Fabrice Kordon
Fabrice.Kordon@lip6.fr

This form is a summary description of the model entitled "SmallOperatingSystem" 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

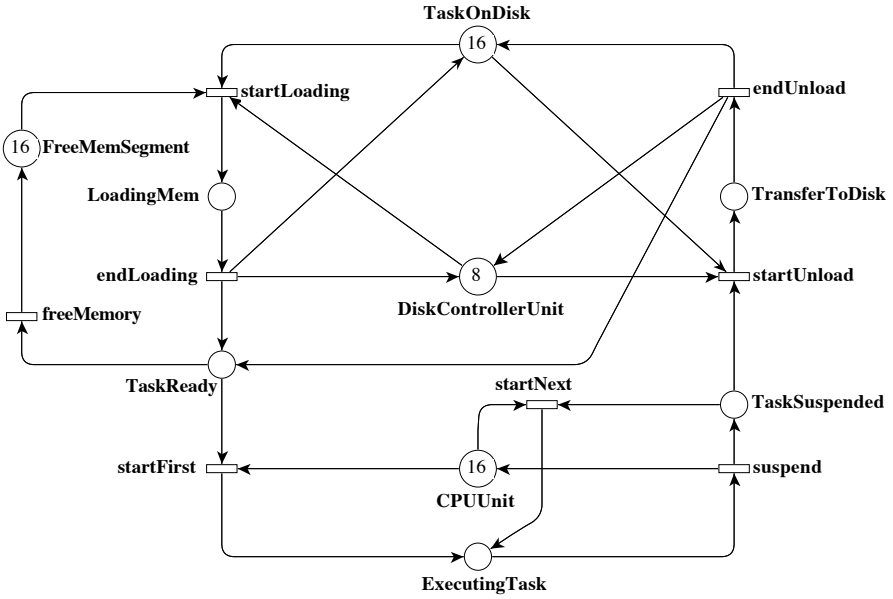
This Petri net models a simplified Operating System handling the execution of tasks on a machine with several so-called "memory segments", Disk controller units, and cores. The typical lifecycle of a task is the following:

1 A task is loaded from disk to memory (requires a segment and a disk controller),

2 When the task is ready to execute, it can get a core, be suspended and get a core again as long as its execution is not finished. It can also be removed from the memory if some is needed otherwise

3 When the execution finishes, the task is saved back on the disk.

The system has several scaling parameters: M (memory segments), T (tasks), D (Disk controllers) and C (cores). However, to simplify this in the MCC, we reduce it to two parameters, MT and DC with the following correspondence: $M = T = MT$, $D = DC$ and $C = 2 \times DC$.



Graphical representation for $MT16$ and $DC = 8$

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
MT and DC	MT to compute available tasks and memory and DC to compute available disk controllers and cores	(MT=16, DC=8), (MT=32, DC=8), (MT=32, DC=16), (MT=64, DC=16), (MT=64, DC=32), (MT=128, DC=32), (MT=128, DC=64), (MT=256, DC=64), (MT=256, DC=128), (MT=512, DC=128), (MT=512, DC=256), (MT=1024, DC=256), (MT=1024, DC=512), (MT=2048, DC=512), (MT=2048, DC=1024), (MT=4096, DC=1024), (MT=4096, DC=2048), (MT=8192, DC=2048), (MT=8192, DC=4096)

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Size of the model

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

number of places:	9
number of transitions:	8
number of arcs:	27

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* ..... ✗
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* ..... ✔

[a] 9 arcs are not simple free choice, e.g., the arc from place "TaskOnDisk" (which has 2 outgoing transitions) to transition "startLoading" (which has 3 input places).
[b] transitions "startLoading" and "startUnload" share a common input place "TaskOnDisk", but only the former transition has input place "FreeMemSegment".
[c] 7 transitions are not of a state machine, e.g., transition "startLoading".
[d] 6 places are not of a marked graph, e.g., place "TaskOnDisk".
[e] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[f] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[g] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[h] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[i] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[j] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[k] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[l] 7 transitions are not conservative, e.g., transition "startLoading".
[m] 3 transitions are not subconservative, e.g., transition "endLoading".
[n] the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
[o] by construction of the model (the initial marking is not safe); confirmed by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[p] stated by CÆSAR.BDD version 3.3 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).
[q] stated by CÆSAR.BDD version 2.6 on all 19 instances ((MT=16, DC=8), (MT=32, DC=8), etc.).

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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
MT=16, DC=8	16 587 [r]	100 896 [s]	?	≥ 56 [t]
MT=32, DC=8	166 515 [u]	1 112 454 [v]	?	≥ 88 [w]
MT=32, DC=16	354 501 [x]	2 451 264 [y]	?	≥ 112 [z]
MT=64, DC=16	7 245 654 [aa]	29 675 132 [ab]	?	≥ 176 [ac]
MT=64, DC=32	9 133 641 [ad]	67 762 816 [ae]	?	≥ 224 [af]
MT=128, DC=32	?	?	?	≥ 352 [ag]
MT=128, DC=64	?	?	?	≥ 448 [ah]
MT=256, DC=64	?	?	?	≥ 704 [ai]
MT=256, DC=128	?	?	?	≥ 896 [aj]
MT=512, DC=128	?	?	?	≥ 1408 [ak]
MT=512, DC=256	?	?	?	≥ 1792 [al]
MT=1024, DC=256	?	?	?	≥ 2816 [am]
MT=1024, DC=512	?	?	?	≥ 3584 [an]
MT=2048, DC=512	?	?	?	≥ 5632 [ao]
MT=2048, DC=1024	?	?	?	≥ 7168 [ap]
MT=4096, DC=1024	?	?	?	≥ 11264 [aq]
MT=4096, DC=2048	?	?	?	≥ 14336 [ar]
MT=8192, DC=2048	?	?	?	≥ 22528 [as]
MT=8192, DC=4096	?	?	?	≥ 28672 [at]

[r] computed by PROD in March 2015.
[s] computed by PROD in March 2015.
[t] lower bound given by the number of initial tokens.
[u] computed by PROD in March 2015.
[v] computed by PROD in March 2015.
[w] lower bound given by the number of initial tokens.
[x] computed by PROD in March 2015.
[y] computed by PROD in March 2015.
[z] lower bound given by the number of initial tokens.
[aa] computed by PROD in March 2015.
[ab] computed by PROD in March 2015.
[ac] lower bound given by the number of initial tokens.
[ad] computed by PROD in March 2015.
[ae] computed by PROD in March 2015.
[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.
[ao] lower bound given by the number of initial tokens.
[ap] lower bound given by the number of initial tokens.
[aq] lower bound given by the number of initial tokens.
[ar] lower bound given by the number of initial tokens.
[as] lower bound given by the number of initial tokens.
[at] lower bound given by the number of initial tokens.