Fabrice.Kordon
Fabrice.Kordon@lip6.fr

This form is a summary description of the model entitled "RobotManipulation" 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.

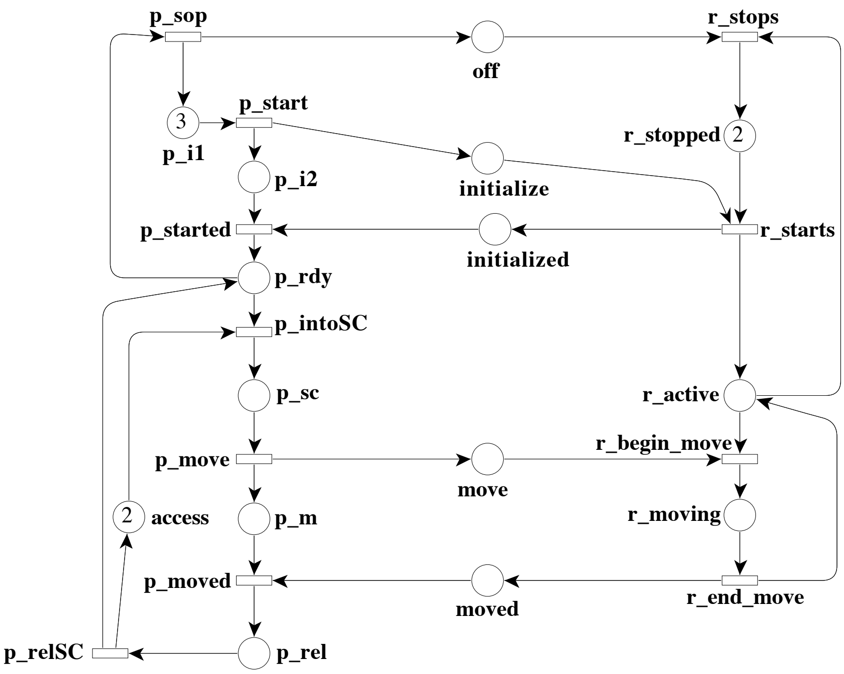
Description

In this model, processes manipulate robots following a simple protocol:

$$(\text{initialize} + \text{initialized}) + (\text{move} + \text{moved})^* + \text{off}$$

Initialization requires a free robot and moves can be sent to any robot by any process but one at a time.

This model is derived from a master examination and may not be very realistic in terms of modeling, but it scales up well.



The model for $N = 1$.

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	The number of initial tokens in places **p_i1**, **access** and **r_sopped** depends on N. card(**p_i1**) $= 2 \times N + 1$ card(**access**) = card(**r_sopped**) $= 2 \times N$	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000

Size of the model

Although the model is parameterized, its size does not depend on parameter values.

number of places:	15
number of transitions:	11
number of arcs:	34

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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]
deadlock — *there exists a reachable marking from which no transition can be fired* ✗
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ✔ [p]
quasi-live — *for every transition t, there exists a reachable marking in which t can fire* ✔ [q]
live — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* ✔ [r]

(a) 3 arcs are not simple free choice, e.g., the arc from place "r_active" (which has 2 outgoing transitions) to transition "r_begin_move" (which has 2 input places).
(b) transitions "r_begin_move" and "r_stops" share a common input place "r_active", but only the former transition has input place "move".
(c) 11 transitions are not of a state machine, e.g., transition "r_starts".
(d) 2 places are not of a marked graph, e.g., place "r_active".
(e) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(f) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(g) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(h) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(i) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(j) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(k) stated by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(l) 10 transitions are not conservative, e.g., transition "r_begin_move".
(m) 5 transitions are not subconservative, e.g., transition "r_end_move".
(n) the definition of Nested-Unit Petri Nets (NUPN) is available from `http://mcc.lip6.fr/nupn.php`
(o) by construction of the initial marking; confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(p) the initial state is a home state.
(q) confirmed by CÆSAR.BDD version 2.7 on all 13 instances (see all aforementioned parameter values).
(r) the net is quasi-live and reversible.

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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
$N = 1$	110 [s]	274 [t]	?	≥ 7 [u]
$N = 2$	1 430 [v]	5 500 [w]	?	≥ 13 [x]
$N = 5$	184 756 [y]	1 137 708 [z]	?	≥ 31 [aa]
$N = 10$	$> 4 \times 10^6$ [ab]	$> 3 \times 10^7$ [ac]	?	≥ 61 [ad]
$N = 20$	?	?	?	≥ 121 [ae]
$N = 50$	?	?	?	≥ 301 [af]
$N = 100$	?	?	?	≥ 601 [ag]
$N = 200$	?	?	?	≥ 1201 [ah]
$N = 500$	?	?	?	≥ 3001 [ai]
$N = 1000$	?	?	?	≥ 6001 [aj]
$N = 2000$	?	?	?	≥ 12001 [ak]
$N = 5000$	?	?	?	≥ 30001 [al]
$N = 10000$	?	?	?	≥ 60001 [am]

[s] stated by Prod in May 2017.
[t] stated by Prod in May 2017.
[u] lower bound given by the number of initial tokens.
[v] stated by Prod in May 2017.
[w] stated by Prod in May 2017.
[x] lower bound given by the number of initial tokens.
[y] stated by Prod in May 2017.
[z] stated by Prod in May 2017.
[aa] lower bound given by the number of initial tokens.
[ab] stated by Prod in May 2017.
[ac] stated by Prod in May 2017.
[ad] lower bound given by the number of initial tokens.
[ae] lower bound given by the number of initial tokens.
[af] lower bound given by the number of initial tokens.
[ag] lower bound given by the number of initial tokens.
[ah] lower bound given by the number of initial tokens.
[ai] lower bound given by the number of initial tokens.
[aj] lower bound given by the number of initial tokens.
[ak] lower bound given by the number of initial tokens.
[al] lower bound given by the number of initial tokens.
[am] lower bound given by the number of initial tokens.