

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.

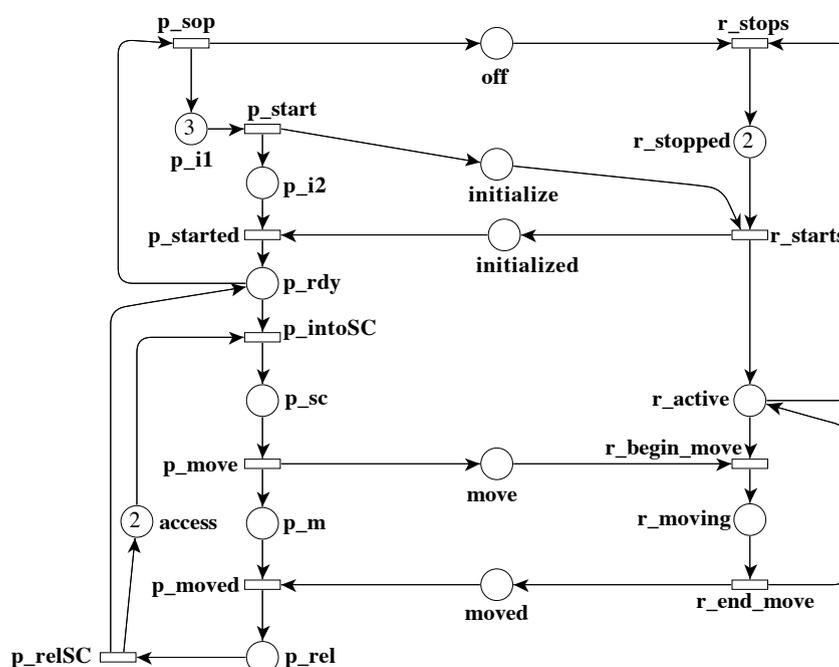
Description

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_stopped depends on N . $\text{card}(\mathbf{p_i1}) = 2 \times N + 1$ $\text{card}(\mathbf{access}) = \text{card}(\mathbf{r_stopped}) = 2 \times N$	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

Structural properties

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

Behavioural properties

safe — in every reachable marking, there is no more than one token on a place	no ^(o)
dead place(s) — one or more places have no token in any reachable marking	no ^(p)
dead transition(s) — one or more transitions cannot fire from any reachable marking	no ^(q)
deadlock — there exists a reachable marking from which no transition can be fired	no
reversible — from every reachable marking, there is a transition path going back to the initial marking	yes ^(r)
live — for every transition t , from every reachable marking, one can reach a marking in which t can fire	yes ^(s)

^(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) stated by [CÆSAR.BDD](#) version 3.3 on all 13 instances (see all aforementioned parameter values).

^(q) confirmed by [CÆSAR.BDD](#) version 2.7 on all 13 instances (see all aforementioned parameter values).

^(r) the initial state is a home state.

^(s) the net is quasi-live and reversible.

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

^(t) stated by Prod in May 2017.

^(u) stated by Prod in May 2017.

^(v) lower bound given by the number of initial tokens.

^(w) stated by Prod in May 2017.

^(x) stated by Prod in May 2017.

^(y) lower bound given by the number of initial tokens.

^(z) stated by Prod in May 2017.

^(aa) stated by Prod in May 2017.

^(ab) lower bound given by the number of initial tokens.

^(ac) stated by Prod in May 2017.

^(ad) stated by Prod in May 2017.

^(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.

^(an) lower bound given by the number of initial tokens.