

*This form is a summary description of the model entitled “MAPKbis” 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 is extracted from a set presented in [1] and modeling biological systems, obtained from influence graphs provided by biologists. This particular Petri net describes a Boolean model of Mitogen-Activated Protein Kinase network [2] (MAPK). It is a different model from the variant proposed in this contest in 2011.

## References

1. Loïc Paulevé, “Reduction of Qualitative Models of Biological Networks for Transient Dynamics Analysis”, <https://hal.archives-ouvertes.fr/hal-01580765>
2. L. Grieco, L. Calzone, I. Bernard-Pierrot, F. Radvanyi, B. Kahn-Perls, and D. Thiéffry, Integrative modelling of the influence of MAPK network on cancer cell fate decision, *PLoS Comput Biol*, vol. 9, no. 10, p. e1003286, oct 2013.

## Scaling parameter

Parameter name	Parameter description	Chosen parameter values
$n1, n2, n3$	setting parameters	(53, 1, 0), (53, 2, 0)

## Size of the model

Although the model is parameterized, its size does not depend on parameter values.

number of places: 106  
 number of transitions: 173  
 number of arcs: 986

## 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 ..... ✗  
**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 transitions(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<sup>(a)</sup> ..... ?

<sup>(a)</sup>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* ..... ✓
- 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* ..... ?