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;

BUF

![Petri net diagram]
Scaling parameter

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter description</th>
<th>Chosen parameter values</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>To set only one parameter, we set a parameter $n$ and compute model parameters with: NCLIENTS=$n^2$, NSERVERS=$n$, BUFFERSIZE=$n$</td>
<td>2, 3, 4, 5, 7, 10</td>
</tr>
</tbody>
</table>

Size of the model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of places</th>
<th>Number of transitions</th>
<th>Number of arcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(N\text{CLIENTS}, N\text{SERVERS}, \text{BUFFER-SIZE})$</td>
<td>$1 + 3^2N\text{CLIENTS} + N\text{SERVERS} + N\text{CLIENTS}^2N\text{SERVERS}$</td>
<td>$3^2N\text{CLIENTS} + 2N\text{CLIENTS}^2N\text{SERVERS}$</td>
<td>$7^2N\text{CLIENTS} + 8^2N\text{CLIENTS} + N\text{SERVERS}$</td>
</tr>
<tr>
<td>$n$</td>
<td>$n^3 + 3n^2 + n + 1$</td>
<td>$2n^3 + 3n^2$</td>
<td>$8n^3 + 7n^2$</td>
</tr>
<tr>
<td>$n = 2$</td>
<td>23</td>
<td>28</td>
<td>92</td>
</tr>
<tr>
<td>$n = 3$</td>
<td>58</td>
<td>81</td>
<td>279</td>
</tr>
<tr>
<td>$n = 4$</td>
<td>117</td>
<td>176</td>
<td>624</td>
</tr>
<tr>
<td>$n = 5$</td>
<td>206</td>
<td>325</td>
<td>1175</td>
</tr>
<tr>
<td>$n = 7$</td>
<td>498</td>
<td>833</td>
<td>3087</td>
</tr>
<tr>
<td>$n = 10$</td>
<td>1311</td>
<td>2300</td>
<td>8700</td>
</tr>
</tbody>
</table>

Structural properties

- ordinary — all arcs have multiplicity one
- simple free choice — all (different) transitions with a shared input place have no other input place
- state machine — every transition has exactly one input place and exactly one output place
- marked graph — every place has exactly one input transition and exactly one output transition
- connected — there is an undirected path between every two nodes (places or transitions)
- strongly connected — there is a directed path between every two nodes (places or transitions)
- source place(s) — one or more places have no input transitions
- sink place(s) — one or more places have no output transitions
- source transition(s) — one or more transitions have no input places
- sink transition(s) — one or more transitions have no output places
- loop-free — no transition has an input place that is also an output place
- conservative — for each transition, the number of input arcs equals the number of output arcs
- subconservative — for each transition, the number of input arcs equals or exceeds the number of output arcs
- nested units — places are structured into hierarchically nested sequential units

\[(a)\] stated by CÆSAR.BDD version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).
\[(b)\] stated by CÆSAR.BDD version 1.7 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).
\[(k)\] 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).
\[(m)\] the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
**Behavioural properties**

**safe** — in every reachable marking, there is no more than one token on a place ................................. \( \times \) \(^{(a)}\)

**deadlock** — there exists a reachable marking from which no transition can be fired .............................. \( \checkmark \) \(^{(a)}\)

**reversible** — from every reachable marking, there is a transition path going back to the initial marking ................................. ?

**quasi-live** — for every transition \( t \), there exists a reachable marking in which \( t \) can fire ................................. ? \(^{(p)}\)

**live** — for every transition \( t \), from every reachable marking, one can reach a marking in which \( t \) can fire ................................. ?

**Size of the marking graphs**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of reachable markings</th>
<th>Number of transition firings</th>
<th>Max. number of tokens per place</th>
<th>Max. number of tokens per marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n = 2 )</td>
<td>7424 (^{(q)})</td>
<td>37 088 (^{(f)})</td>
<td>2 (^{(s)})</td>
<td>8 (^{(t)})</td>
</tr>
<tr>
<td>( n = 3 )</td>
<td>1.3408E+8 (^{(u)})</td>
<td>1.2939E+9 (^{(v)})</td>
<td>3 (^{(w)})</td>
<td>15 (^{(x)})</td>
</tr>
<tr>
<td>( n = 4 )</td>
<td>3.0948E+13 (^{(r)})</td>
<td>?</td>
<td>4 (^{(k)})</td>
<td>21 (^{(aa)})</td>
</tr>
<tr>
<td>( n = 5 )</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>( \geq 35 )</td>
</tr>
<tr>
<td>( n = 7 )</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>( \geq 63 )</td>
</tr>
<tr>
<td>( n = 10 )</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>( \geq 120 )</td>
</tr>
</tbody>
</table>

\(^{(a)}\) stated by CÆSAR.BDD version 2.0 on all 6 instances (2, 3, 4, 5, 7, and 10).

\(^{(o)}\) confirmed at MCC’2014 by Helena on all 6 colored instances, and by Lola and Tapaal on all 6 P/T instances.

\(^{(p)}\) stated by CÆSAR.BDD version 2.0 to be true on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s).

\(^{(q)}\) 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.

\(^{(r)}\) computed at MCC’2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

\(^{(s)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(t)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

\(^{(u)}\) 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.

\(^{(v)}\) computed at MCC’2014 by Marcie.

\(^{(w)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(x)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

\(^{(y)}\) computed at MCC’2014 by GreatSPN on the colored net instance, and by PNMC on the P/T net instance.

\(^{(z)}\) computed at MCC’2014 by PNMC.

\(^{(aa)}\) computed at MCC’2014 by PNMC.