This form is a summary description of the model entitled “Lamport’s fast mutual exclusion algorithm” 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 net models Lamport’s fast mutual exclusion algorithm designed for multi-processor architectures with a shared memory. The pseudo code of this algorithm is given in file code.pdf. Each transition of the net has a name of the form \texttt{XXX.N} where \texttt{XXX} is a description of the statement executed and \texttt{N} is the corresponding line number of the statement in the pseudo-code of the algorithm.

References


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>Number of processes competing to access the critical section.</td>
<td>2,3,4,5,6,7,8</td>
</tr>
</tbody>
</table>

Size of the colored net model

- number of places: 18
- number of transitions: 17
- number of arcs: 68

Size of the derived P/T model instances

<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 = 2</td>
<td>69</td>
<td>96</td>
<td>402</td>
</tr>
<tr>
<td>N = 3</td>
<td>100</td>
<td>156</td>
<td>664</td>
</tr>
<tr>
<td>N = 4</td>
<td>135</td>
<td>230</td>
<td>990</td>
</tr>
<tr>
<td>N = 5</td>
<td>174</td>
<td>318</td>
<td>1380</td>
</tr>
<tr>
<td>N = 6</td>
<td>217</td>
<td>420</td>
<td>1834</td>
</tr>
<tr>
<td>N = 7</td>
<td>264</td>
<td>536</td>
<td>2352</td>
</tr>
<tr>
<td>N = 8</td>
<td>315</td>
<td>666</td>
<td>2934</td>
</tr>
</tbody>
</table>

Structural properties

ordinary — all arcs have multiplicity one

simple free choice — all transitions sharing a common input place have no other input place

extended free choice — all transitions sharing a common input place have the same input places

(a) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
(b) transitions “T-setbi.2.3” and “T-setbi.2.4” share a common input place “P-start.1.1”, but only the former transition has input place “P-b.1_false”.

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Model: Lamport’s fast mutual exclusion algorithm
Type: Colored Net (with derived P/T Nets)
Origin: Academic

Behavioural properties

- **safe** — in every reachable marking, there is no more than one token on a place
- **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
- **quasi-live** — for every transition t, there exists a reachable marking in which t can fire
- **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>380 (e)</td>
<td>716 (f)</td>
<td>1 (g)</td>
<td>8 (v)</td>
</tr>
<tr>
<td>N = 3</td>
<td>19,742 (w)</td>
<td>58,272 (x)</td>
<td>1 (y)</td>
<td>14 (z)</td>
</tr>
<tr>
<td>N = 4</td>
<td>1,914E+6 (aa)</td>
<td>9,046E+6 (ab)</td>
<td>1 (ac)</td>
<td>22 (ad)</td>
</tr>
<tr>
<td>N = 5</td>
<td>5,306E+8 (ab)</td>
<td>?</td>
<td>1 (ad)</td>
<td>≥ 16</td>
</tr>
<tr>
<td>N = 6</td>
<td>≥ 3,0E+8 (ab)</td>
<td>?</td>
<td>?</td>
<td>≥ 14</td>
</tr>
<tr>
<td>N = 7</td>
<td>≥ 5,1E+11 (aa)</td>
<td>?</td>
<td>?</td>
<td>≥ 18</td>
</tr>
<tr>
<td>N = 8</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Notes:

- (e) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (f) from place “P-start_1_1” one cannot reach place “P-wait_0_0”.
- (g) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (h) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (i) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (j) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (k) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (l) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (m) stated by CÆSAR.BDD version 1.7 on all 7 instances (2, 3, 4, 5, 6, 7, and 8).
- (n) the definition of Nested-Unit Petri Nets (NUPN) is available from [http://mcc.1isp6.fr/nupn.php](http://mcc.1isp6.fr/nupn.php)
- (o) stated by CÆSAR.BDD version 2.0 to be true on 3 instance(s) out of 7, and unknown on the remaining 4 instance(s).
- (p) stated by CÆSAR.BDD version 2.0 to be false on 3 instance(s) out of 7, and unknown on the remaining 4 instance(s); confirmed at MCC’2014 by Helena on 3 colored instances (N = 2, N = 3, and N = 4) and by GreatSPN and Lola on the 3 corresponding P/T instances.
- (q) stated by CÆSAR.BDD version 2.0 to be true on 3 instance(s) out of 7, and unknown on the remaining 4 instance(s).
- (r) the net is not quasi-live and, thus, not live.
- (s) computed by Alpina, ITS-Tools, Marcie, Neco, and PNDD at MCC’2013; confirmed by CÆSAR.BDD 1.8; confirmed at MCC’2014 by GreatSPN and Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNDD, Stratagem, and Tapaal on the P/T net instance.
- (t) confirmed 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 on the P/T net instance.
- (v) confirmed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal on the P/T net instance.
- (w) computed at MCC’2013 by Alpina, ITS-Tools, Marcie, Neco, and PNDD; confirmed by CÆSAR.BDD 1.8; confirmed at MCC’2014 by GreatSPN and Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNDD, Stratagem, and Tapaal on the P/T net instance.

...
confirmed at MCC’2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

(y) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

(z) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.

(aa) computed at MCC’2013 by ITS-Tools, and PNXDD; confirmed by CÆSAR.BDD 1.8; confirmed at MCC’2014 by GreatSPN and Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, and PNXDD on the P/T net instance.

(ab) confirmed at MCC’2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

(ac) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

(ad) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.

(af) computed at MCC’2014 by PNMC.

(ag) computed at MCC’2014 by PNMC.

(ai) stated by CÆSAR.BDD version 2.0.

(al) stated by CÆSAR.BDD version 2.0.