Model: SemanticWebServices
Type: P/T Net
Origin: Academic

since
MCC 2021

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

Given is an ontology, a couple of web services that are semantically annotated based on this ontology, an initial and a final (goal) state. The task is to find a composition of (some of the given) services such that the initial state is transformed into the goal state. This task is referred to as *abstract planning* in the web services community. In the given Petri nets, feasibility of the problem refers to reachability of a certain marking. The path to that marking codes the particular *plan*, i.e. the proposed composition of services. The nets were obtained in a case study that aimed at evaluating the feasibility of the tool LoLA as abstract planning engine in the PlanICS framework.

References

A. Niewiadomski, K. Wolf: LoLA as Abstract Planning Engine of PlanICS. PNSE @ Petri Nets 2014: 349-350 r (http://ceur-ws.org/Vol-1160/paper26.pdf)

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
$\langle s, p \rangle$	s is the number of available services, and p is the length of the shortest possible plan, i.e. the number of services in the resulting composition.	$\langle 64, 6 \rangle$, $\langle 64, 9 \rangle$, $\langle 64, 12 \rangle$, $\langle 64, 15 \rangle$, $\langle 64, 18 \rangle$, $\langle 128, 6 \rangle$, $\langle 128, 9 \rangle$, $\langle 128, 12 \rangle$, $\langle 128, 15 \rangle$, $\langle 128, 18 \rangle$, $\langle 256, 6 \rangle$, $\langle 256, 9 \rangle$, $\langle 256, 12 \rangle$, $\langle 256, 15 \rangle$, $\langle 256, 18 \rangle$

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
$s = 64, p = 6$	97	164	661
$s = 64, p = 9$	100	164	719
$s = 64, p = 12$	104	158	863
$s = 64, p = 15$	118	194	1007
$s = 64, p = 18$	154	236	1265
$s = 128, p = 6$	262	1328	9727
$s = 128, p = 9$	242	946	6609
$s = 128, p = 12$	191	414	1559
$s = 128, p = 15$	188	416	1593
$s = 128, p = 18$	184	466	1873
$s = 256, p = 6$	439	14102	130267
$s = 256, p = 9$	418	27524	270595
$s = 256, p = 12$	356	20464	190527
$s = 256, p = 15$	329	29492	267319
$s = 256, p = 18$	198	9732	78799

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Structural properties

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

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* .... yes [q]
dead transition(s) — *one or more transitions cannot fire from any reachable marking* .... yes [r]
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* .... ? [s]

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[a] stated by CÆSAR.BDD version 3.5 to be true on 7 instance(s) out of 15, and false on the remaining 8 instance(s).
[b] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[c] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[d] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[e] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[f] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[g] from place "p4" one cannot reach place "p1".
[h] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[i] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[j] stated by CÆSAR.BDD version 3.5 to be true on 12 instance(s) out of 15, and false on the remaining 3 instance(s).
[k] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[l] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[m] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[n] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[o] the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
[p] stated by CÆSAR.BDD version 3.5 to be false on 7 instance(s) out of 15, and unknown on the remaining 8 instance(s).
[q] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[r] stated by CÆSAR.BDD version 3.5 on all 15 instances (see all aforementioned scaling parameter values).
[s] stated by CÆSAR.BDD version 3.5 to be false on 7 instance(s) out of 15, and unknown on the remaining 8 instance(s).

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
$s = 64, p = 6$	$\geq 1.99418\mathrm{e}{+}17$ [t]	?	?	≥ 85
$s = 64, p = 9$	?	?	?	≥ 2 [u]
$s = 64, p = 12$	$\geq 1.84641\mathrm{e}{+}10$ [v]	?	?	≥ 92
$s = 64, p = 15$	$\geq 1.05102\mathrm{e}{+}11$ [w]	?	?	≥ 106
$s = 64, p = 18$	$\geq 1.31607\mathrm{e}{+}12$ [x]	?	?	≥ 142
$s = 128, p = 6$	?	?	?	≥ 2 [y]
$s = 128, p = 9$	?	?	?	≥ 2 [z]
$s = 128, p = 12$	$\geq 1.98474\mathrm{e}{+}33$ [aa]	?	?	≥ 179
$s = 128, p = 15$	$\geq 5.98138\mathrm{e}{+}29$ [ab]	?	?	≥ 176
$s = 128, p = 18$	$\geq 1.26275\mathrm{e}{+}21$ [ac]	?	?	≥ 172
$s = 256, p = 6$	?	?	?	≥ 2 [ad]
$s = 256, p = 9$	?	?	?	≥ 2 [ae]
$s = 256, p = 12$	?	?	?	≥ 2 [af]
$s = 256, p = 15$	?	?	?	≥ 2 [ag]
$s = 256, p = 18$	?	?	?	≥ 2 [ah]

Other properties

The original property of interest – existence of a plan – refers to "EF(ExpectedWorld > 0)" in all individual models.

[t] stated by CÆSAR.BDD version 3.5.
[u] lower bound given by the number of initial tokens.
[v] stated by CÆSAR.BDD version 3.5.
[w] stated by CÆSAR.BDD version 3.5.
[x] stated by CÆSAR.BDD version 3.5.
[y] lower bound given by the number of initial tokens.
[z] lower bound given by the number of initial tokens.
[aa] stated by CÆSAR.BDD version 3.5.
[ab] stated by CÆSAR.BDD version 3.5.
[ac] stated by CÆSAR.BDD version 3.5.
[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.