Model: Client/Server with Repetitions
Type: Colored Net (with derived P/T Nets)
Origin: Academic

since
MCC 2012

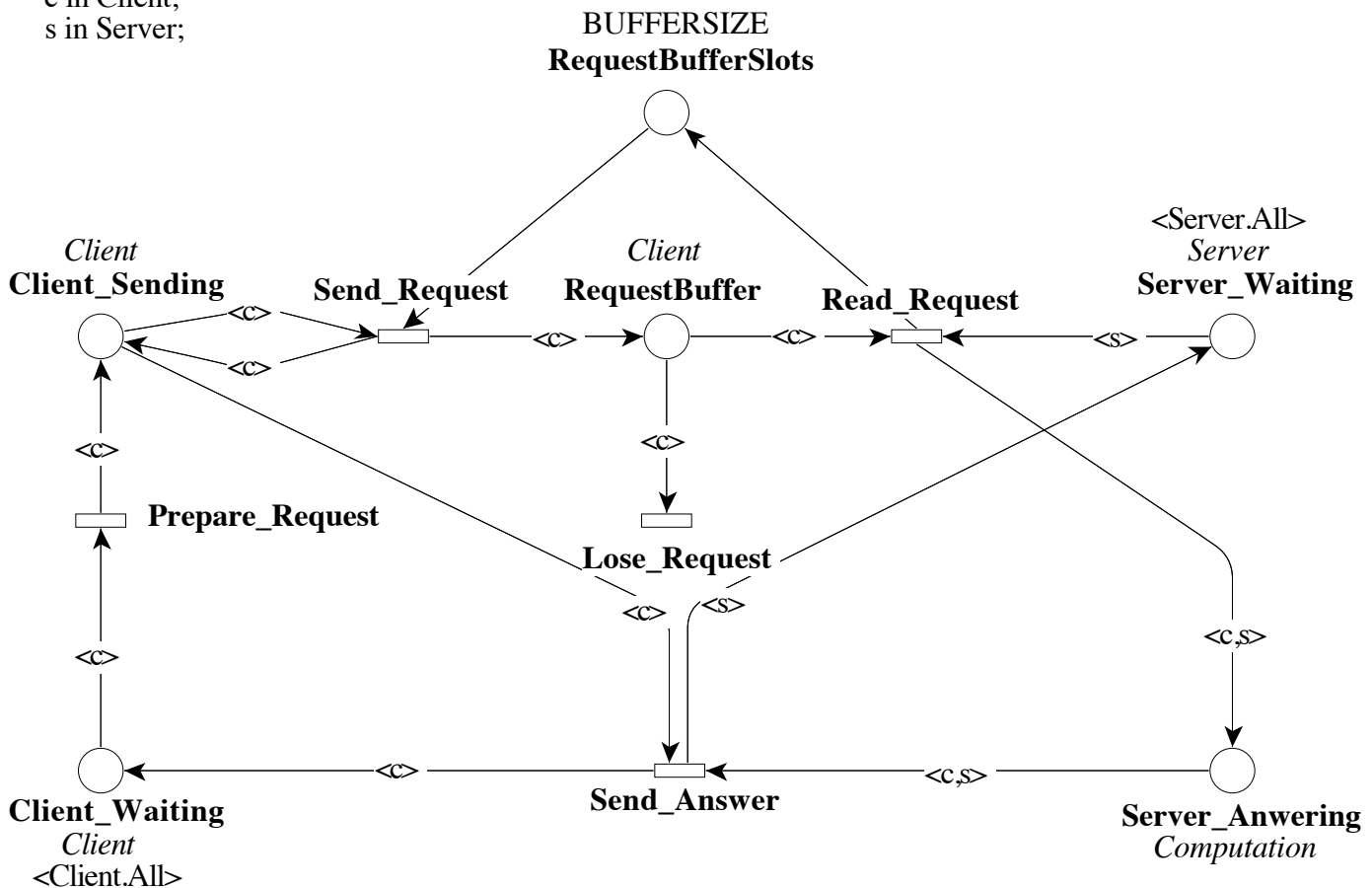Alban Linard
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This form is a summary description of the model entitled "Client/Server with Repetitions" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets 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 client/server application with NCLIENTS clients and NSERVERS servers. Communication from clients to servers is not reliable, with requests stored in a buffer of size BUFFERSIZE. Communication from servers to clients are reliable. A client send its message until it receives an answer.

The interesting point is that place RequestBuffer is not 1-bounded. This model can thus be used to assess how model checkers behave for colored non-safe nets.

Class
  Client is 1..NCLIENTS;
  Server is 1..NSERVERS;
Domain
  Computation is <Client,Server>;
Var
  c in Client;
  s in Server;

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Scaling parameter

Parameter name	Parameter description	Chosen parameter values
n	To set only one parameter, we set a parameter n and compute model parameters with: NCLIENTS=n^2, NSERVERS=n, BUFFERSIZE=n	2, 3, 4, 5, 7, 10

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
(NCLIENTS, NSERVERS, BUFFERSIZE)	1 + 3*NCLIENTS + NSERVERS + NCLIENTS*NSERVERS	3*NCLIENTS + 2*NCLIENTS*NSERVERS	7*NCLIENTS + 8*NCLIENTS+NSERVERS
n	$n^3 + 3n^2 + n + 1$	$2n^3 + 3n^2$	$8n^3 + 7n^2$
$n = 2$	23	28	92
$n = 3$	58	81	279
$n = 4$	117	176	624
$n = 5$	206	325	1175
$n = 7$	498	833	3087
$n = 10$	1311	2300	8700

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)] .... ✗

(a) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(b) stated by CÆSAR.BDD version 2.6 on all 6 instances (2, 3, 4, 5, 7, and 10).

(c) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(d) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(e) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(f) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(g) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(h) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(i) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(j) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10); transition "Lose_Request" is a sink transition.

(k) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(l) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(m) stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(n) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php

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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* .... ✔ [(r)]
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* .... ?

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
$n = 2$	7424 [(s)]	37088 [(t)]	2 [(u)]	8 [(v)]
$n = 3$	1.3408E+8 [(w)]	1.2939E+9 [(x)]	3 [(y)]	15 [(z)]
$n = 4$	3.0948E+13 [(aa)]	?	4 [(ab)]	24 [(ac)]
$n = 5$	?	?	?	35 [(ad)]
$n = 7$	?	?	?	63 [(ae)]
$n = 10$	?	?	?	120 [(af)]

[(o)] stated by CÆSAR.BDD version 2.0 on all 6 instances (2, 3, 4, 5, 7, and 10).

[(p)] stated by CÆSAR.BDD version 3.3 to be false on 3 instance(s) out of 6, and unknown on the remaining 3 instance(s).

[(q)] stated by CÆSAR.BDD version 2.0 to be false on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s).

[(r)] confirmed at MCC'2014 by Helena on all 6 colored instances, and by Lola and Tapaal on all 6 P/T instances.

[(s)] computed at MCC'2013 by Alpina and ITS-Tools; confirmed at MCC'2014 by GreatSPN and Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal on the P/T net instance.

[(t)] computed at MCC'2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

[(u)] computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.

[(v)] number of initial tokens, because the net is sub-conservative.

[(w)] computed at MCC'2013 by Alpina and ITS-Tools; confirmed at MCC'2014 by GreatSPN on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.

[(x)] computed at MCC'2014 by Marcie.

[(y)] computed at MCC'2014 by GreatSPN, Marcie, and PNMC.

[(z)] number of initial tokens, because the net is sub-conservative.

[(aa)] computed at MCC'2014 by GreatSPN on the colored net instance, and by PNMC on the P/T net instance.

[(ab)] computed at MCC'2014 by PNMC.

[(ac)] number of initial tokens, because the net is sub-conservative.

[(ad)] number of initial tokens, because the net is sub-conservative.

[(ae)] number of initial tokens, because the net is sub-conservative.

[(af)] number of initial tokens, because the net is sub-conservative.

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