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This form is a summary description of the model entitled "Vasy2003" 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 present benchmark was submitted to the Petri net mailing list on July 28, 2003. It originates from an industrial case study, namely a model (8,500 lines of LOTOS and 3,000 lines of C) developed by Bull for it FAME high-end multiprocessor architecture. The source code of this model (in LOTOS and C) was automatically translated into an interpreted Petri net using the CÆSAR compiler of the CADP toolbox. The present benchmark was obtained by removing all data information (namely, data types, variables, conditions, actions, offers) from the interpreted Petri net in order to obtain a place/transition Petri net. At the time it was submitted, three Petri net tools had failed to handle this benchmark due to a lack of memory (there are nearly 9.810^{21} reachable markings). After the submission, four tools managed to process the benchmark, entirely or at least in part. The purpose of this example is to check how tool capabilities have improved over the last ten years.

References

- Regarding this benchmark, see
  http://www.informatik.uni-hamburg.de/cgi-bin/TGI/pnml/getpost?id=2003/07/2709
  and
  http://www.informatik.uni-hamburg.de/cgi-bin/TGI/pnml/getpost?id=2003/09/2736
- Regarding the CÆSAR model checker, see http://cadp.inria.fr

Scaling parameter

This model is not parameterized.

Size of the model

number of places:	485
number of transitions:	776
number of arcs:	2809

Structural properties

free choice — *all (different) transitions with a shared input place have no other input place* ..... ✗ (a)
state machine — *every transition has exactly one input place and exactly one output place* ..... ✗ (b)
marked graph — *every place has exactly one input transition and exactly one output transition* ..... ✗ (c)
connected — *there is a undirected path between every two nodes (places or transitions)* ..... ✓ (d)
strongly connected — *there is a directed path between every two nodes (places or transitions)* ..... ✗ (e)
source place(s) — *one or more places have no input transitions* ..... ✓ (f)
sink place(s) — *one or more places have no output transitions* ..... ✗ (g)

(a) arc "a1955" goes from place "p476" to transition "t498"; there are 13 other arcs (e.g., "a61") going out from "p476", and there is another arc "a1956" going to transition "t498".
(b) transition "t0" has 60 outgoing arcs.
(c) place "p25" has 39 outgoing arcs.
(d) the Petri nets produced by CÆSAR are connected.
(e) no arc goes to the initial place "p0".
(f) place "p0" is a source place.
(g) stated by CÆSAR.BDD version 2.0.

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source transition(s) — *one or more transitions have no input places* ..... ✗ (h)
sink transitions(s) — *one or more transitions have no output places* ..... ✗ (i)
loop-free — *no transition has an input place that is also an output place* ..... ✗ (j)
conservative — *for each transition, the number of input arcs equals the number of output arcs* ..... ✗ (k)
subconservative — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ..... ✗ (l)

Behavioural properties

safe — *in every reachable marking, there is no more than one token on a place* ..... ✓ (m)
deadlock — *there exists a reachable marking from which no transition can be fired* ..... ✗ (n)
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ..... ✗ (o)
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 graph

number of reachable markings:	$\approx 9.8 \times 10^{21}$ — precisely: 9,794,739,147,610,899,087,361 (q)
number of transition firings:	?
max. number of tokens per place:	1
max. number of tokens per marking:	60

Other properties

Because it was generated from a process algebraic specification (LOTOS) the present benchmark has structural properties guaranteed by construction (but that can be checked using Petri tools):

- It contains 60 sequential components (named *units* and noted "u1"..."u60") that execute concurrently and synchronize on certain transitions. A root unit (noted "u0") encapsulates all the other 60 units. Units are described in the `<toolspecific>` section of the PNML file. They form a partition of the set of places: each place belongs to a single unit. The places of a given unit are listed between the `<places>` and `</places>` tags.
- The places of the same unit are mutually exclusive (in every reachable marking, at most one of these places has a token) This leads to 61 invariants, one for each unit. For instance, unit u1 has two places p1 and p2, which leads to the corresponding invariant: $p1 + p2 \leq 1$.
- Notice that the conjonction of these 61 invariants imples the 1-safe property for the net (here at most one token per place in every reachable marking). It also ensures that each reachable marking as at most 61 tokens (actually 60, because the root unit is mutually exclusive with any other unit).

Properties to be queried, which are not guaranteed by construction and practically useful, are the following:

- Absence/presence of deadlocks
- Quasi-liveness: does the net contain transitions that are not enabled from any reachable marking? (if so, which ones?)

(h) stated by CÆSAR.BDD version 2.0.
(i) stated by CÆSAR.BDD version 2.0.
(j) 143 transitions are not loop free, e.g., transition "t22".
(k) transition "t0" is not conservative.
(l) transition "t0" is not subconservative.
(m) net is 1-safe by construction, as it was generated from LOTOS using CÆSAR.
(n) checked by various tools in 2003 — see http://www.informatik.uni-hamburg.de/cgi-bin/TGI/pnml/getpost?id=2003/09/2736.
(o) no arc goes to the initial place "p0".
(p) checked by various tools in 2003 — see http://www.informatik.uni-hamburg.de/cgi-bin/TGI/pnml/getpost?id=2003/09/2736; confirmed by CÆSAR.BDD version 2.0.
(q) computed by the SMART and Versify tools – see http://www.informatik.uni-hamburg.de/cgi-bin/TGI/pnml/getpost?id=2003/09/2736; confirmed by CÆSAR.BDD version 1.8.