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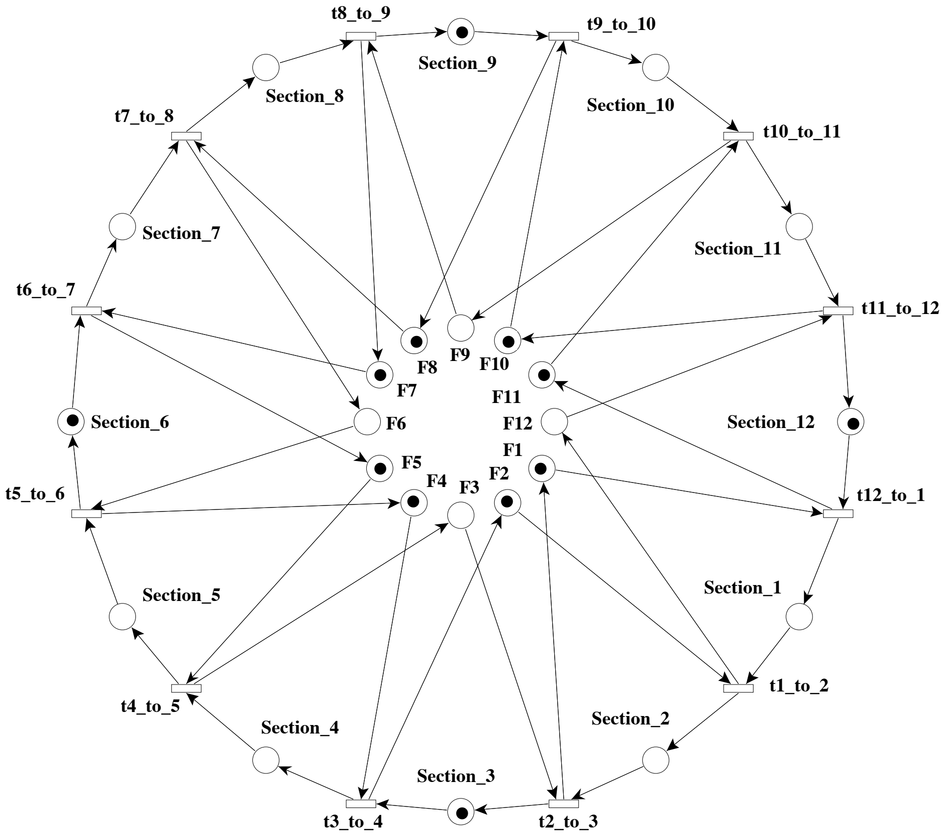
This form is a summary description of the model entitled "Circular Trains" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given 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. N 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]
deadlock — *there exists a reachable marking from which no transition can be fired* ✗ [q]
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ✔

(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) by construction; confirmed at MCC'2014 by Lola on 5 instances, and by GreatSPN and Tapaal on 2 instances.

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quasi-live — *for every transition t, there exists a reachable marking in which t can fire* .... ✔ [r]
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 [s]	496 [t]	2 [u]	12 [v]
$S = 24$	86 515 [w]	411 680 [x]	2 [y]	24 [z]
$S = 48$	2.3974×10^{10} [aa]	2.2124×10^{11} [ab]	2 [ac]	48 [ad]
$S = 96$	2.5913×10^{21} [ae]	4.7121×10^{22} [af]	?	96 [ag]
$S = 192$	4.2702×10^{43} [ah]	1.532×10^{45} [ai]	2 [aj]	192 [ak]
$S = 384$	?	?	?	384 [al]
$S = 768$	?	?	?	768 [am]

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