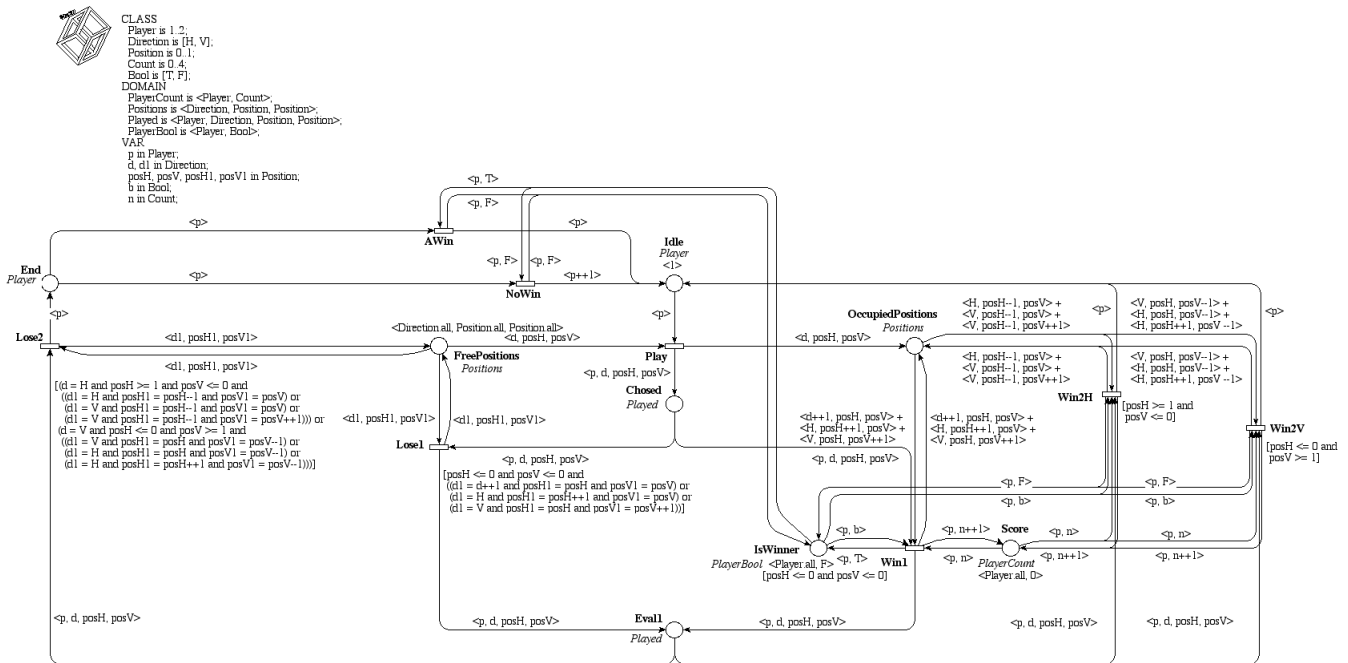


*This form is a summary description of the model entitled "Dot&Boxes" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.*

## Description

Dot and Boxes is a pencil and paper game you have certainly played in your childhood: from an empty grid of dots, two players add, in turn, a line between two adjacent dots. The player that finishes a box owns it and can play again. The game ends when all possible lines are drawn and the winner is the player that owns the larger number of boxes.

Exceptionally, this model has no equivalent P/T.



Graphical representation for  $N = 2$

## References

[http://en.wikipedia.org/wiki/Dots\\_and\\_Boxes](http://en.wikipedia.org/wiki/Dots_and_Boxes)

## Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	The grid has been squared with $N+1$ dots per line	2, 3, 4, 5

## Size of the model

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

- number of places: 8
- number of transitions: 8
- number of arcs: 44

## Structural properties

<b>ordinary</b> — all arcs have multiplicity one .....	✓
<b>simple free choice</b> — all transitions sharing a common input place have no other input place .....	✗ (a)
<b>extended free choice</b> — all transitions sharing a common input place have the same input places .....	✗ (b)
<b>state machine</b> — every transition has exactly one input place and exactly one output place .....	✗ (c)
<b>marked graph</b> — every place has exactly one input transition and exactly one output transition .....	✗ (d)
<b>connected</b> — there is an undirected path between every two nodes (places or transitions) .....	✓ (e)
<b>strongly connected</b> — there is a directed path between every two nodes (places or transitions) .....	? (f)
<b>source place(s)</b> — one or more places have no input transitions .....	✗ (g)
<b>sink place(s)</b> — one or more places have no output transitions .....	? (h)
<b>source transition(s)</b> — one or more transitions have no input places .....	✗ (i)
<b>sink transitions(s)</b> — one or more transitions have no output places .....	✗ (j)
<b>loop-free</b> — no transition has an input place that is also an output place .....	✗ (k)
<b>conservative</b> — for each transition, the number of input arcs equals the number of output arcs .....	✓ (l)
<b>subconservative</b> — for each transition, the number of input arcs equals or exceeds the number of output arcs .....	✓ (m)
<b>nested units</b> — places are structured into hierarchically nested sequential units <sup>(n)</sup> .....	✗

## Behavioural properties

<b>safe</b> — in every reachable marking, there is no more than one token on a place .....	✓
<b>deadlock</b> — there exists a reachable marking from which no transition can be fired .....	✓ (o)
<b>reversible</b> — from every reachable marking, there is a transition path going back to the initial marking .....	✗ (p)
<b>quasi-live</b> — for every transition $t$ , there exists a reachable marking in which $t$ can fire .....	? (q)
<b>live</b> — for every transition $t$ , from every reachable marking, one can reach a marking in which $t$ can fire .....	? (r)

## 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
$N = 2$	11 <sup>(s)</sup>	14 <sup>(t)</sup>	?	?
$N = 3$	383 <sup>(u)</sup>	559 <sup>(v)</sup>	?	?
$N = 4$	? <sup>(w)</sup>	340 193 <sup>(x)</sup>	?	?

- (a) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (b) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (c) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (d) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (e) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (f) stated by [CÆSAR.BDD](#) version 2.6 to be true on 3 instance(s) out of 4, and false on the remaining 1 instance(s).  
 (g) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (h) stated by [CÆSAR.BDD](#) version 2.6 to be true on 1 instance(s) out of 4, and false on the remaining 3 instance(s).  
 (i) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (j) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (k) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (l) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (m) stated by [CÆSAR.BDD](#) version 2.6 on all 4 instances (2, 3, 4, and 5).  
 (n) the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>  
 (o) stated by [CÆSAR.BDD](#) version 2.6 to be true on 1 instance(s) out of 4, and unknown on the remaining 3 instance(s); confirmed at MCC'2014 by Helena on all 4 colored instances.  
 (p) stated by [CÆSAR.BDD](#) version 2.6 to be false on 1 instance(s) out of 4, and unknown on the remaining 3 instance(s).  
 (q) stated by [CÆSAR.BDD](#) version 2.6 to be false on 1 instance(s) out of 4, and unknown on the remaining 3 instance(s).  
 (r) stated by [CÆSAR.BDD](#) version 2.6 to be false on 1 instance(s) out of 4, and unknown on the remaining 3 instance(s).  
 (s) computed at MCC'2013 by Alpina, and ITS-Tools; confirmed at MCC'2014 by Helena.  
 (t) confirmed at MCC'2014 by Helena.  
 (u) computed at MCC'2013 by ITS-Tools; confirmed at MCC'2014 by Helena.  
 (v) computed at MCC'2014 by Helena.  
 (w) either 270 156, as computed at MCC'2013 by ITS-Tools, or 220 819, as computed at MCC'2014 by Helena.

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<sup>(x)</sup> computed at MCC'2014 by Helena.