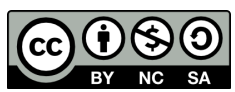
CDM

Safra's Algorithm

Klaus Sutner

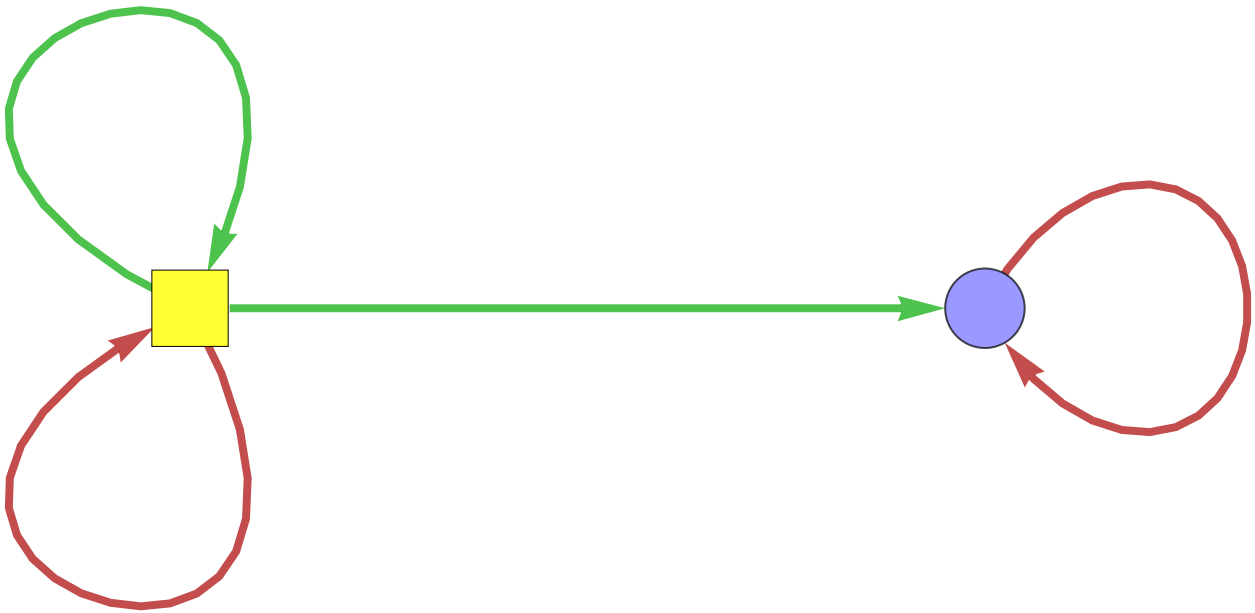
Carnegie Mellon University

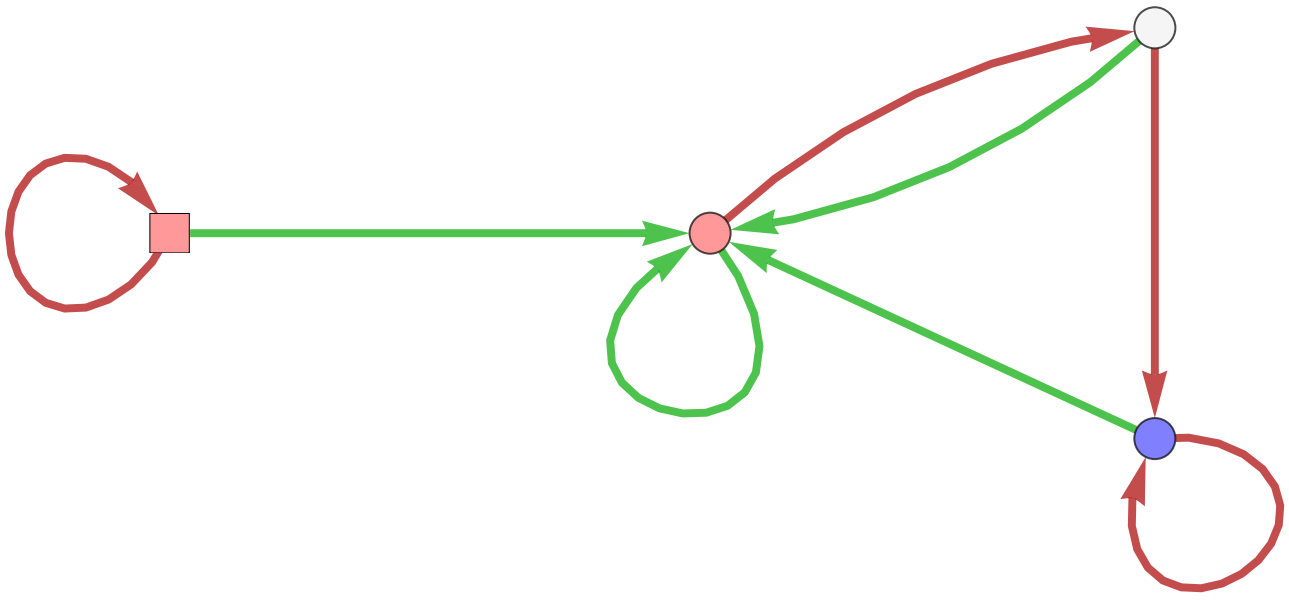
Spring 2024



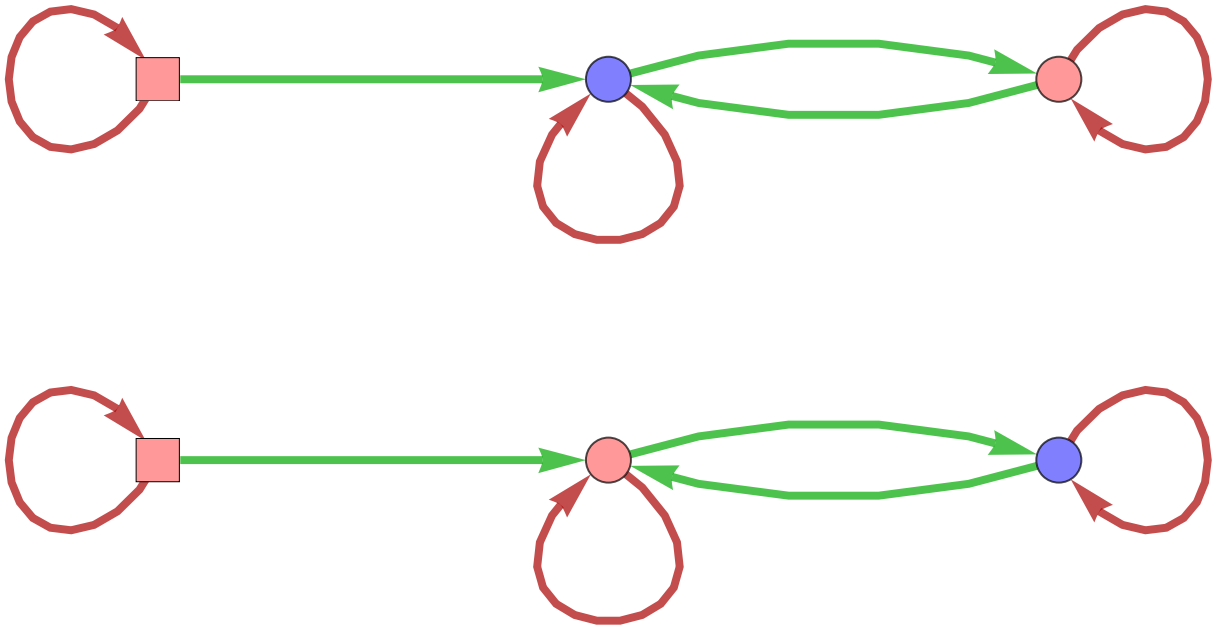
1 **Reasonable Examples**

2 **Blow-Up**

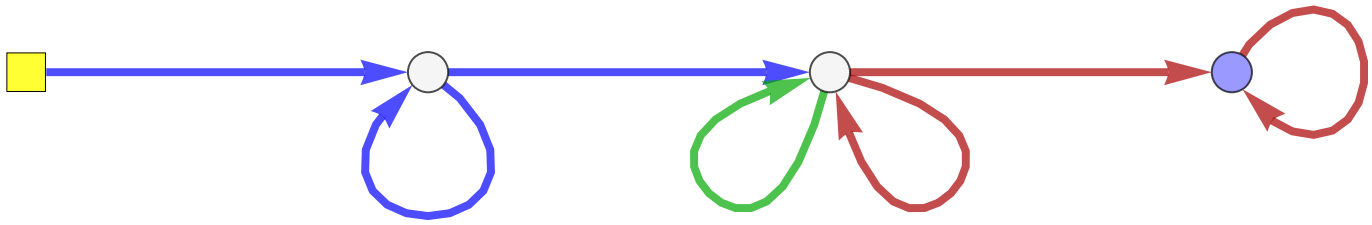




Note how an input a resets the machine. Branch first, 1 Rabin pair.

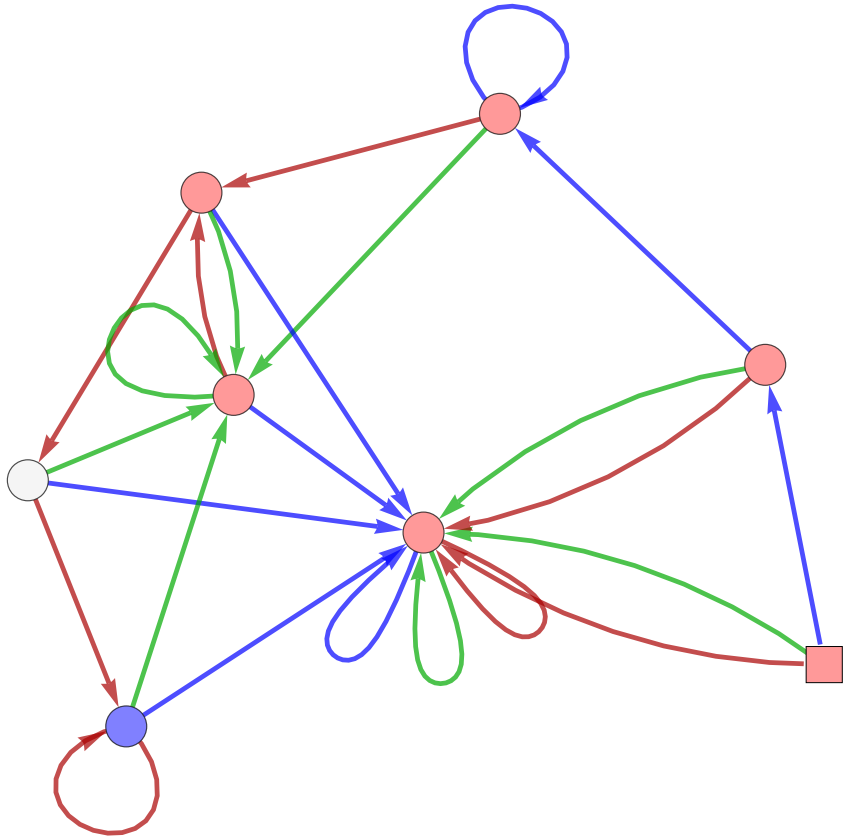


Transitions first, 2 Rabin pairs.



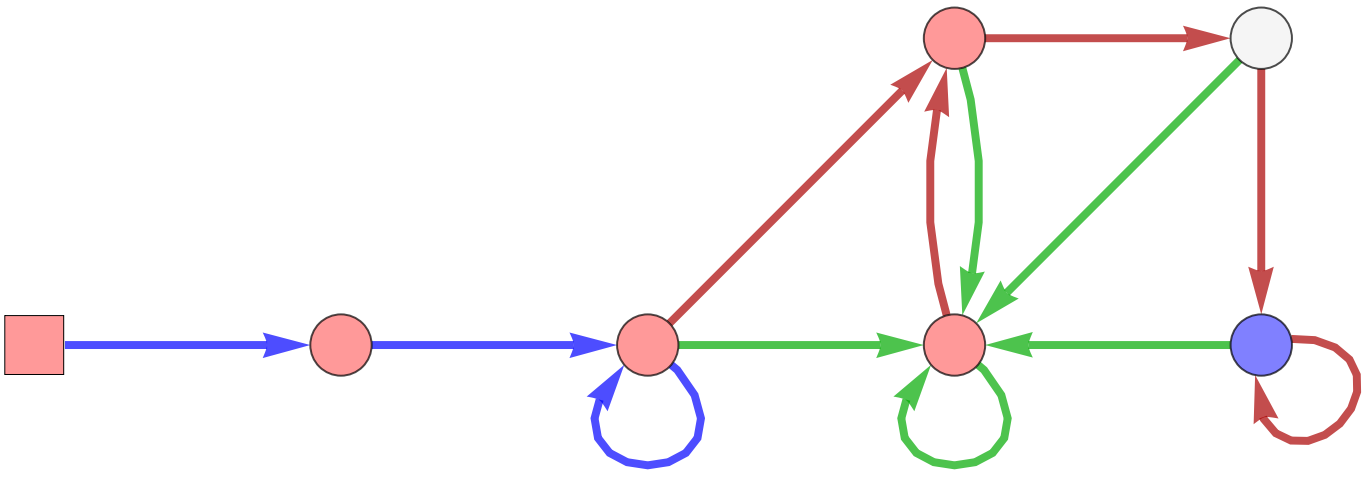
$L = ccc^\star(a+b)^\star aa^\star$

This could be managed by hand ...



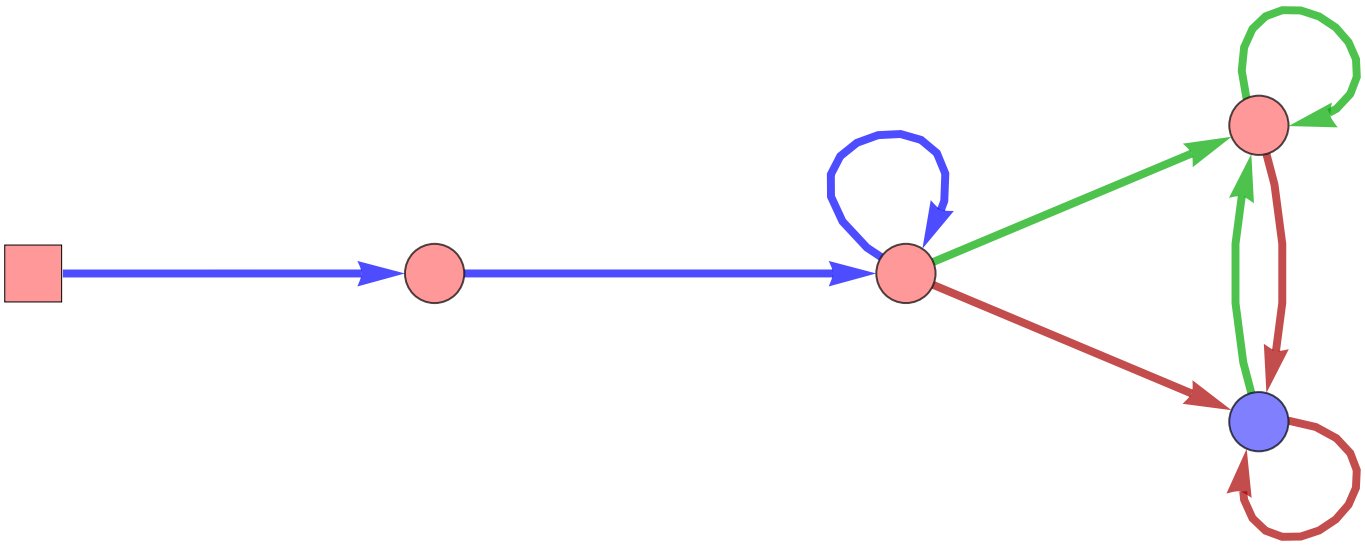
Branching first, 1 Rabin pair.

Note the accepting trap.



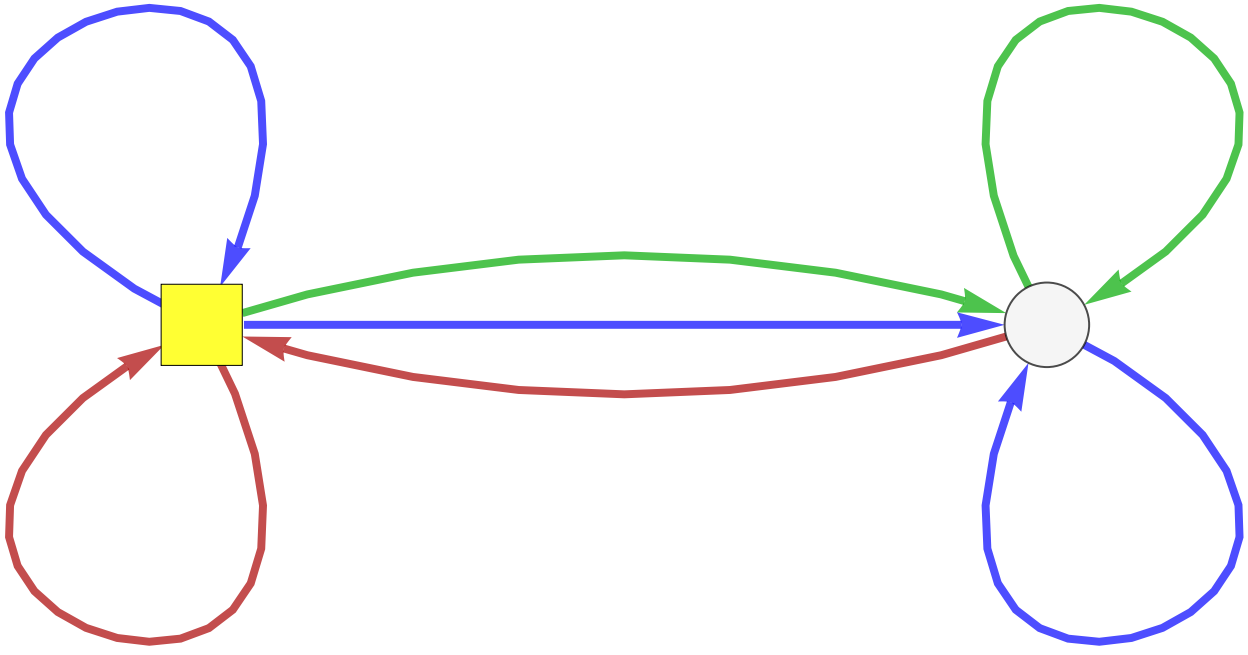
Without the sink.

Input b resets the right part of the automaton.

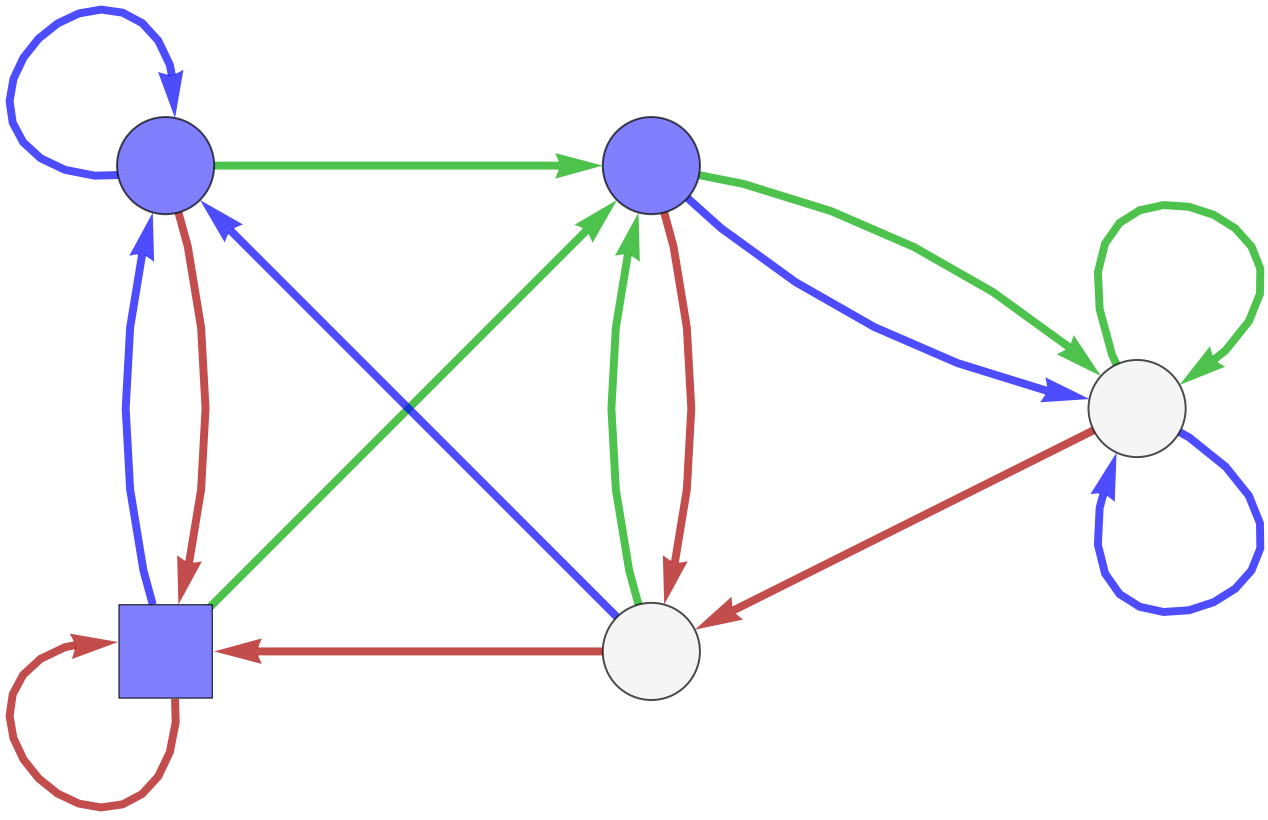


Transitions first, 1 Rabin pair. Clearly better.

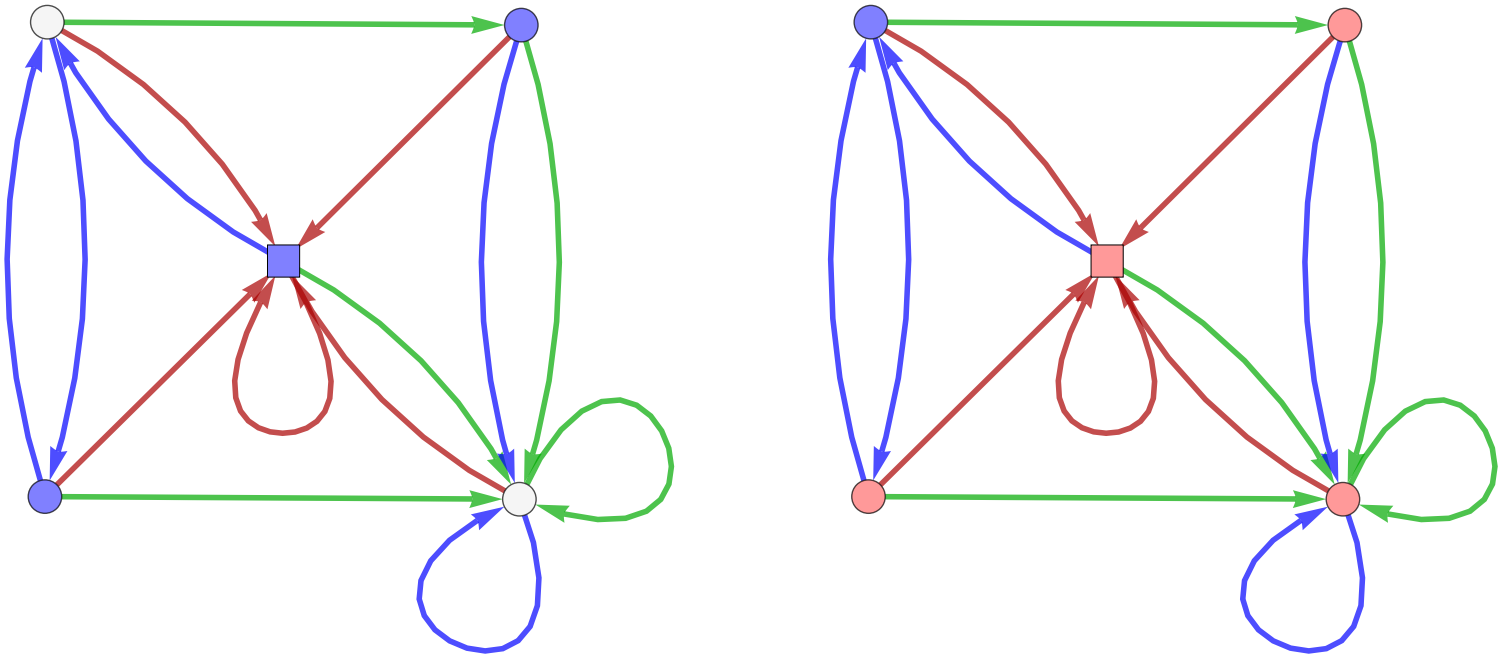
Figure out how to construct this machine from the previous one by state-merging.



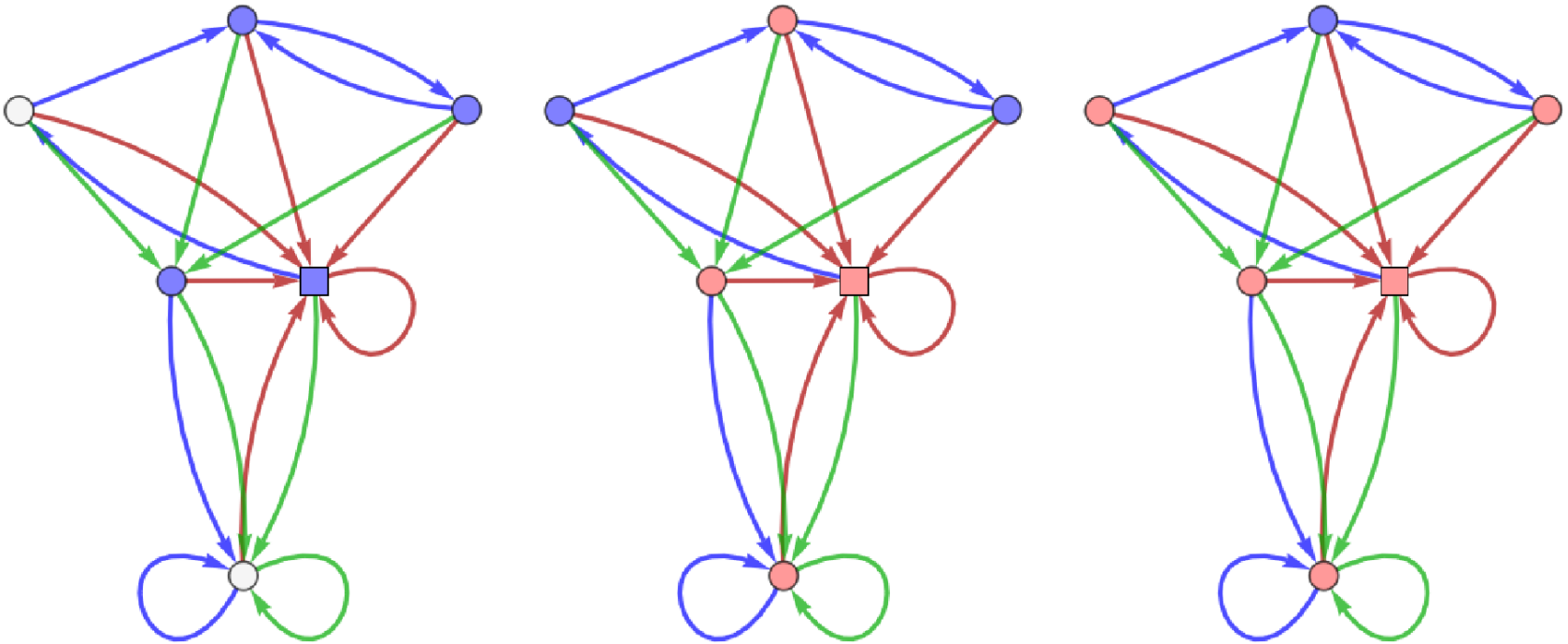
A surprisingly messy example from the Pin/Perrin book.



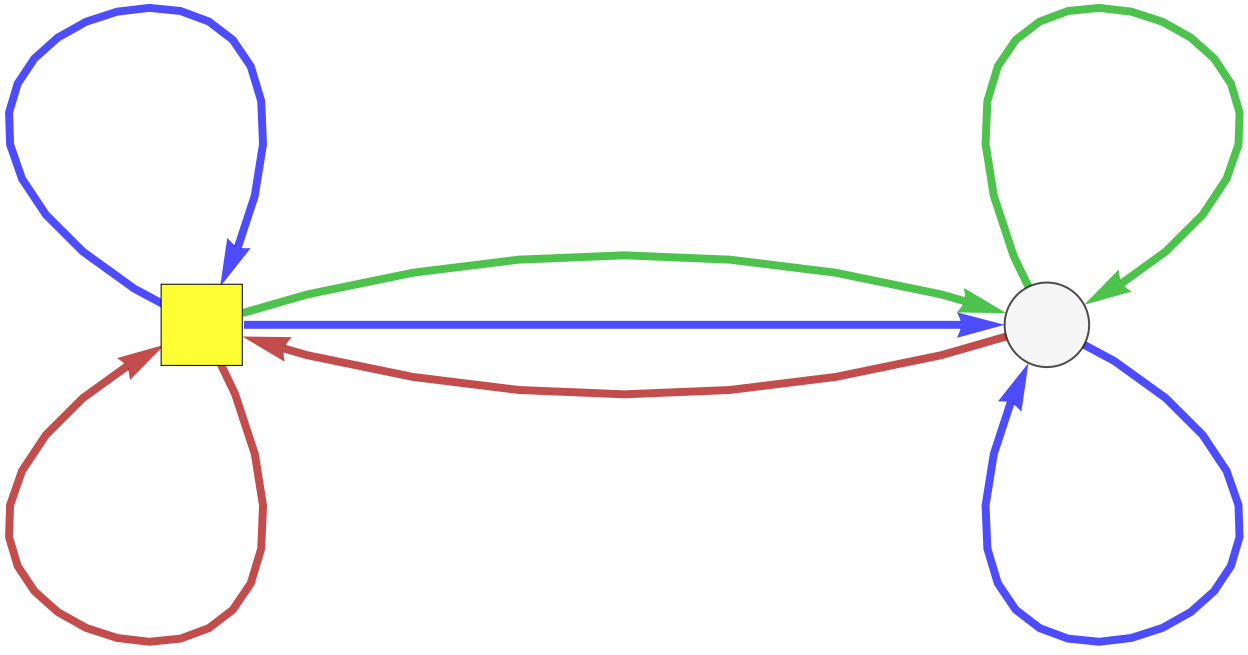
Branching first.



Transitions first. 2 Rabin pairs.



A different algorithm due to Muller and Schupp.



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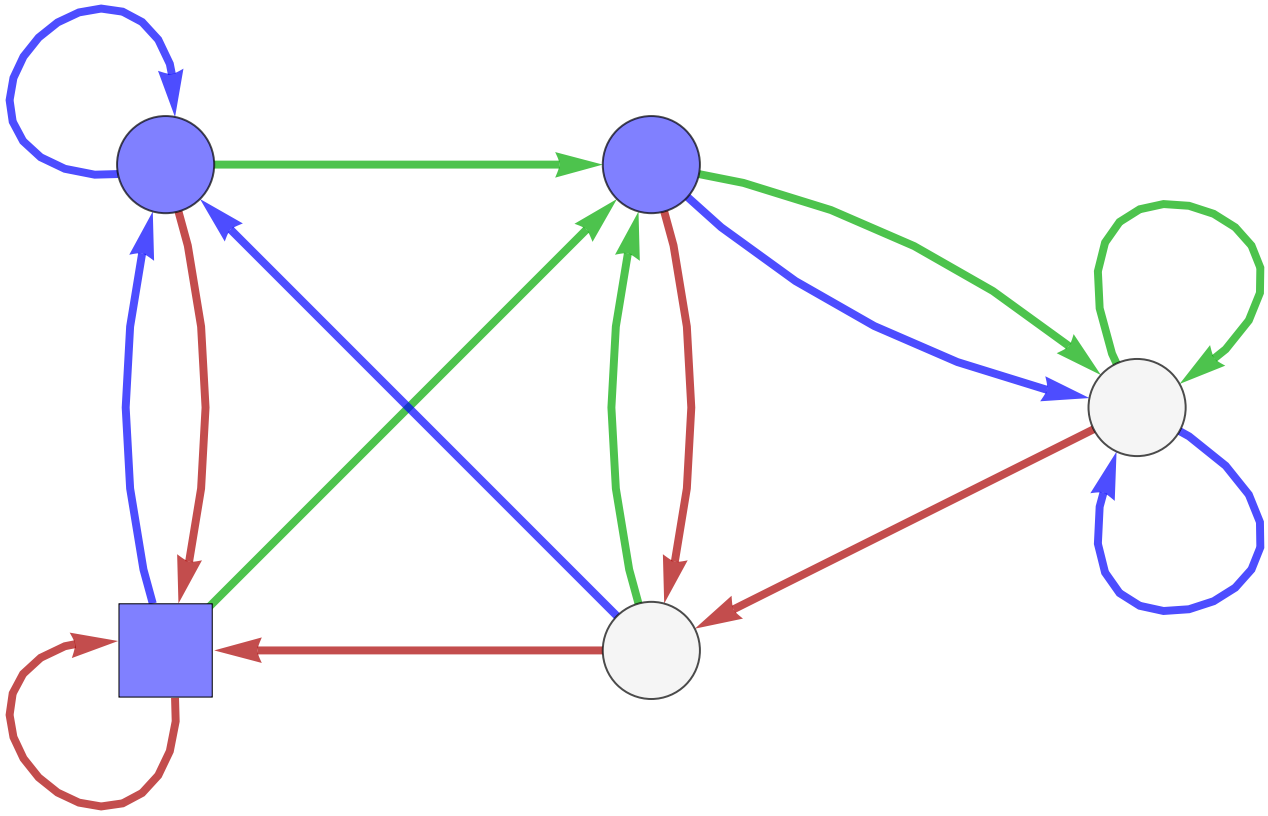

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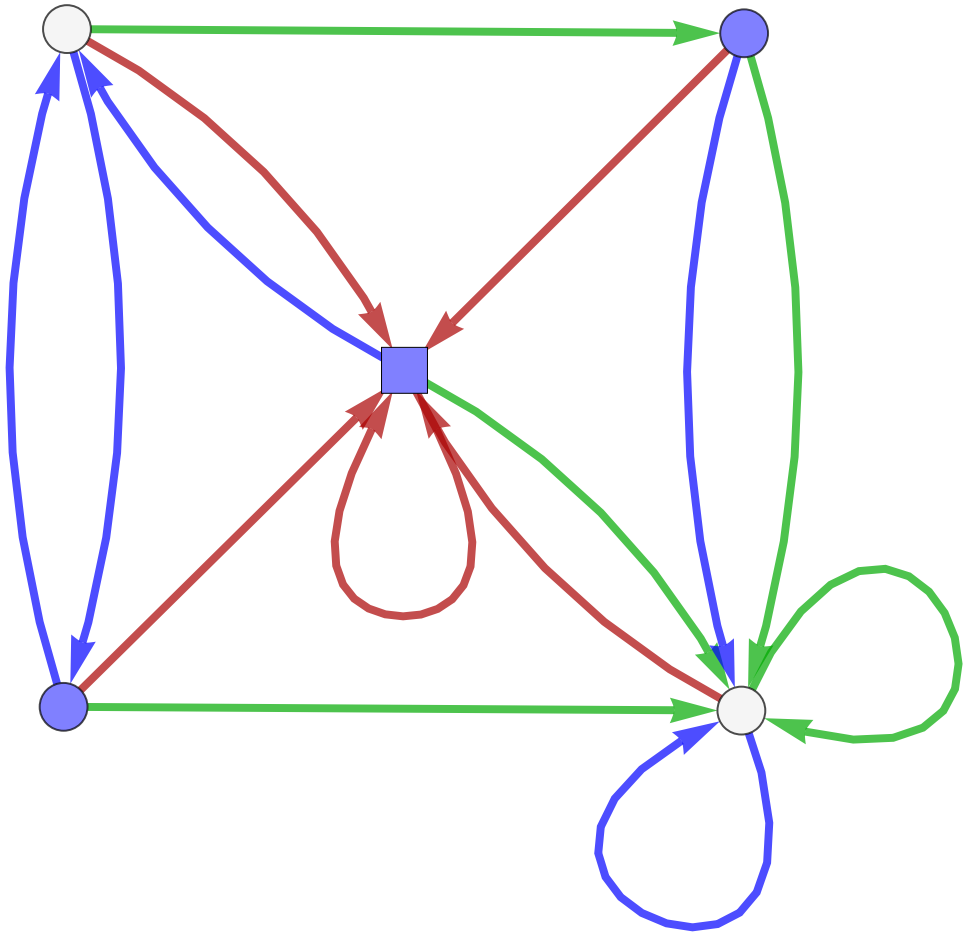

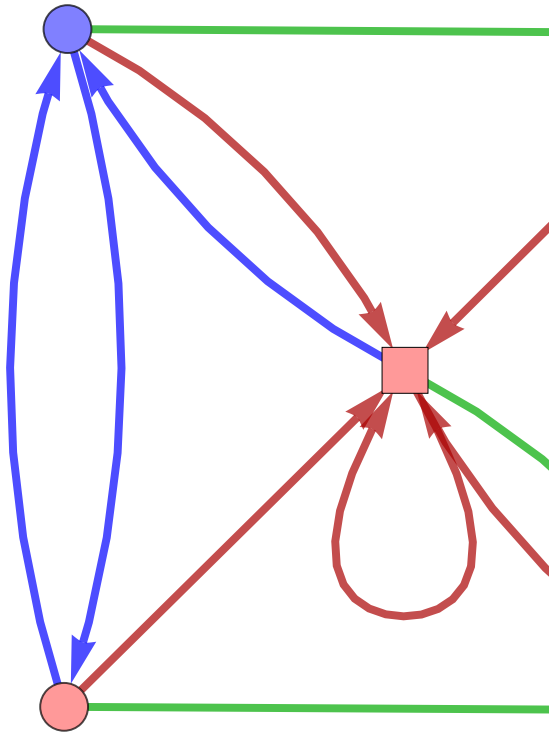

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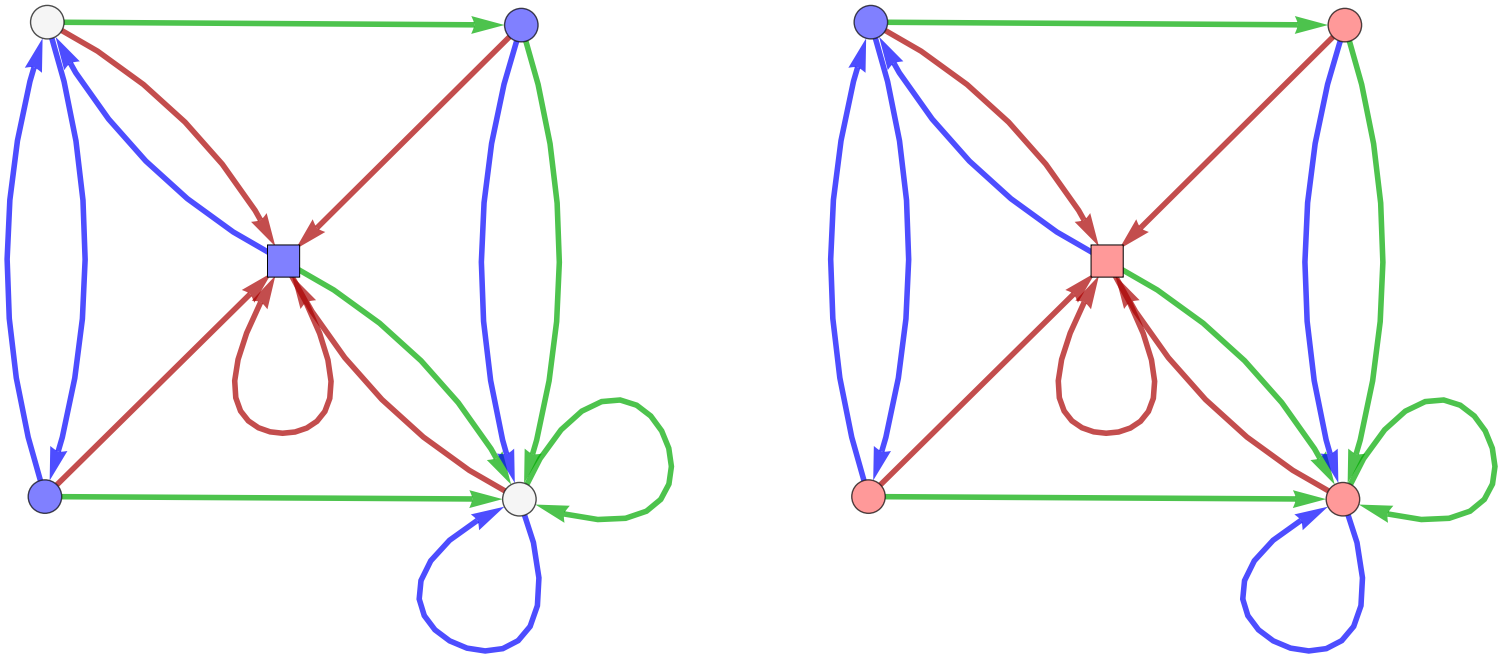

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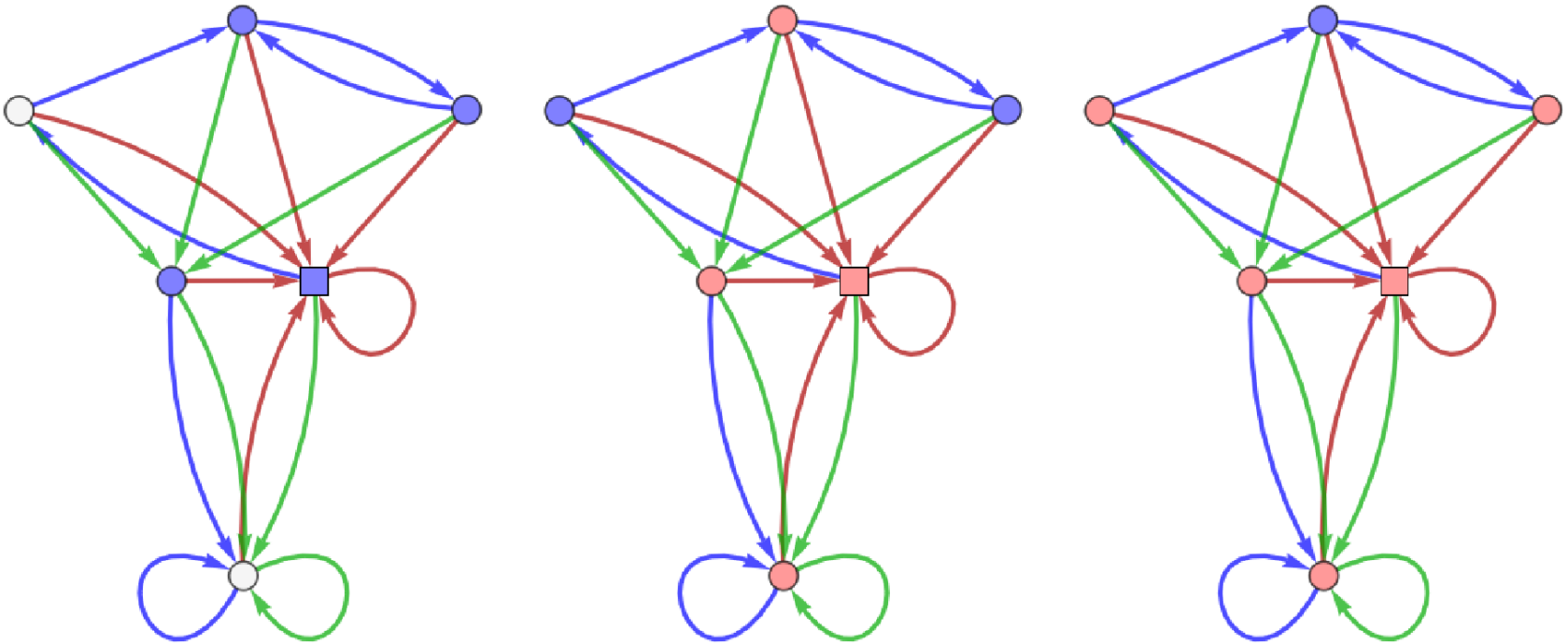

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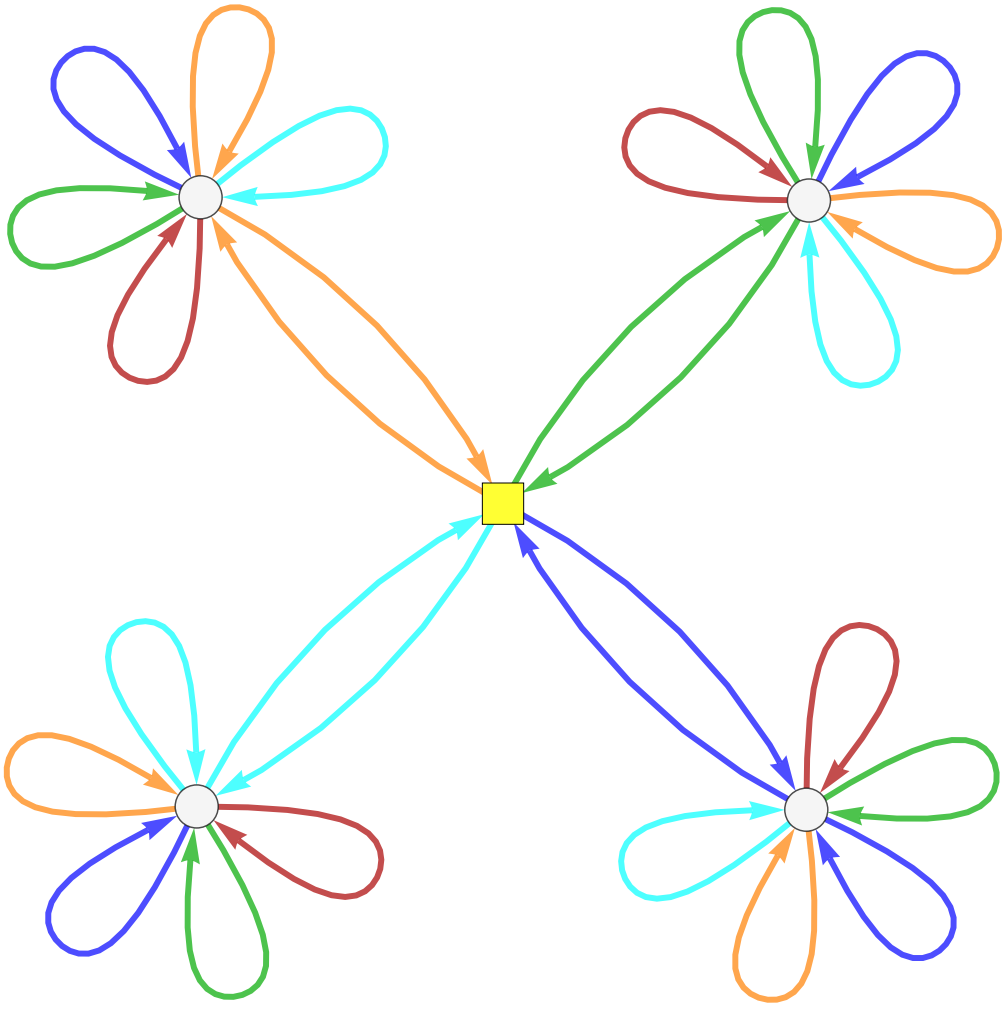
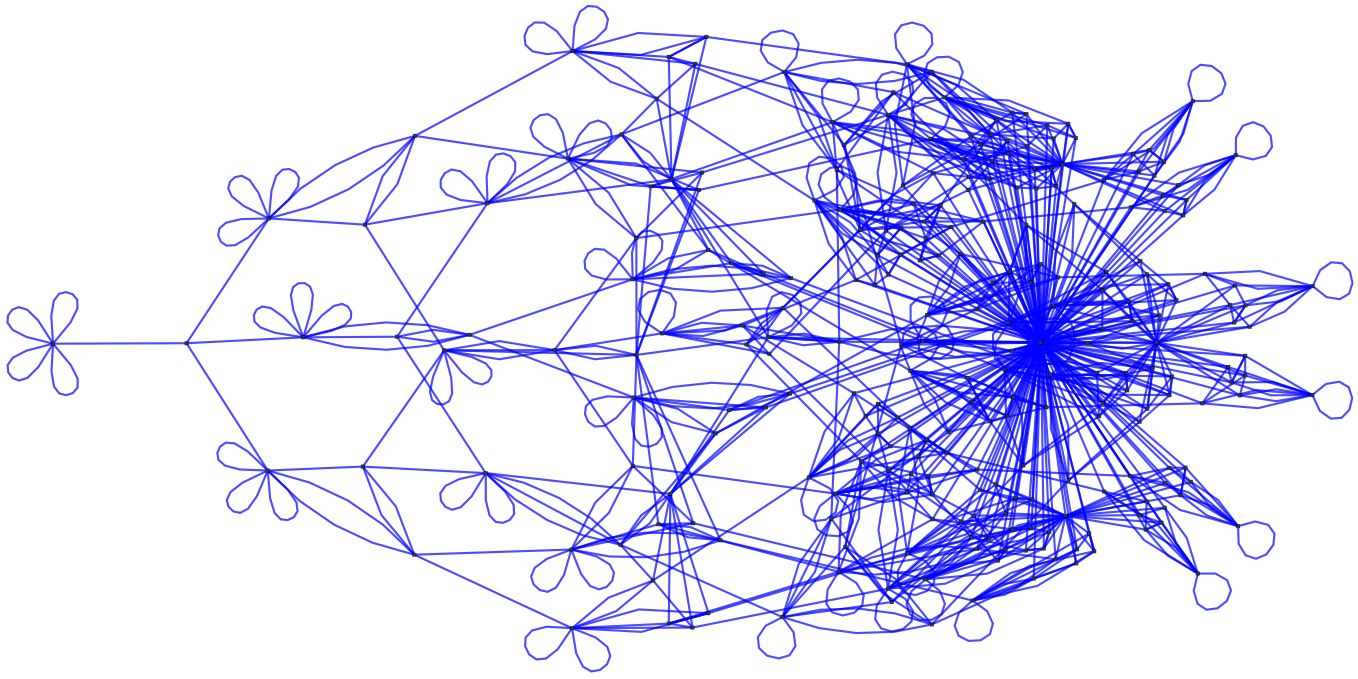
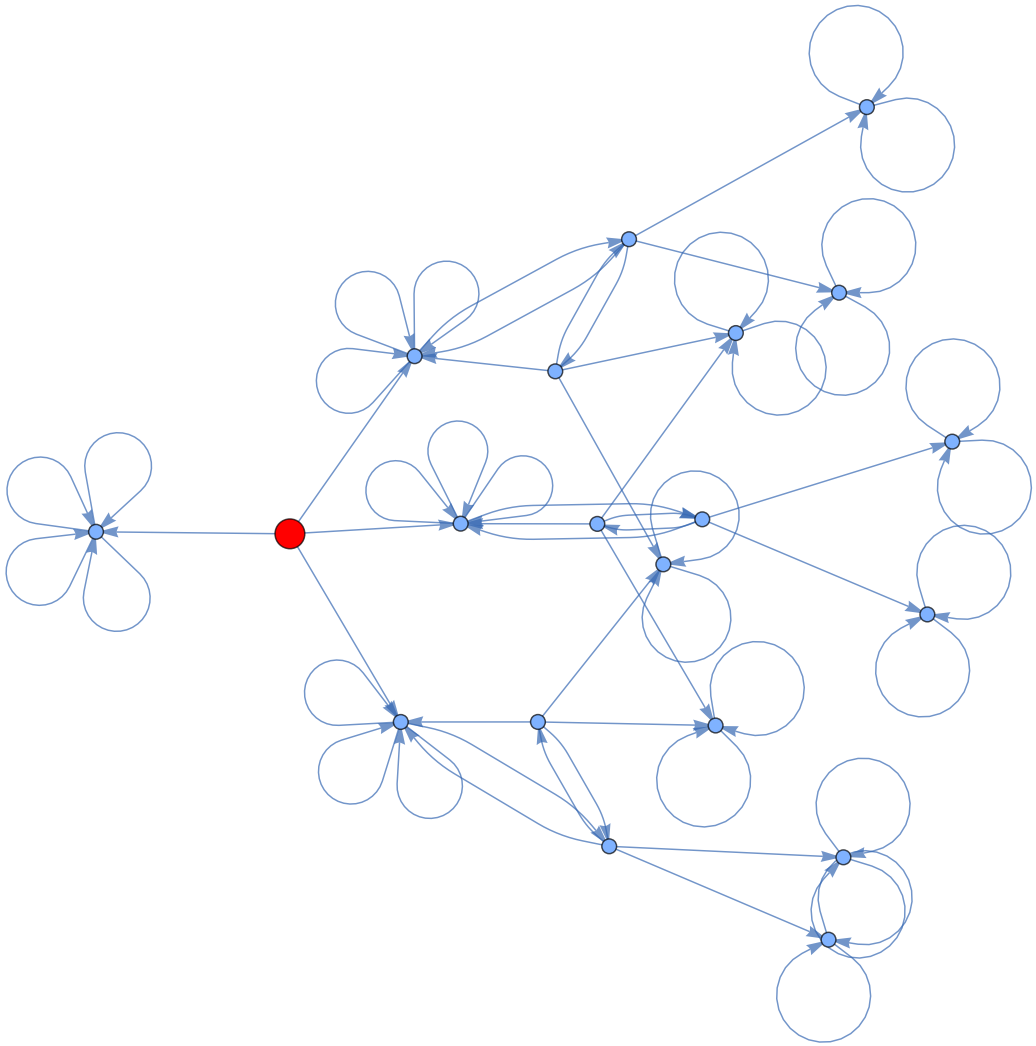
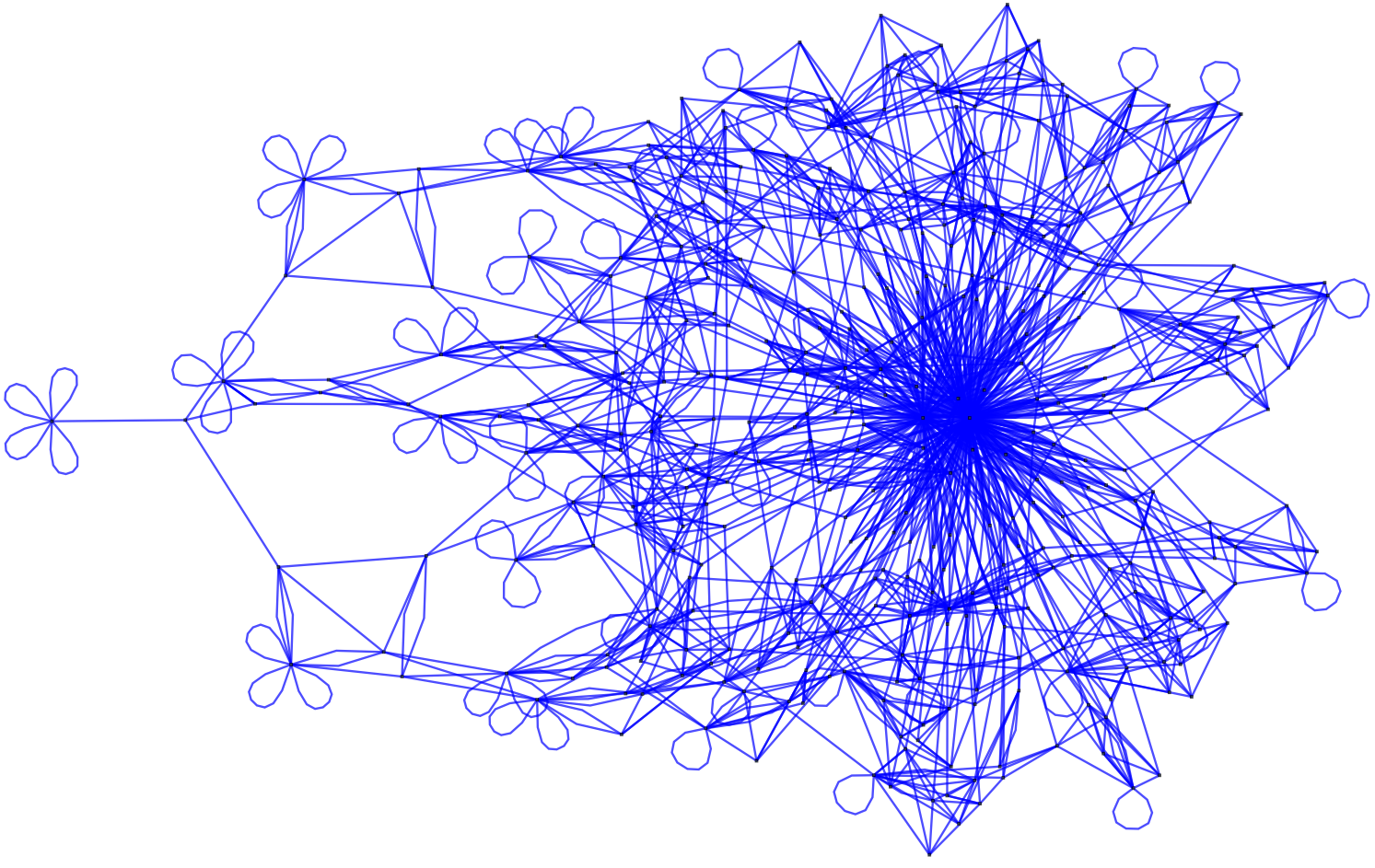


The Michel “infinite path” automaton for $k = 4$.

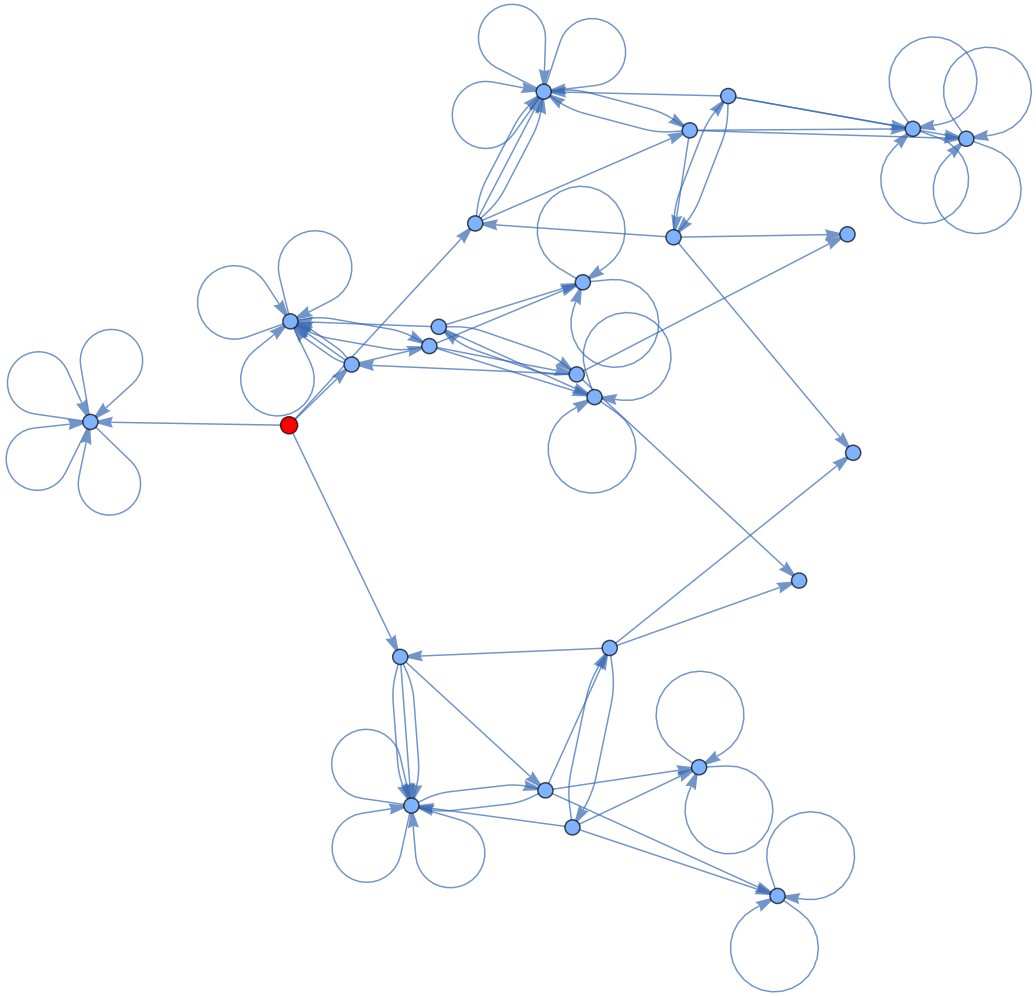


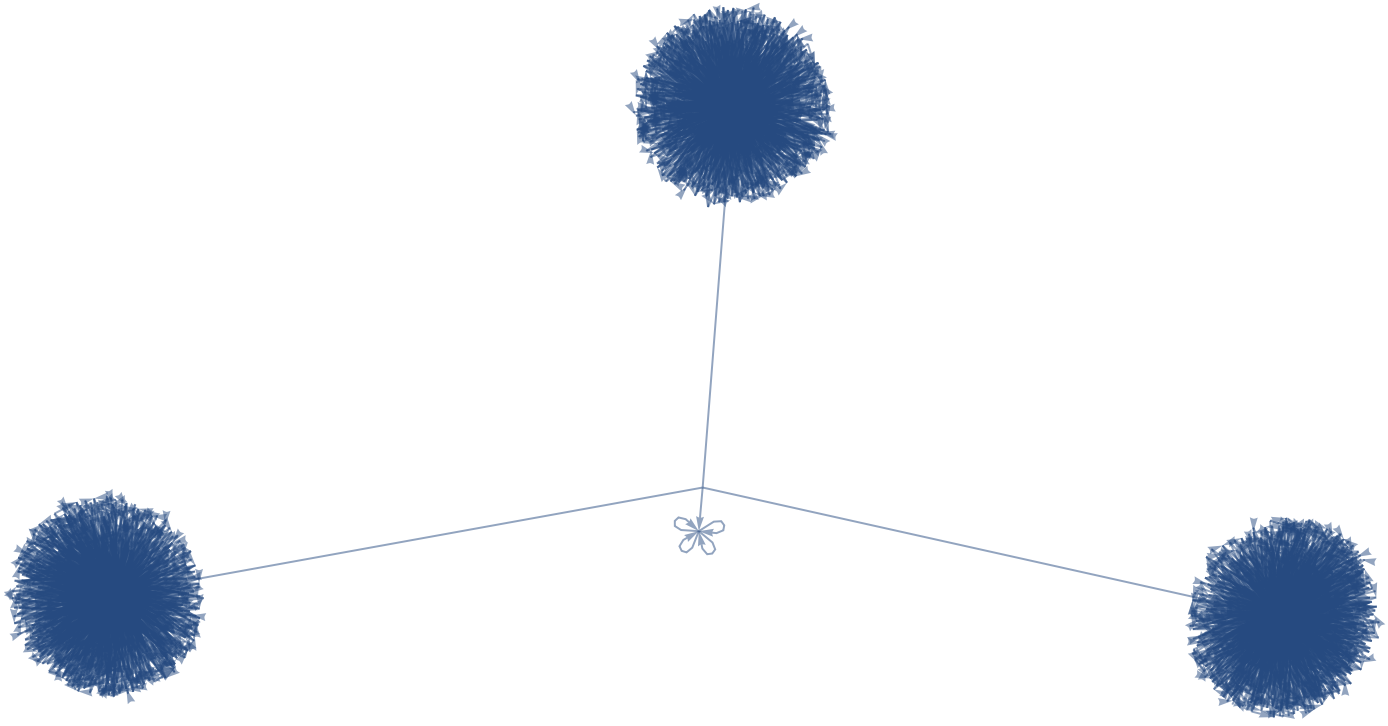
257 states—from a 4-state machine!





Even worse, this time there are 385 states.





Muller-Schupp produces a machine with a whopping $13,907$ states.
The picture is the 2-neighborhood of state 1, containing 1919 states.

Timing

$n = 3$	385	<1 sec	branch first
	257	<1 sec	trans first
	$13,907$	20 sec	Muller-Schupp
$n = 4$	$13,349$	19 sec	branch first
	$10,369$	17 sec	trans first

This is a straightforward implementation in Mathematica and should be taken with a grain of salt.