 (x)	411 680 (y)	2 (z)	24 (aa)
$S = 48$	2.3974×10^{10} (ab)	2.2124×10^{11} (ac)	2 (ad)	48 (ae)
$S = 96$	2.5913×10^{21} (af)	4.7121×10^{22} (ag)	?	96 (ah)
$S = 192$	4.2702×10^{43} (ai)	1.532×10^{45} (aj)	2 (ak)	192 (al)
$S = 384$	?	?	?	384 (am)
$S = 768$	?	?	?	768 (an)

(r) stated by CÆSAR.BDD version 2.0 to be false on 3 instance(s) out of 7, and unknown on the remaining 4 instance(s).
(s) by construction; confirmed at MCC'2014 by Lola on 5 instances, and by GreatSPN and Tapaal on 2 instances.
(t) computed by Prod and PNXDD on January 2014; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.
(u) computed by Prod on January 2014; confirmed at MCC'2014 by Marcie.
(v) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
(w) number of initial tokens, because the net is conservative.
(x) computed by Prod and PNXDD on January 2014; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal.
(y) computed by Prod on January 2014; confirmed at MCC'2014 by Marcie.
(z) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
(aa) number of initial tokens, because the net is conservative.
(ab) computed by PNXDD on January 2014; confirmed at MCC'2014 by Marcie, PNMC, and PNXDD.
(ac) computed at MCC'2014 by Marcie.
(ad) computed at MCC'2014 by Marcie and PNMC.
(ae) number of initial tokens, because the net is conservative.
(af) computed by PNXDD on January 2014; confirmed at MCC'2014 by Marcie and PNXDD.
(ag) computed at MCC'2014 by Marcie.
(ah) number of initial tokens, because the net is conservative.
(ai) computed at MCC'2014 by Marcie.
(aj) computed at MCC'2014 by Marcie.
(ak) computed at MCC'2014 by Marcie.
(al) number of initial tokens, because the net is conservative.
(am) number of initial tokens, because the net is conservative.
(an) number of initial tokens, because the net is conservative.