A Modular Model Checker for Reference Nets: MoMoC

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Content

Introduction

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MoMoC pursues two goals:

- Teaching model checking
- Extensibility, to form a basis for further research on model checking of Reference nets

Reference Nets

The Java Reference Net Formalism

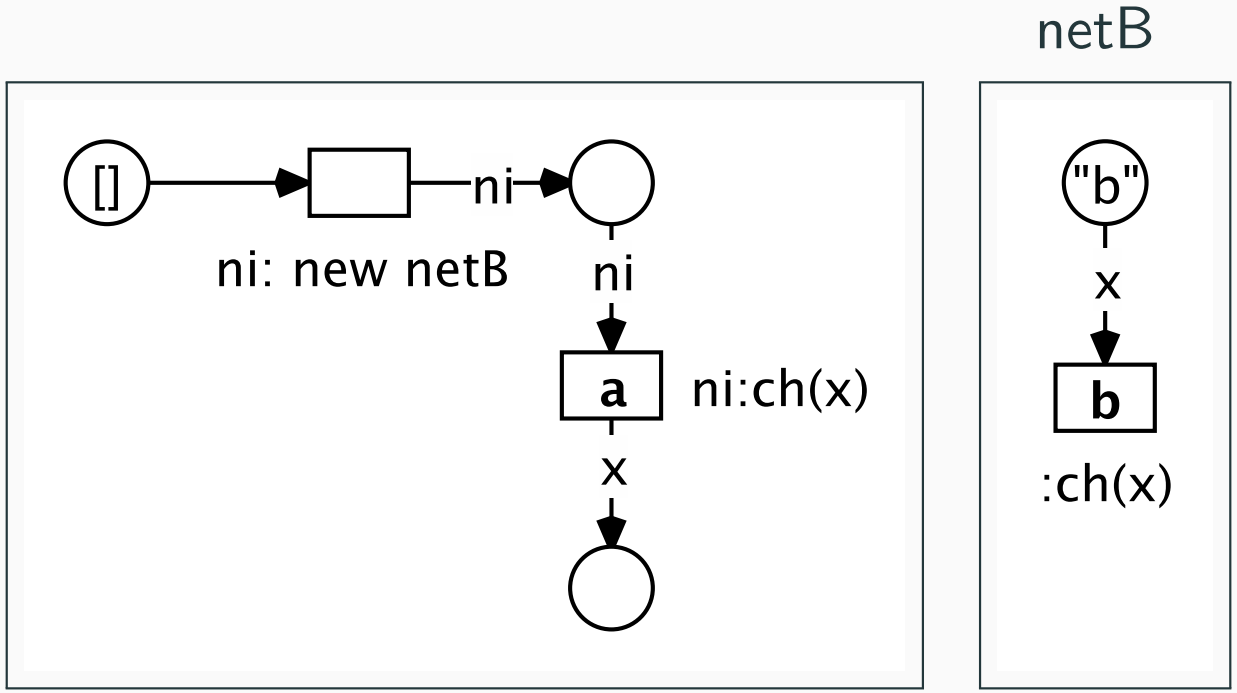
- Coloured Petri net (CPN) formalism
- Primary formalism of the Renew simulator
- Java code inscriptions
- Tokens: Java objects or *net instances*
- Interaction: *synchronous channels*

Net Instance Tokens

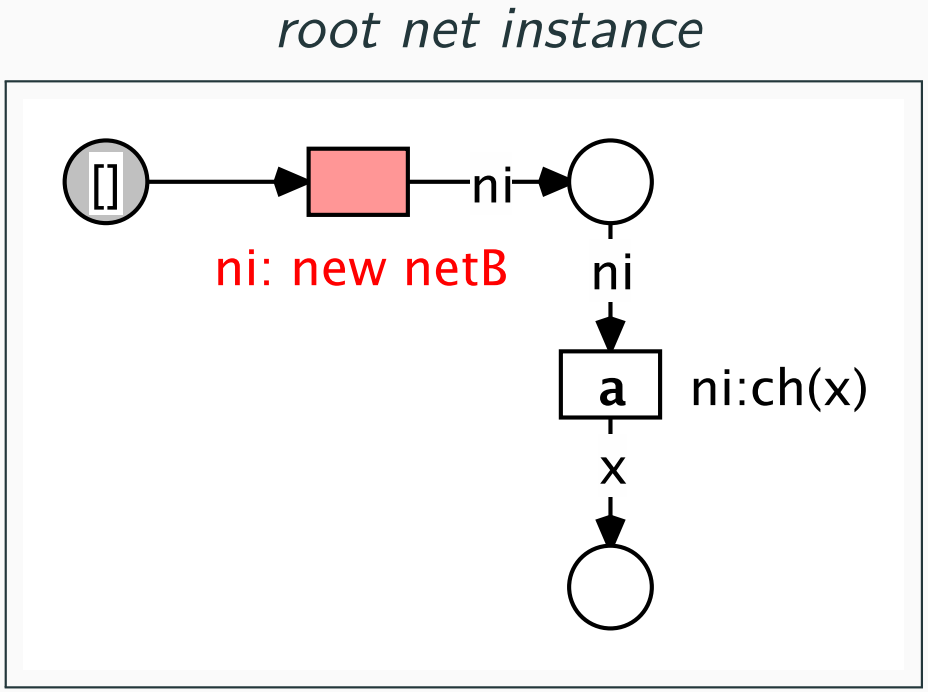
- nets-within-nets
- follows the object-oriented paradigm

net template	class
net instance	instance/object
net elements	internals of a class
uplinks of a net	methods/interface of a class
invoking an uplink	invoking a method

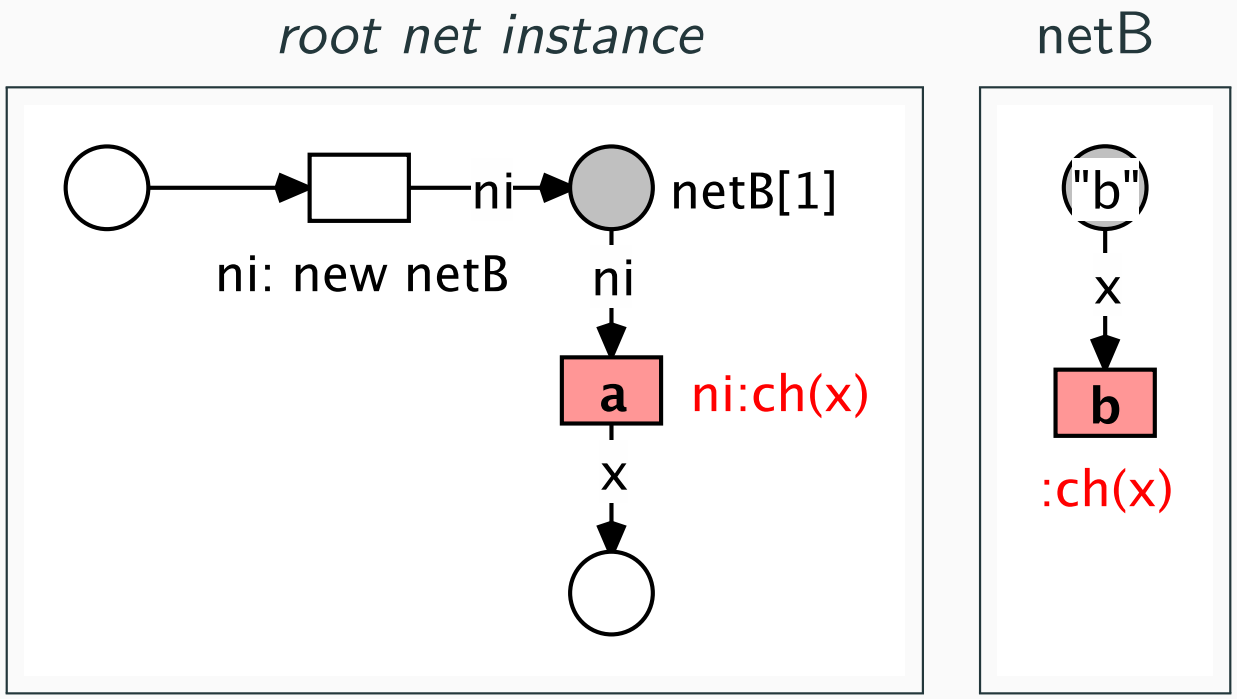
Java Reference Net Example



Java Reference Net Example



Java Reference Net Example



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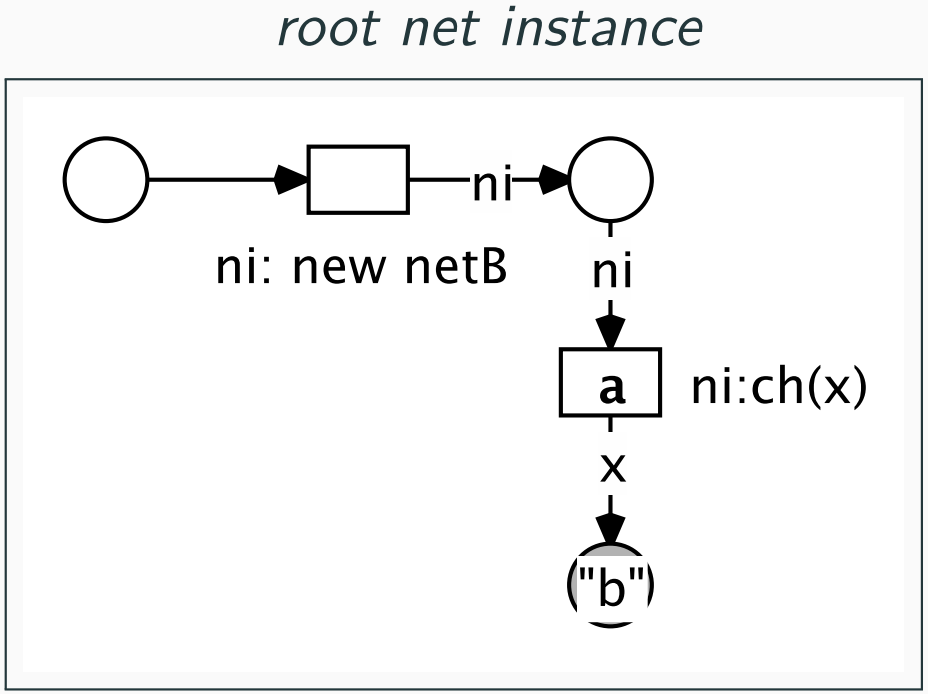

Features

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Modular Model Checker (MoMoC)

- Explicit CTL-Model Checking for Reference Nets
- Parsing
- Result visualization (exploration, colorization, layouting)
- Net Instance Quantifier
- Simpler net formalisms (P/T nets, CPNs) can be treated as flat Reference nets

Atomic Propositions

- FIREABLE(T)
- DEADLOCK

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Scales independently of the size of the reachability graph, however net instances cannot be tracked over multiple states.

Parsing

Uses ANTLR as a framework for parsing.

Parsing features of MoMoC:

- Parsing of different notations
- Normalization
- Reduction
- Encoding

Result Visualization

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- States of the RG can be explored
- RG can interactively be colorized with results of subroutines

Architecture

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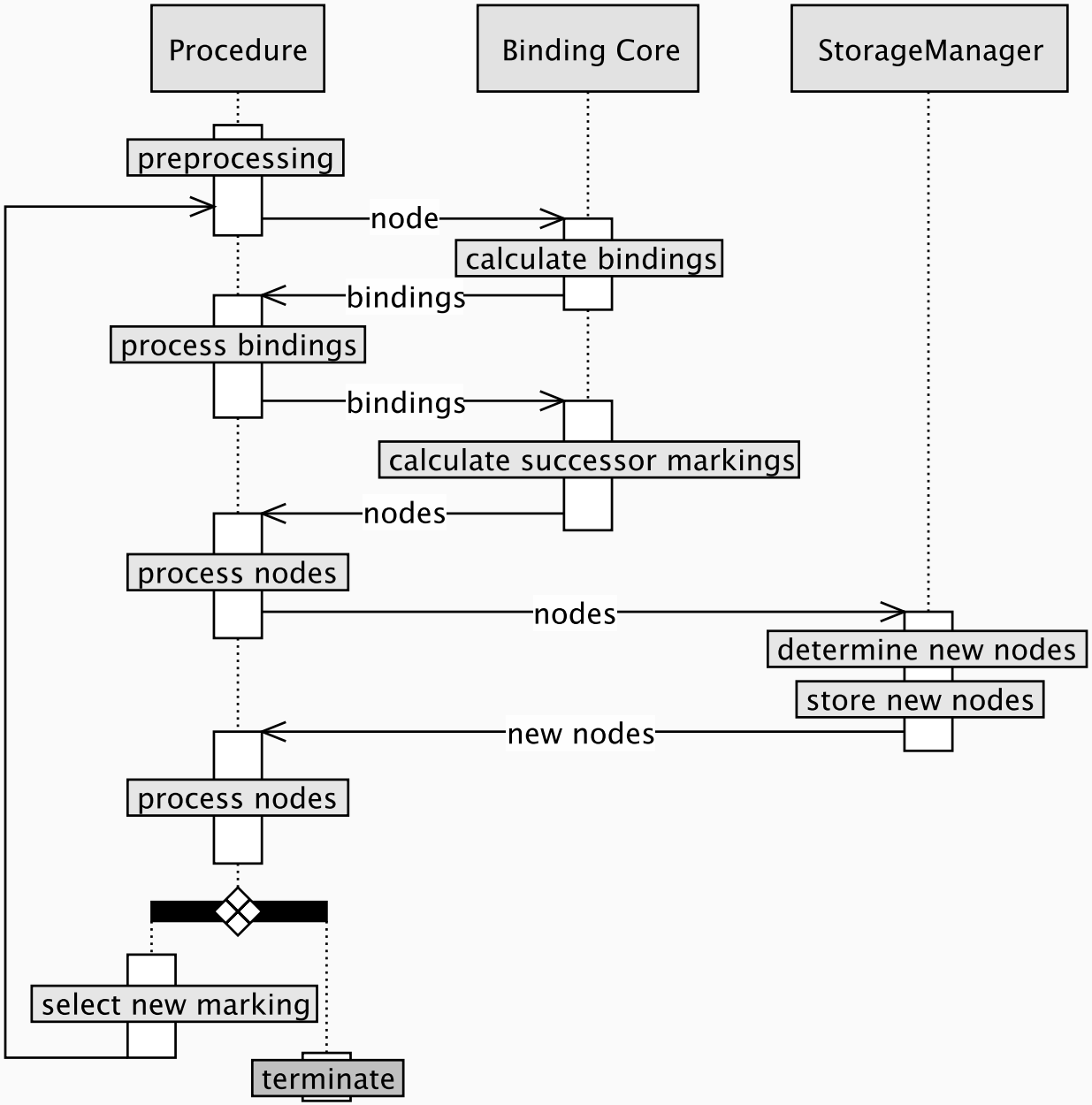
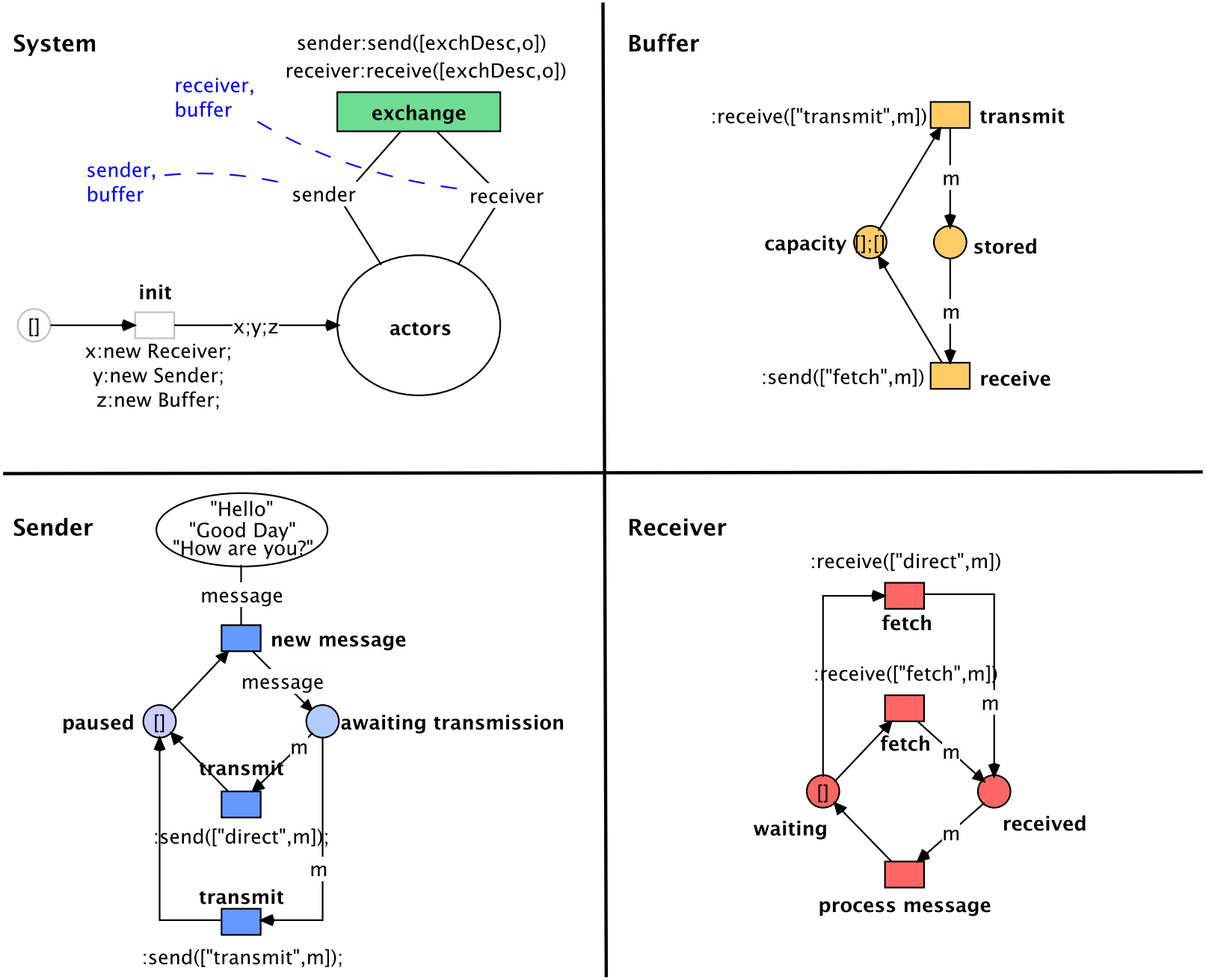
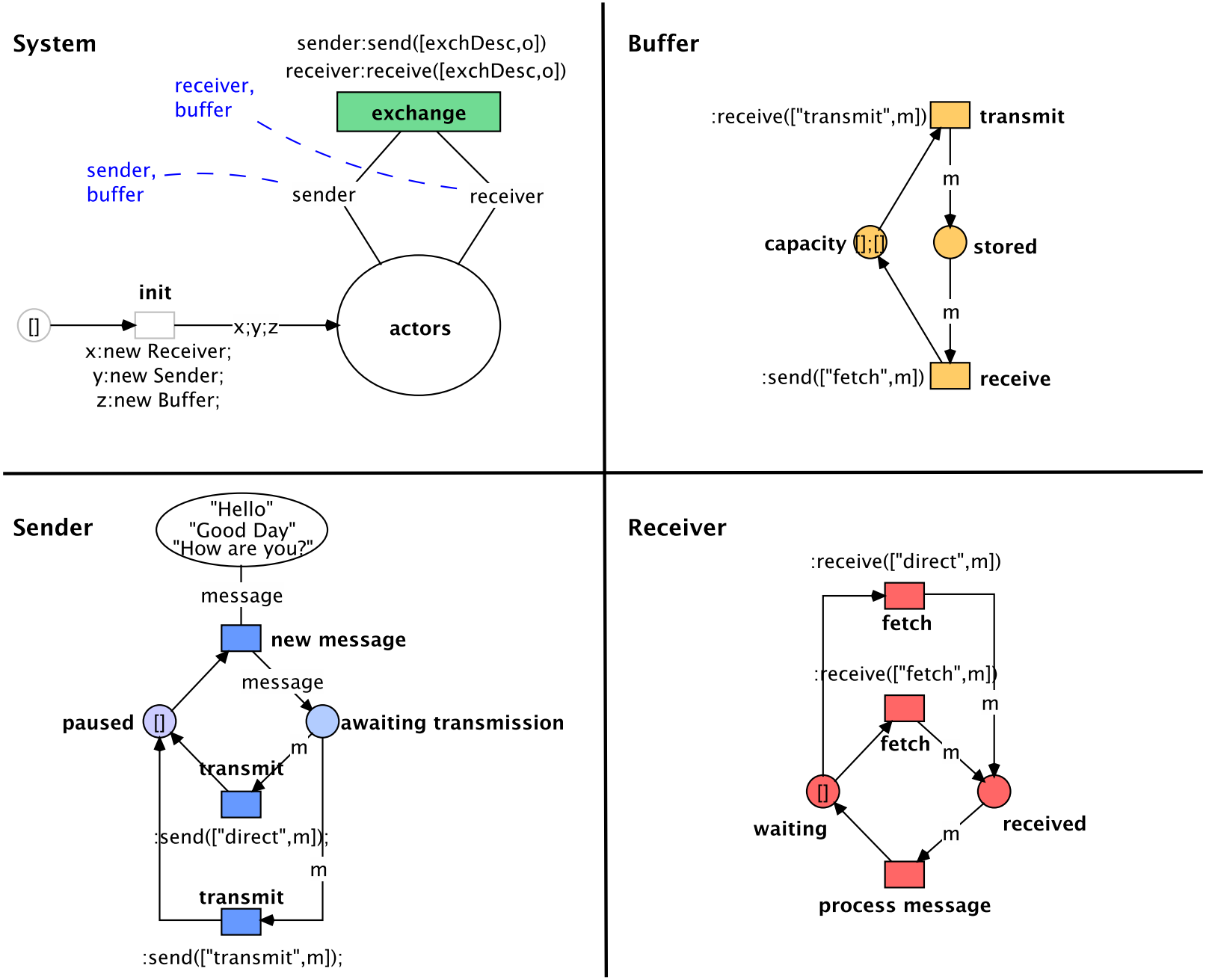
- **Binding Core** - Finds bindings and calculates successive markings, thus defines the semantics
- **Storage Manager** - Stores the reachability graph and finds cycles in the graph
- **Procedure** - Contains logic and steps to process a query

Module Interaction



Demo


System
sender:send([exchDesc,o])
receiver:receive([exchDesc,o])
receiver,
buffer
exchange
sender,
buffer
sender
receiver
init
[]
x;y;z
actors
x:new Receiver;
y:new Sender;
z:new Buffer;
Buffer
:receive(["transmit",m])
transmit
m
capacity [];[]
stored
m
:send(["fetch",m])
receive
Sender
"Hello"
"Good Day"
"How are you?"
message
new message
message
paused
[]
awaiting transmission
m
transmit
:send(["direct",m]);
m
transmit
:send(["transmit",m]);
Receiver
:receive(["direct",m])
fetch
:receive(["fetch",m])
m
fetch
m
[]
received
waiting
m
process message



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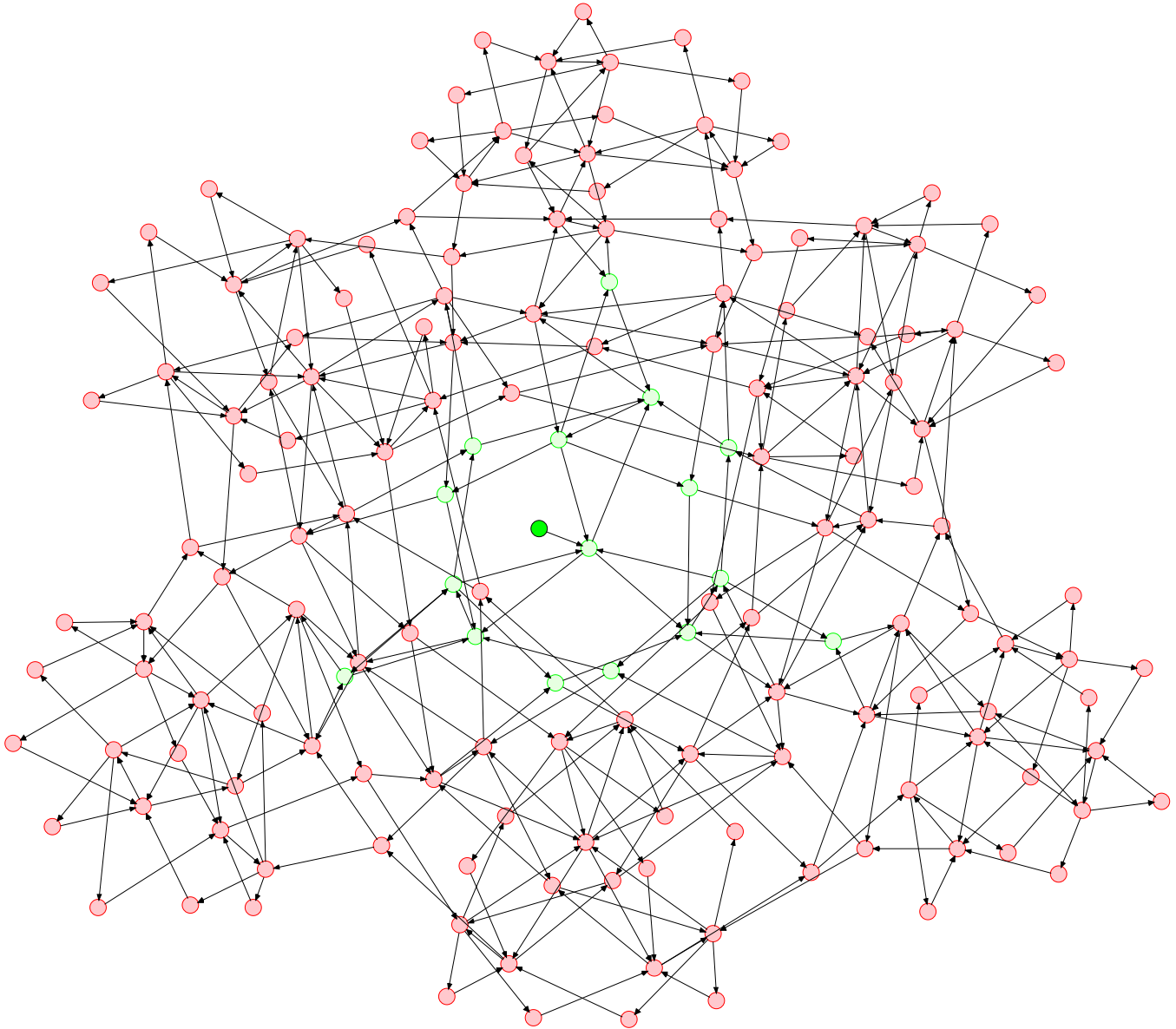
Show Reachability Graph



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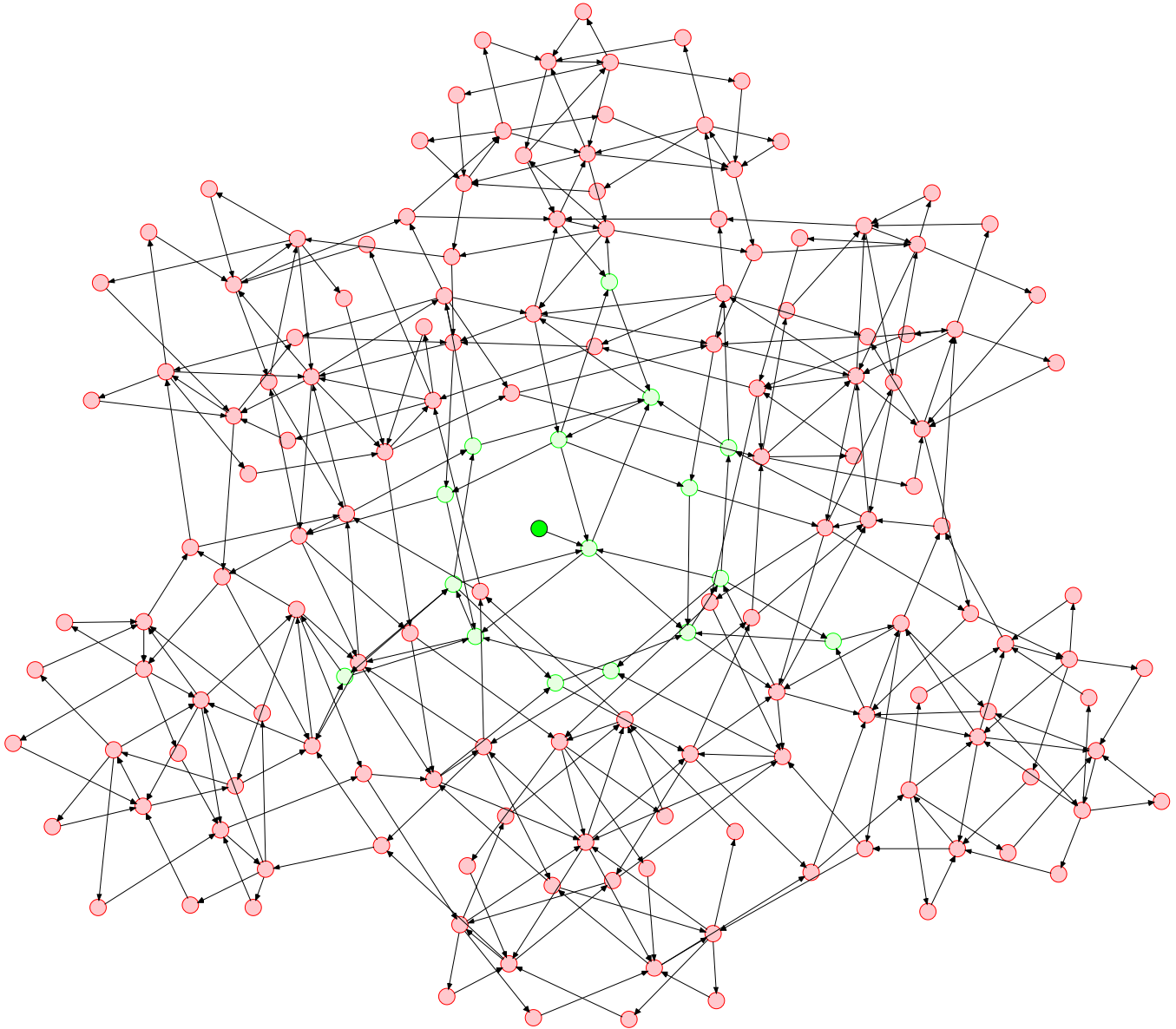

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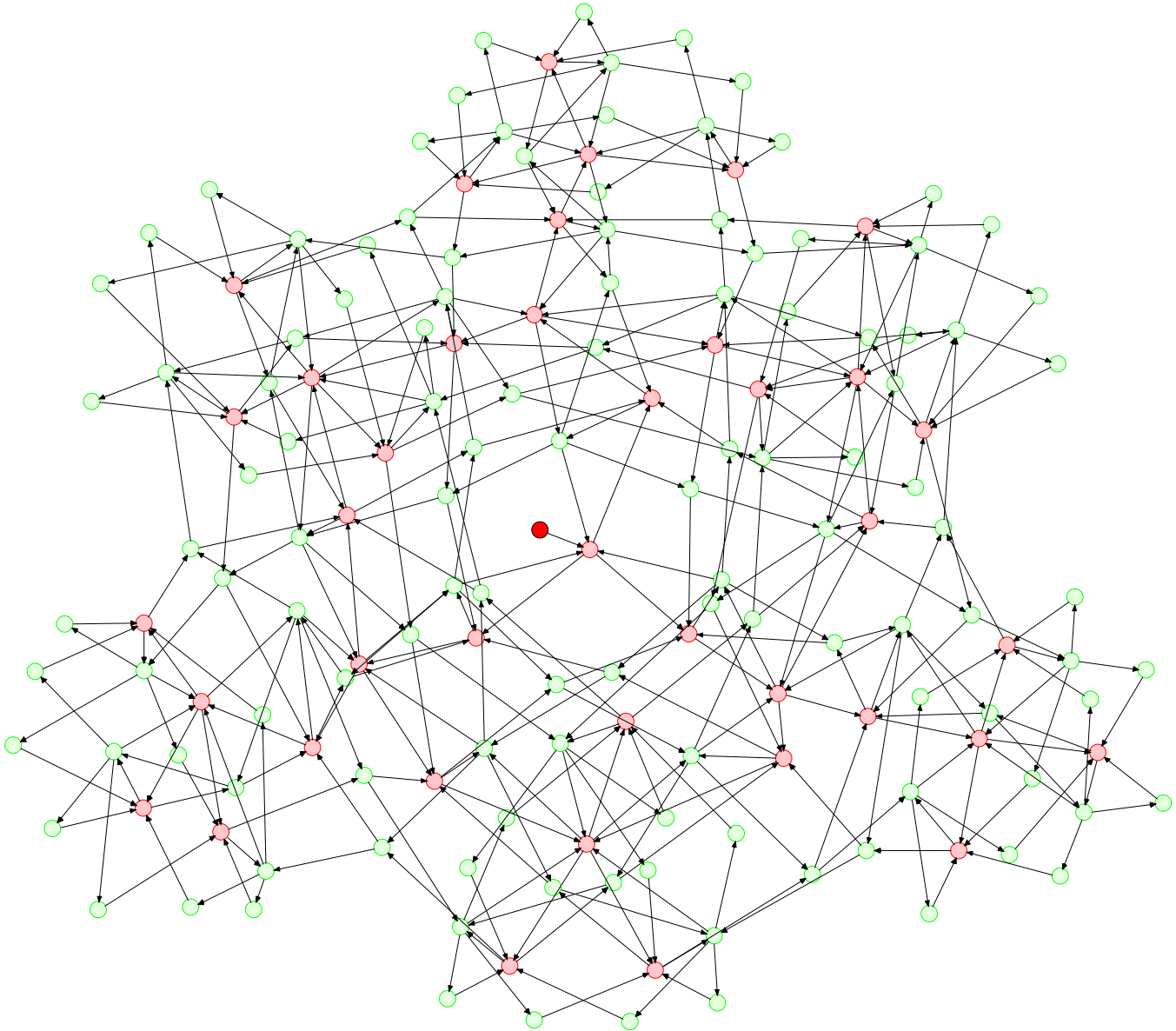

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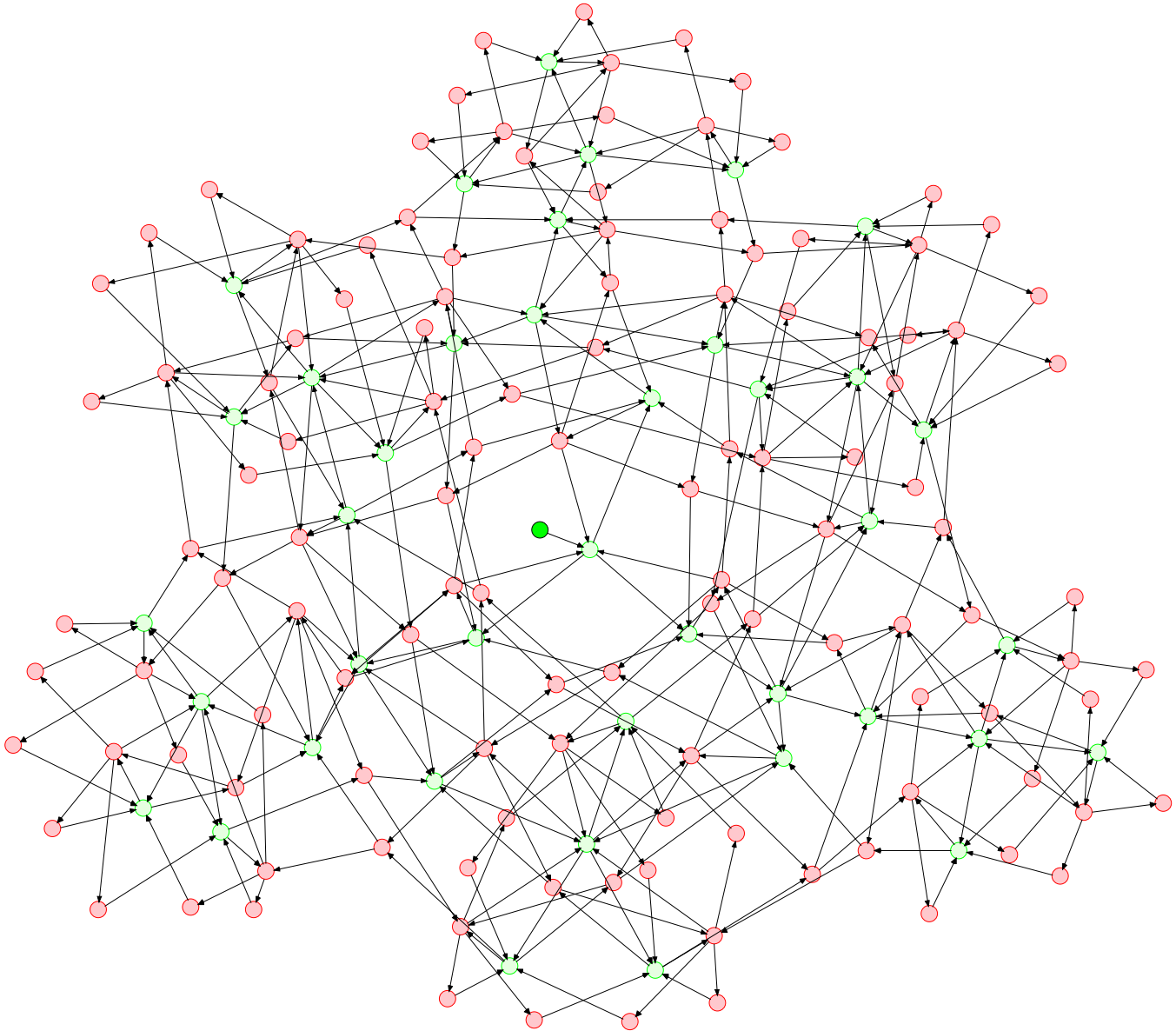

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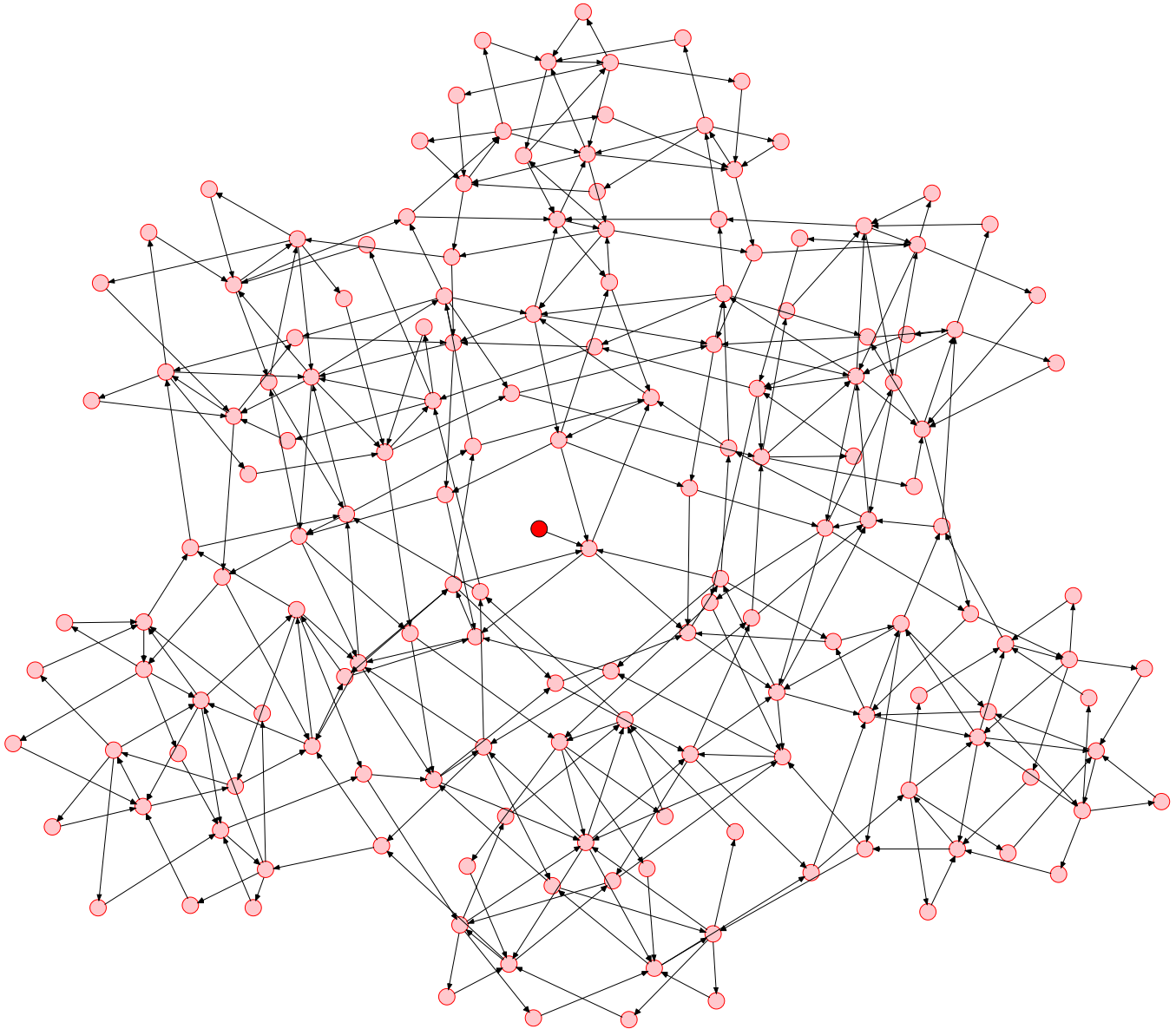

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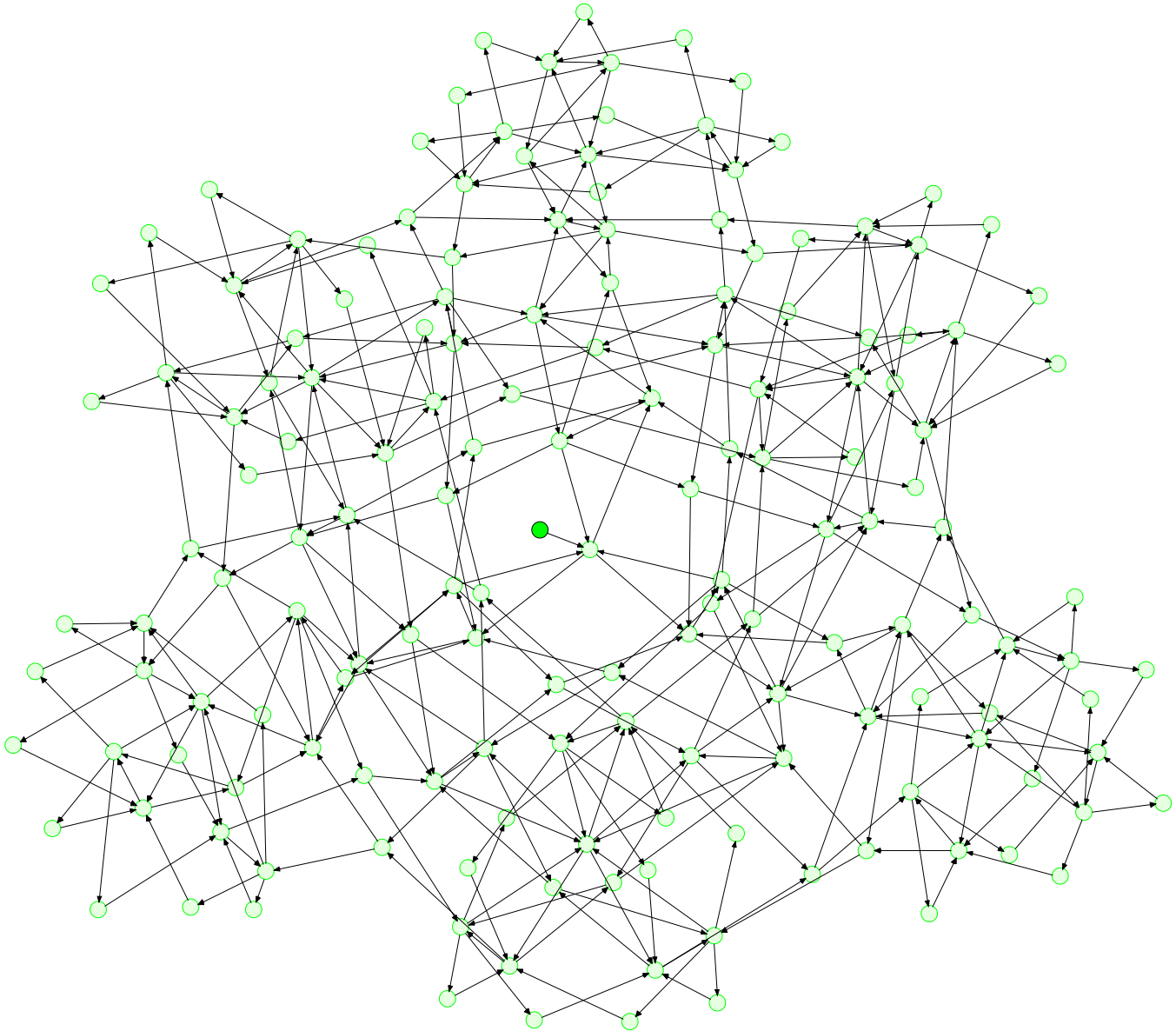

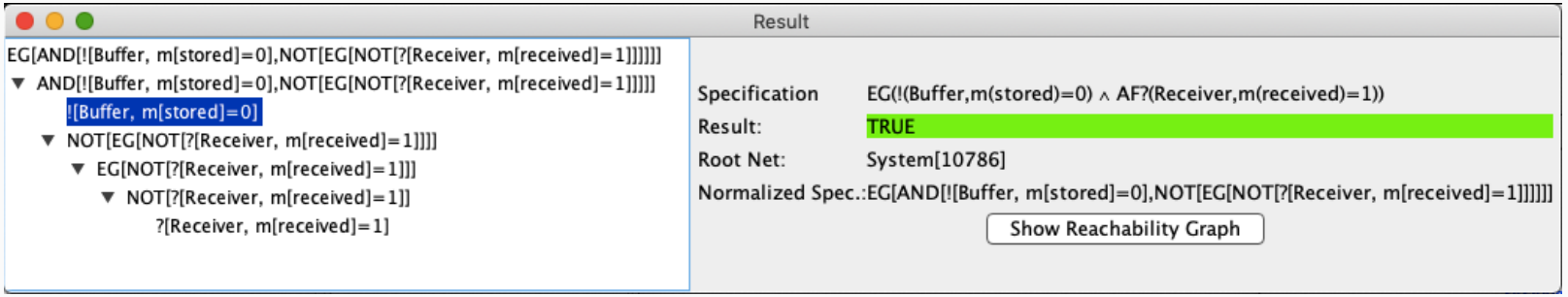
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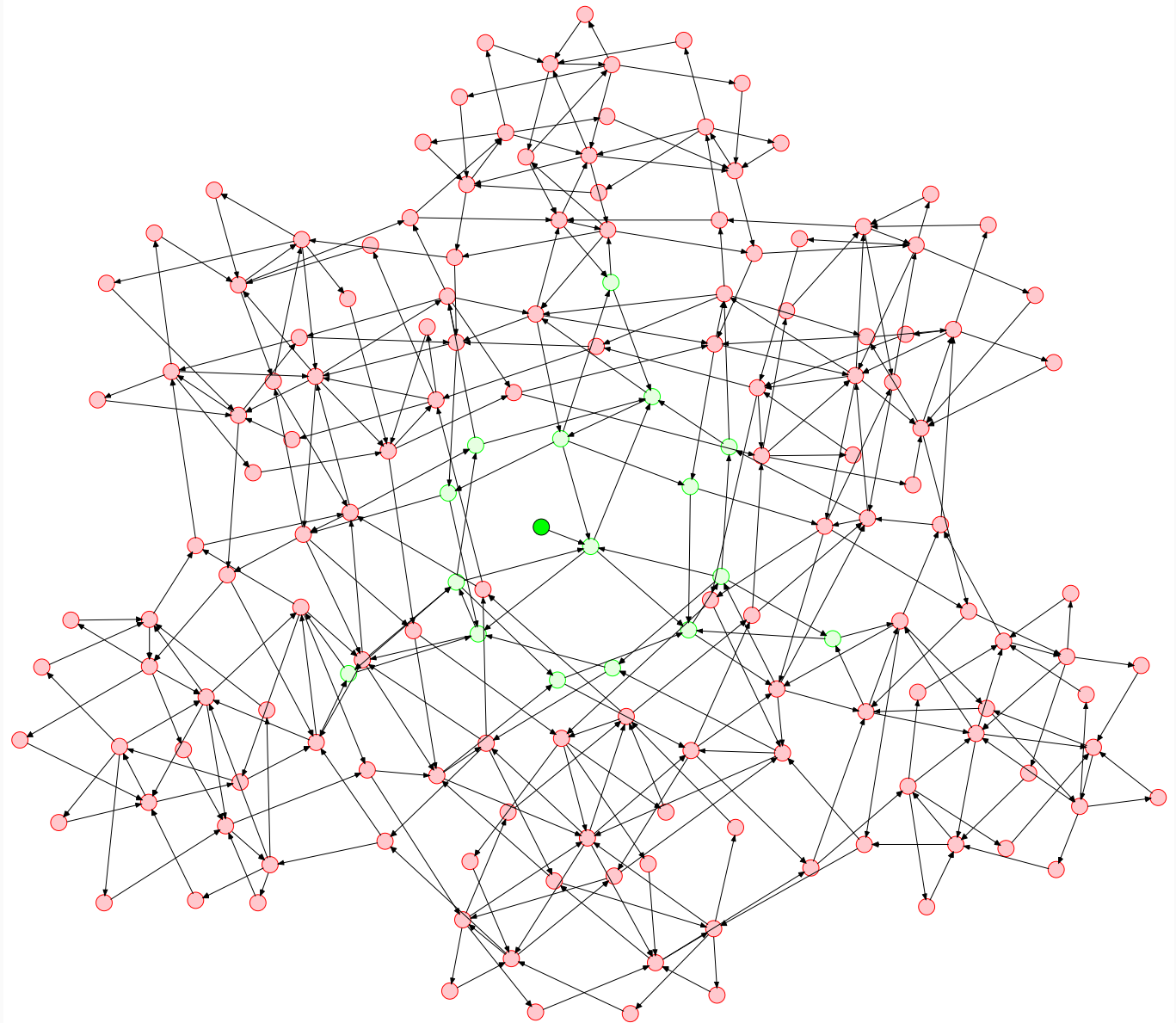

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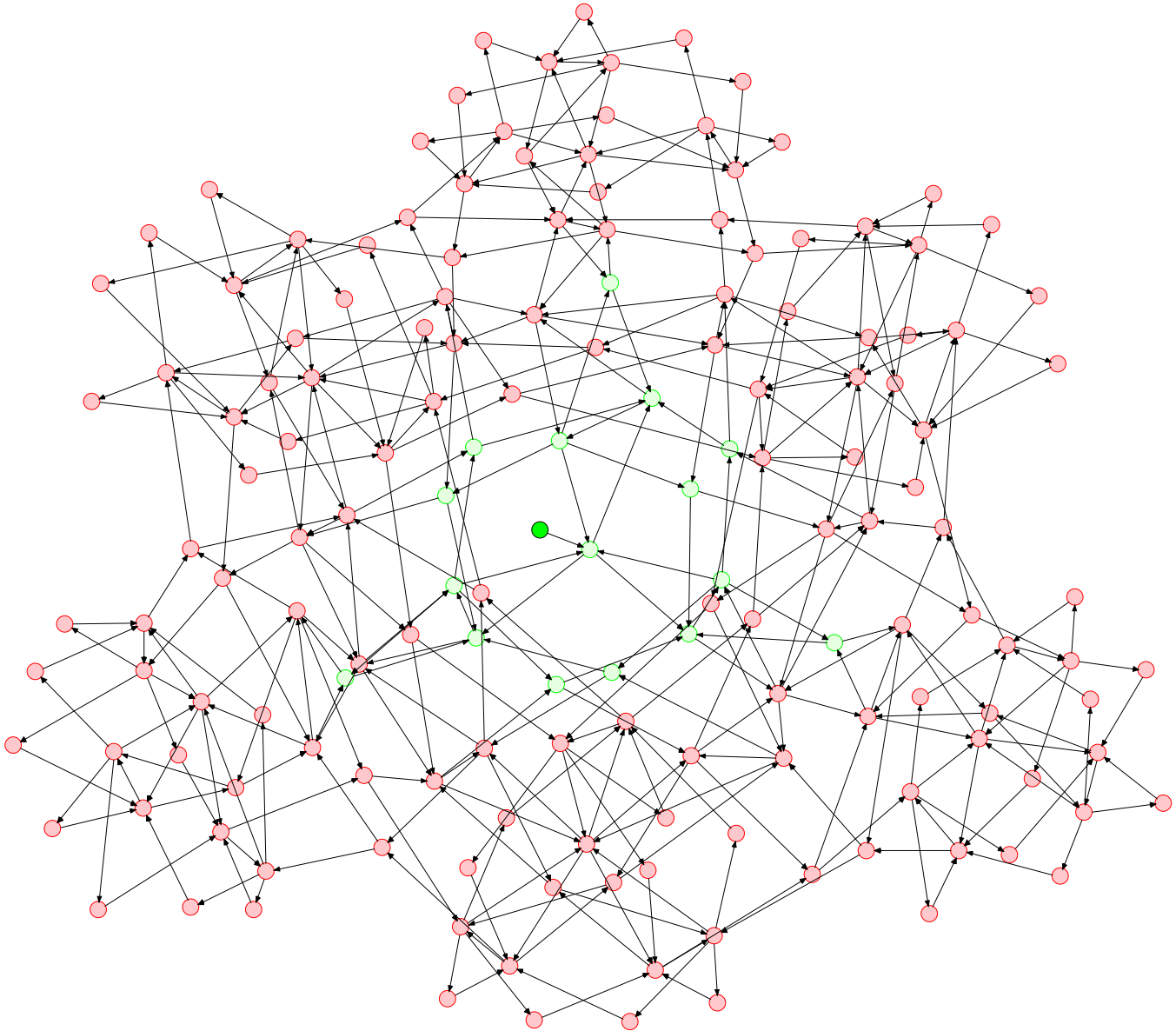

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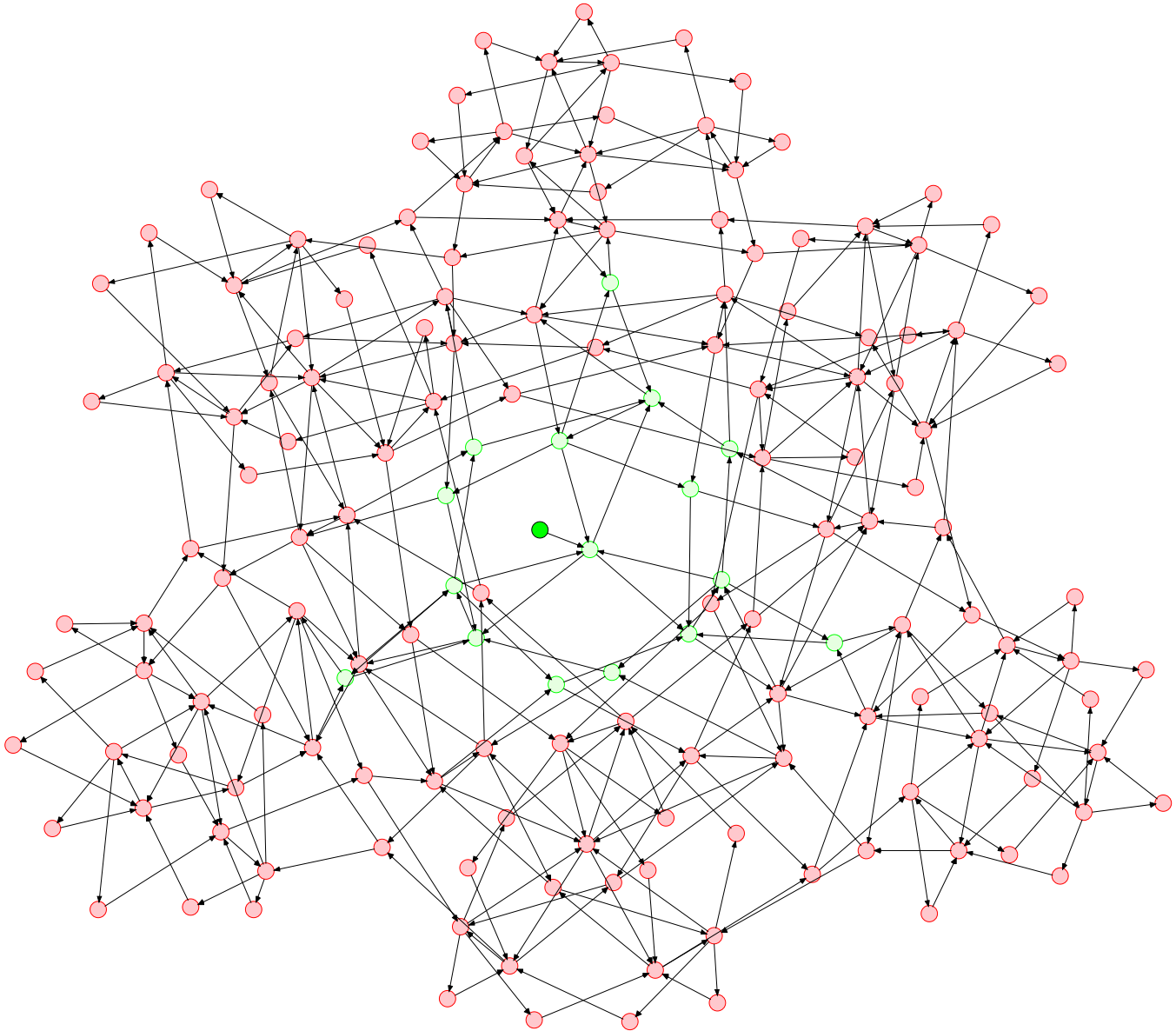

Evaluation

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- Teaching-size problems ($<$10k states) are unproblematic with average computing power
- Colorization is helpful

Conclusion

- CTL Model-Checking of Reference nets
- Modular architecture
- Net Instance Quantifier
- Result visualization

Outlook

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- LTL-Model Checking
- Coverability graph
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Efficiency-oriented goals:

- Code-specific improvements
- Transfer of known techniques to Reference nets
- Techniques that exploit the structural information contained in Reference nets