This form is a summary description of the model entitled “Eratosthenes’ sieve” 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 model implements an Eratosthenes’ sieve: place $p$ contains all the integers from 2 to scaling parameter $n$, to be filtered by the sieve. Each firing of $t$ consumes two integers $x$ and $y$ from $p$ if $y$ is a divider of $x$ and returns only $y$ to the place. When $t$ cannot be fired anymore, $p$ is marked with only prime numbers.

An unfolding can be provided but would reduce the complexity of the model because all the guards would have been already validated. But this is exactly one of the difficulties with coloured Petri on this model: the combinatorial when choosing token $x$ and $y$ such that $x \mod y = 0$. So we strongly suggest that unfolding, if allowed, should be included into the analysis time of P/T net tools.

This model was produced from a high-level colored net (Python-like description).

\[
\begin{array}{ccc}
2, \ldots, n & x, y & t \\
\rightarrow & & x \mod y = 0 \\
\end{array}
\]

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>size of the sieve</td>
<td>10, 20, 50, 100, 200, 500</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>$n = 5$</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>$n = 10$</td>
<td>9</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>$n = 20$</td>
<td>19</td>
<td>27</td>
<td>81</td>
</tr>
<tr>
<td>$n = 50$</td>
<td>49</td>
<td>108</td>
<td>324</td>
</tr>
<tr>
<td>$n = 100$</td>
<td>99</td>
<td>283</td>
<td>849</td>
</tr>
<tr>
<td>$n = 200$</td>
<td>199</td>
<td>699</td>
<td>2097</td>
</tr>
<tr>
<td>$n = 500$</td>
<td>499</td>
<td>2191</td>
<td>6573</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
- **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

(a) stated by CÆSAR.BDD version 1.7 to be true on 1 instance (namely, $n = 5$) out of 7, and false on the remaining 6 instances.
(b) stated by CÆSAR.BDD version 2.6 to be true on 1 instance(s) out of 7, and false on the remaining 6 instance(s).
(c) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(d) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
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 

countertransitions(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

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, there exists a reachable marking in which it can fire 

live — for every transition, from every reachable marking, one can reach a marking in which it 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 = 5</td>
<td>2 (a)</td>
<td>?</td>
<td>1 (w)</td>
<td>4 (t)</td>
</tr>
<tr>
<td>n = 10</td>
<td>32 (u)</td>
<td>120 (v)</td>
<td>1 (aa)</td>
<td>9 (x)</td>
</tr>
<tr>
<td>n = 20</td>
<td>2048 (y)</td>
<td>23040 (z)</td>
<td>1 (aaa)</td>
<td>19 (ab)</td>
</tr>
<tr>
<td>n = 50</td>
<td>1.7180E+10 (ac)</td>
<td>7.3014E+11 (ad)</td>
<td>1 (aee)</td>
<td>49 (af)</td>
</tr>
<tr>
<td>n = 100</td>
<td>1.8890E+22 (ag)</td>
<td>2.0259E+24 (ah)</td>
<td>1 (aai)</td>
<td>99 (aj)</td>
</tr>
<tr>
<td>n = 200</td>
<td>1.1418E+46 (ak)</td>
<td>2.9173E+48 (am)</td>
<td>1 (aaw)</td>
<td>199 (an)</td>
</tr>
<tr>
<td>n = 500</td>
<td>4.1316E+121 (ao)</td>
<td>3.2061E+124 (ap)</td>
<td>1 (aq)</td>
<td>499 (aq)</td>
</tr>
</tbody>
</table>

(a) stated by CÆSAR.BDD version 2.0 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(b) the net is not connected and, thus, not strongly connected.
(c) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(d) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(e) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(f) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(g) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(h) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(i) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(j) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(k) stated by CÆSAR.BDD version 1.7 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(l) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(m) stated by CÆSAR.BDD version 2.0 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(n) the number of initial tokens, because the net is sub-conservative.
(o) the number of initial tokens, because the net is sub-conservative.
(p) stated by CÆSAR.BDD version 2.0 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(q) stated by CÆSAR.BDD version 2.0 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(r) the number of initial tokens, because the net is sub-conservative.
(s) stated by CÆSAR.BDD version 2.0 on all 7 instances (5, 10, 20, 50, 100, 200, and 500).
(t) the number of initial tokens, because the net is sub-conservative.
(u) stated by CÆSAR.BDD version 1.8.
(v) the number of initial tokens, because the net is sub-conservative.
(w) stated by CÆSAR.BDD version 1.8.
(x) number of initial tokens, because the net is sub-conservative.
(y) number of initial tokens, because the net is sub-conservative.
(z) number of initial tokens, because the net is sub-conservative.
(ab) number of initial tokens, because the net is sub-conservative.
(ac) computed at MCC'2013 by Alpina, ITS-Tools, Marcie, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.
(ad) computed at MCC'2014 by Marcie.
(af) computed at MCC'2013 by ITS-Tools, Marcie, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.
(ah) computed at MCC'2014 by Marcie.
(ai) confirmed at MCC'2016 by GreatSPN, Marcie, and PNMC.
(ai) number of initial tokens, because the net is sub-conservative.
(aj) computed at MCC'2013 by ITS-Tools, Marcie, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.
(ak) computed at MCC'2014 by Marcie.
(am) confirmed at MCC'2014 by GreatSPN, Marcie, and PNMC.
(an) number of initial tokens, because the net is sub-conservative.
(ao) computed at MCC'2013 by ITS-Tools, Marcie, and PNXDD; confirmed by CÆSAR.BDD version 1.8; confirmed at MCC'2014 by Marcie, PNMC, and PNXDD.
(ap) computed at MCC'2014 by Marcie.
(aq) confirmed at MCC'2014 by Marcie and PNMC.
(ar) number of initial tokens, because the net is sub-conservative.