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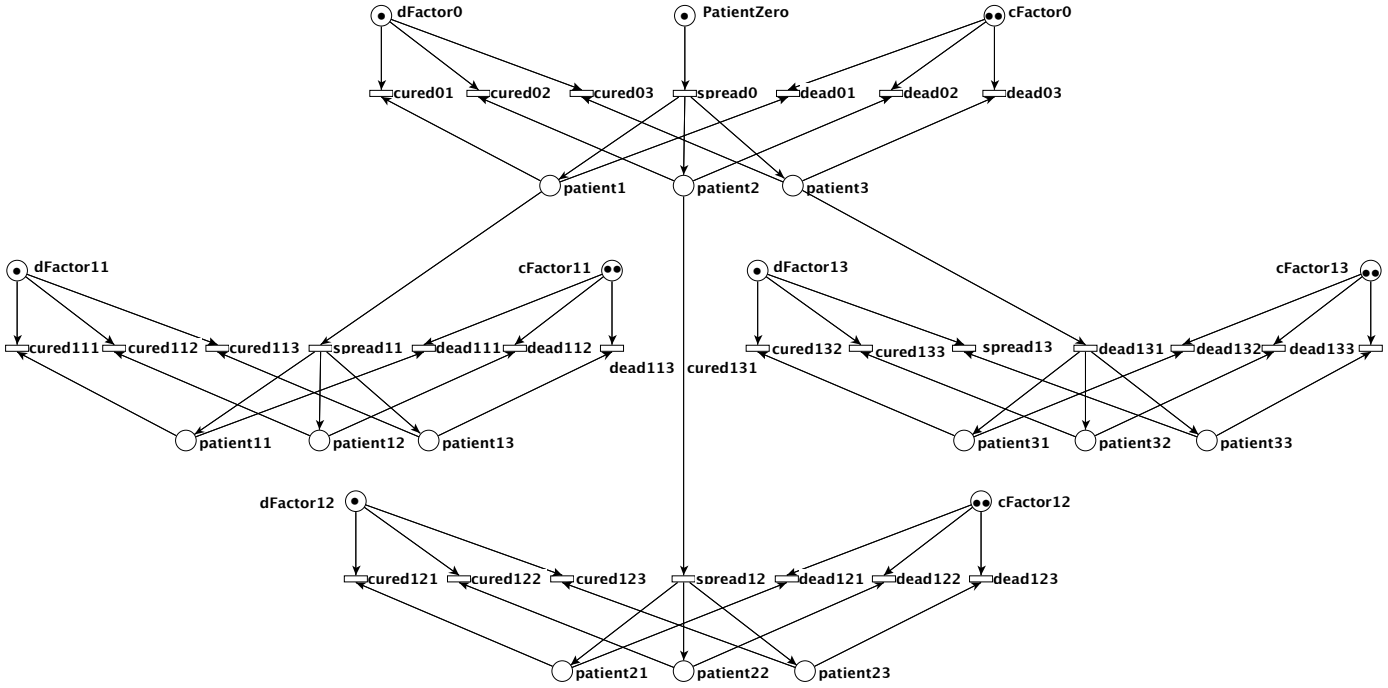
*This form is a summary description of the model entitled "ViralEpidemic" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given 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 the simplified propagation of a contagious disease (from the point of view of a distributed system). It is based on a standard module describing a step where a given patient may either:

- propagate the disease
- die (according to an upper bound)
- cure himself (according to an upper bound)

In the two later cases, the disease does not propagate again.




*Instantiation of this model for a spread factor of the virus (R0) of 3 (i.e. a patient contaminates 3 others), a death factor of 1 (i.e. at one stage, $\frac{1}{3}$ of the patients may die) and a potential cure factor of 2 (i.e. at one stage, $\frac{2}{3}$ of the patients may cure themselves); the analysis depth is 1 (one level of propagation of the disease)*

## Scaling parameter

| Parameter name | Parameter description | Chosen parameter values |
|---|---|---|
| $S, D, C, A$ | $S$, the spread factor (how many people are contaminated), $D$, the number of potential deaths at each step of the propagation, $C$, the number of potential cured patients at each step of the propagation, $A$, the depth of the analysis (how many steps of the contamination are explored) | $\langle 2,1,1,10\rangle$, $\langle 2,1,1,12\rangle$, $\langle 3,1,1,2\rangle$, $\langle 3,1,1,4\rangle$, $\langle 3,1,1,6\rangle$, $\langle 3,1,1,8\rangle$, $\langle 4,1,1,2\rangle$, $\langle 4,1,1,3\rangle$, $\langle 4,1,1,4\rangle$, $\langle 4,1,1,6\rangle$, $\langle 8,1,2,2\rangle$, $\langle 8,1,2,4\rangle$, $\langle 16,2,4,1\rangle$, $\langle 16,2,4,2\rangle$, $\langle 16,2,4,3\rangle$ |

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## Size of the model

| Parameter | Number of places | Number of transitions | Number of arcs |
|---|---|---|---|
| $\langle 2,1,1,10\rangle$ | 8 189 | 10 235 | 22 517 |
| $\langle 2,1,1,12\rangle$ | 32 765 | 40 955 | 90 101 |
| $\langle 3,1,1,2\rangle$ | 66 | 91 | 208 |
| $\langle 3,1,1,4\rangle$ | 606 | 847 | 1 936 |
| $\langle 3,1,1,6\rangle$ | 5 466 | 7 651 | 17 488 |
| $\langle 3,1,1,8\rangle$ | 49 206 | 68 887 | 157 456 |
| $\langle 4,1,1,2\rangle$ | 127 | 189 | 441 |
| $\langle 4,1,1,3\rangle$ | 511 | 765 | 1 785 |
| $\langle 4,1,1,4\rangle$ | 2 047 | 3 069 | 7 161 |
| $\langle 4,1,1,6\rangle$ | 32 767 | 49 149 | 114 681 |
| $\langle 8,1,2,2\rangle$ | 731 | 1 241 | 2 993 |
| $\langle 8,1,2,4\rangle$ | 46 811 | 79 577 | 191 921 |
| $\langle 16,2,4,1\rangle$ | 307 | 561 | 1 377 |
| $\langle 16,2,4,2\rangle$ | 4 915 | 9 009 | 22 113 |
| $\langle 16,2,4,3\rangle$ | 78 643 | 144 177 | 353 889 |

## 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 3.3 on all 15 instances (see all aforementioned parameter values).
[b] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[c] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[d] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[e] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[f] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[g] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[h] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[i] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[j] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[k] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[l] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[m] stated by CÆSAR.BDD version 3.3 on all 15 instances (see all aforementioned parameter values).
[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* ..... ? [s]
**live** — *for every transition t, from every reachable marking, one can reach a marking in which t can fire* ..... ? [t]

## 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 |
|---|---|---|---|---|
| $\langle 2,1,1,10\rangle$ | ? | ? | ? | $\geq 6142$ |
| $\langle 2,1,1,12\rangle$ | ? | ? | ? | $\geq 24574$ |
| $\langle 3,1,1,2\rangle$ | 9.16868e+09 [u] | ? | 1 | $\in [53, 66]$ [v] |
| $\langle 3,1,1,4\rangle$ | 4.5789e+89 [w] | ? | ? | $\geq 485$ |
| $\langle 3,1,1,6\rangle$ | ? | ? | ? | $\geq 4373$ |
| $\langle 3,1,1,8\rangle$ | ? | ? | ? | $\geq 39365$ |
| $\langle 4,1,1,2\rangle$ | 9.93735e+19 [x] | ? | 1 | $\in [106, 127]$ [y] |
| $\langle 4,1,1,3\rangle$ | ? | ? | ? | $\geq 426$ |
| $\langle 4,1,1,4\rangle$ | ? | ? | ? | $\geq 1706$ |
| $\langle 4,1,1,6\rangle$ | ? | ? | ? | $\geq 27306$ |
| $\langle 8,1,2,2\rangle$ | ? | ? | ? | $\geq 220$ [z] |
| $\langle 8,1,2,4\rangle$ | ? | ? | ? | $\geq 14044$ [aa] |
| $\langle 16,2,4,1\rangle$ | 1.21378e+35 [ab] | ? | ? | $\geq 103$ [ac] |
| $\langle 16,2,4,2\rangle$ | ? | ? | ? | $\geq 1639$ [ad] |
| $\langle 16,2,4,3\rangle$ | ? | ? | ? | $\geq 26215$ [ae] |

[o] stated by CÆSAR.BDD version 3.3 to be true on 2 instance(s) out of 15, false on the remaining 5 instance(s), and unknown on the remaining 8 instance(s).
[p] stated by CÆSAR.BDD version 3.3 to be false on 3 instance(s) out of 15, and unknown on the remaining 12 instance(s).
[q] stated by CÆSAR.BDD version 3.3 to be false on 3 instance(s) out of 15, and unknown on the remaining 12 instance(s).
[r] stated by CÆSAR.BDD version 3.3 to be true on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
[s] stated by CÆSAR.BDD version 3.3 to be false on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
[t] stated by CÆSAR.BDD version 3.3 to be false on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
[u] stated by CÆSAR.BDD version 3.3.
[v] upper bound given by the number of places.
[w] stated by libITS version 1.1.
[x] stated by CÆSAR.BDD version 3.3.
[y] upper bound given by the number of places.
[z] lower bound given by the number of initial tokens.
[aa] lower bound given by the number of initial tokens.
[ab] stated by libITS version 1.1.
[ac] lower bound given by the number of initial tokens.
[ad] lower bound given by the number of initial tokens.
[ae] lower bound given by the number of initial tokens.