

Visualizing Model Architecture

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SASB `17

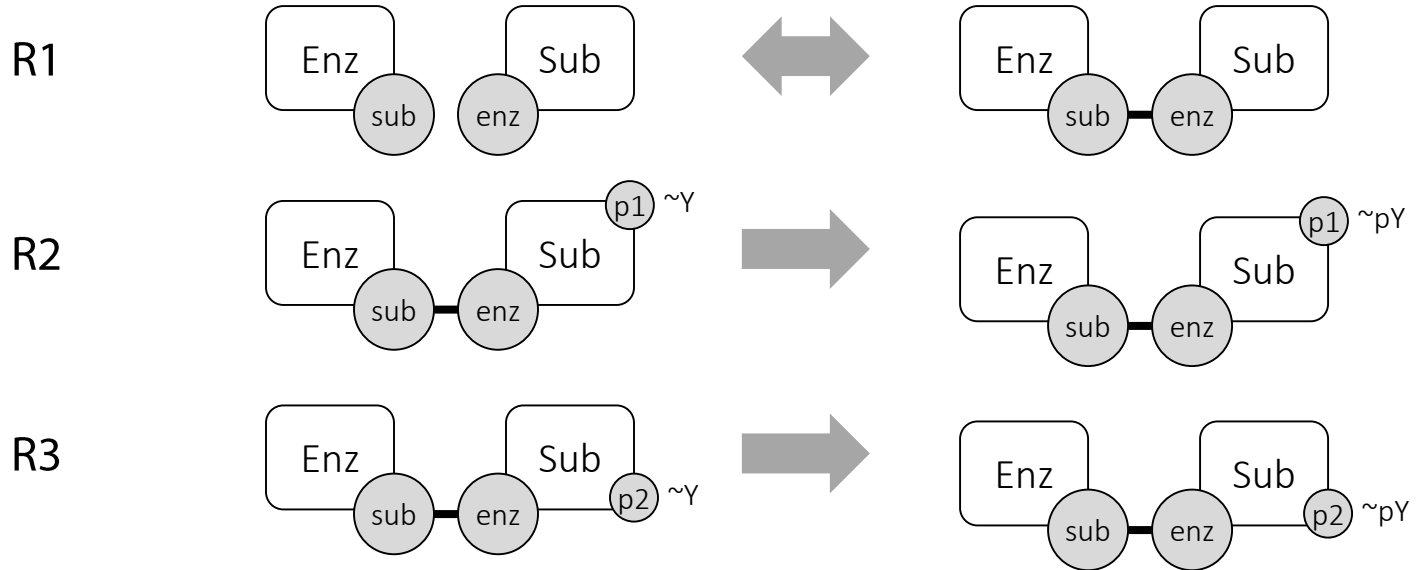


Icahn
School of
Medicine at
Mount
Sinai



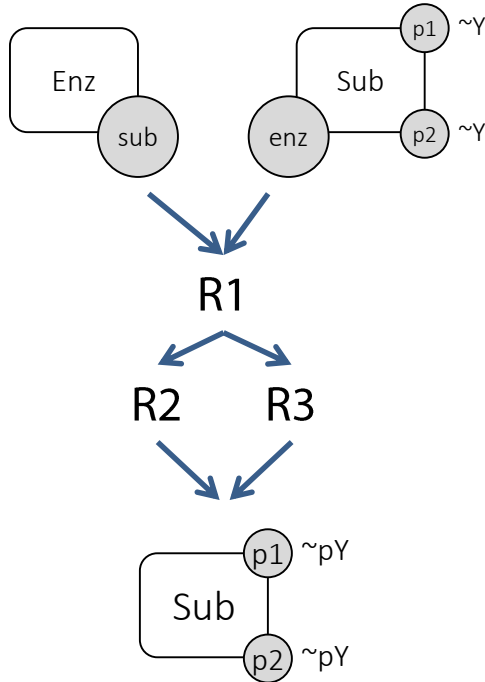
University of
Pittsburgh

Kinetics ~ Reaction Rules

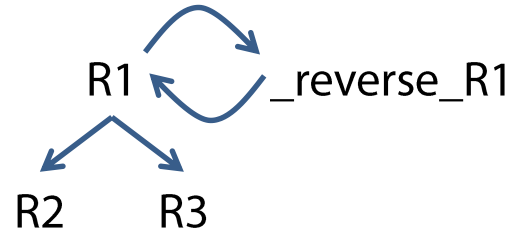


Causality Analysis

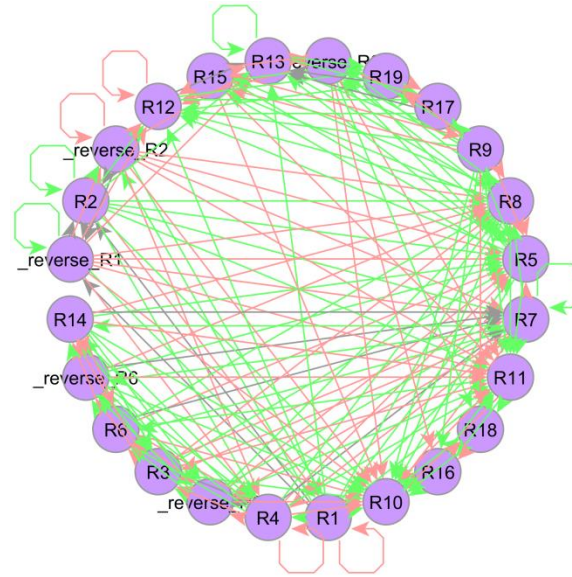
Story



Influence Diagram



RINF of FceRI model with 24 rules

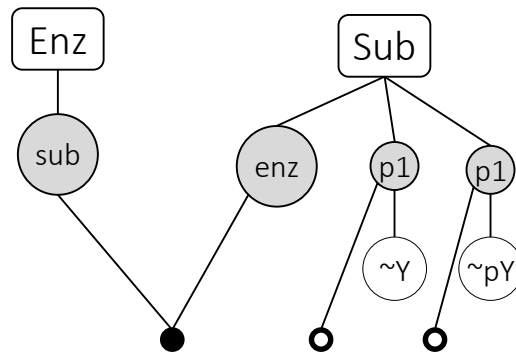
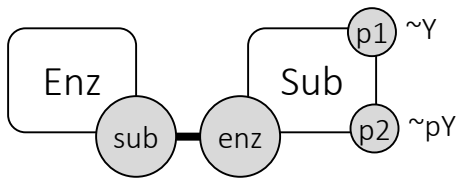


Goals

A representation of causality that is

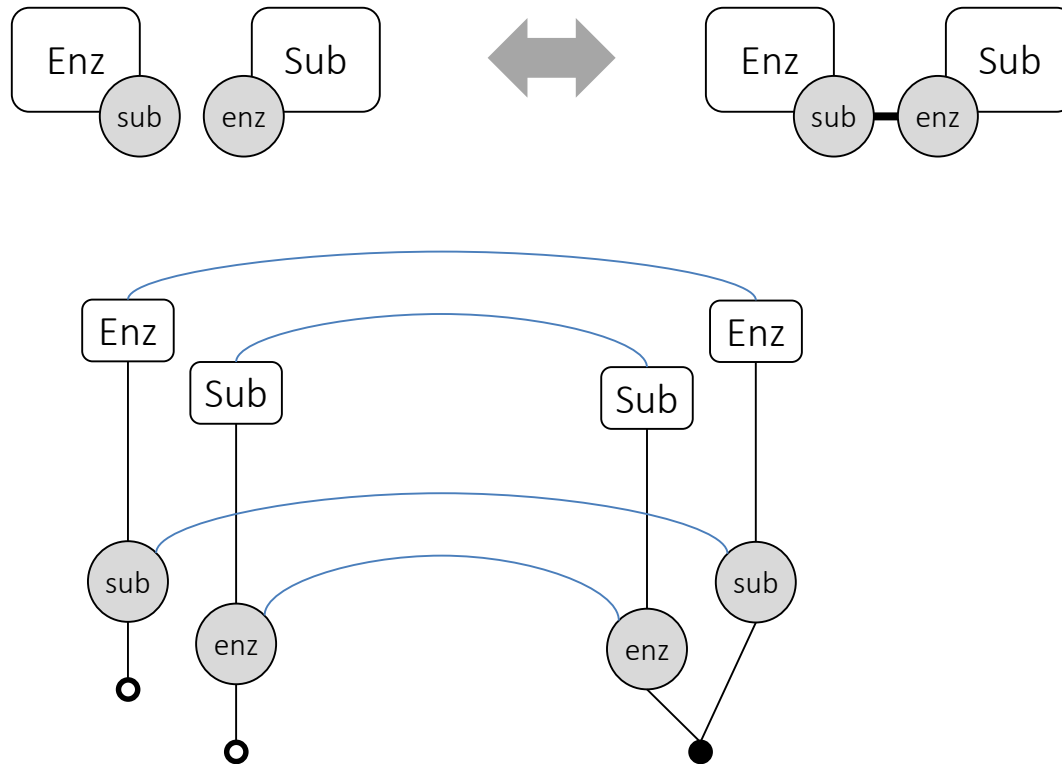
- Bipartite
- Global
- Informative

Structure Graph Representation

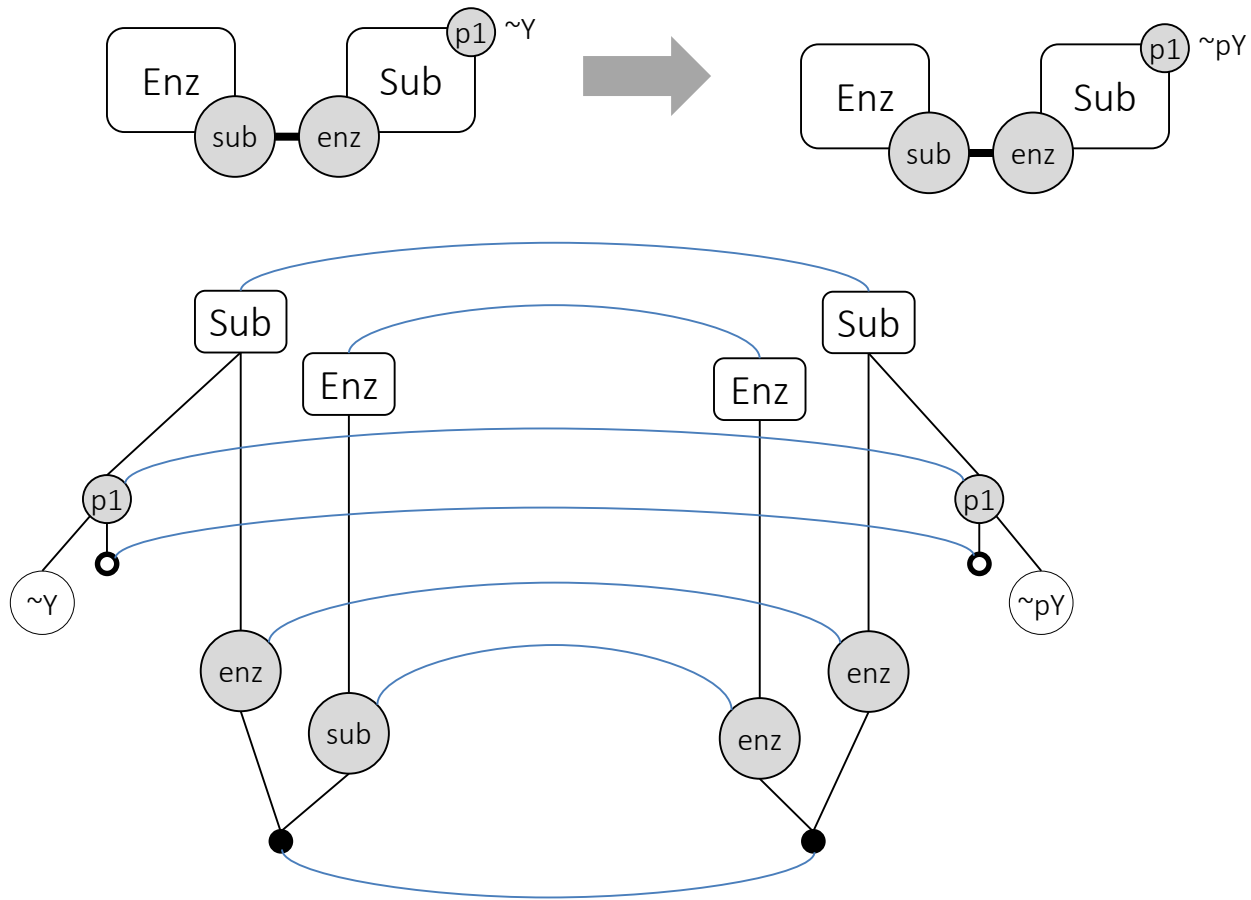


Correspondence Map

R1



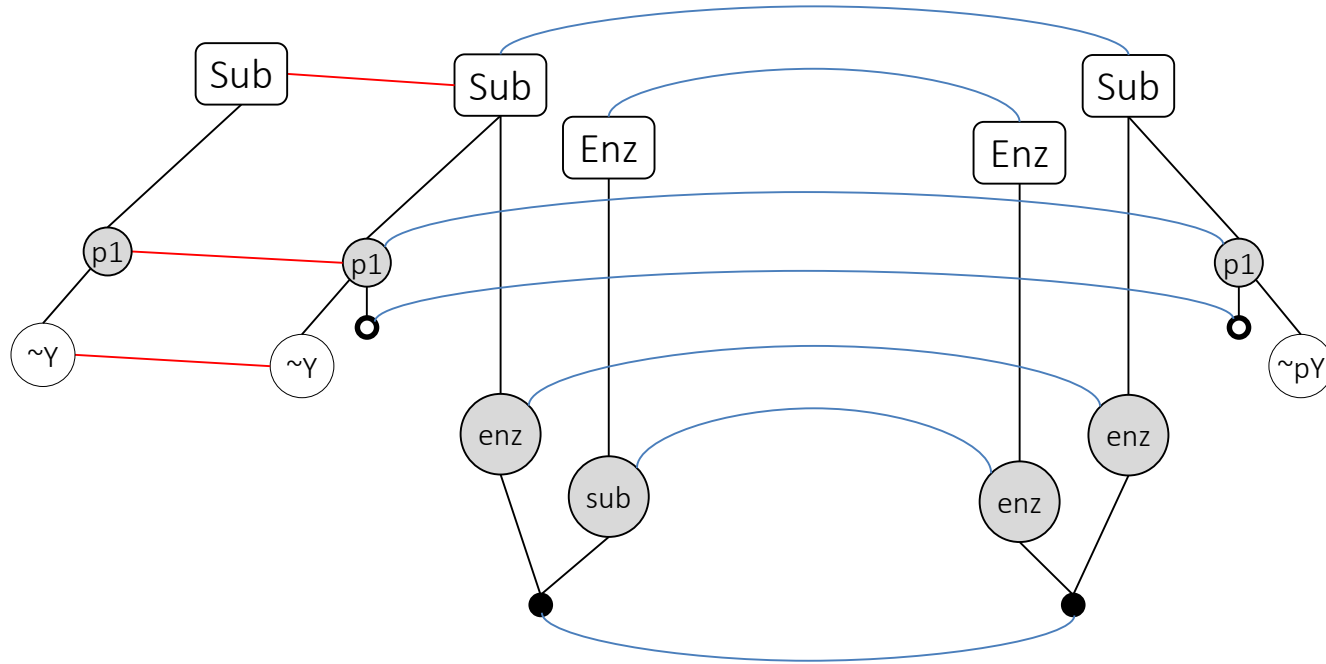
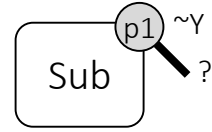
R2



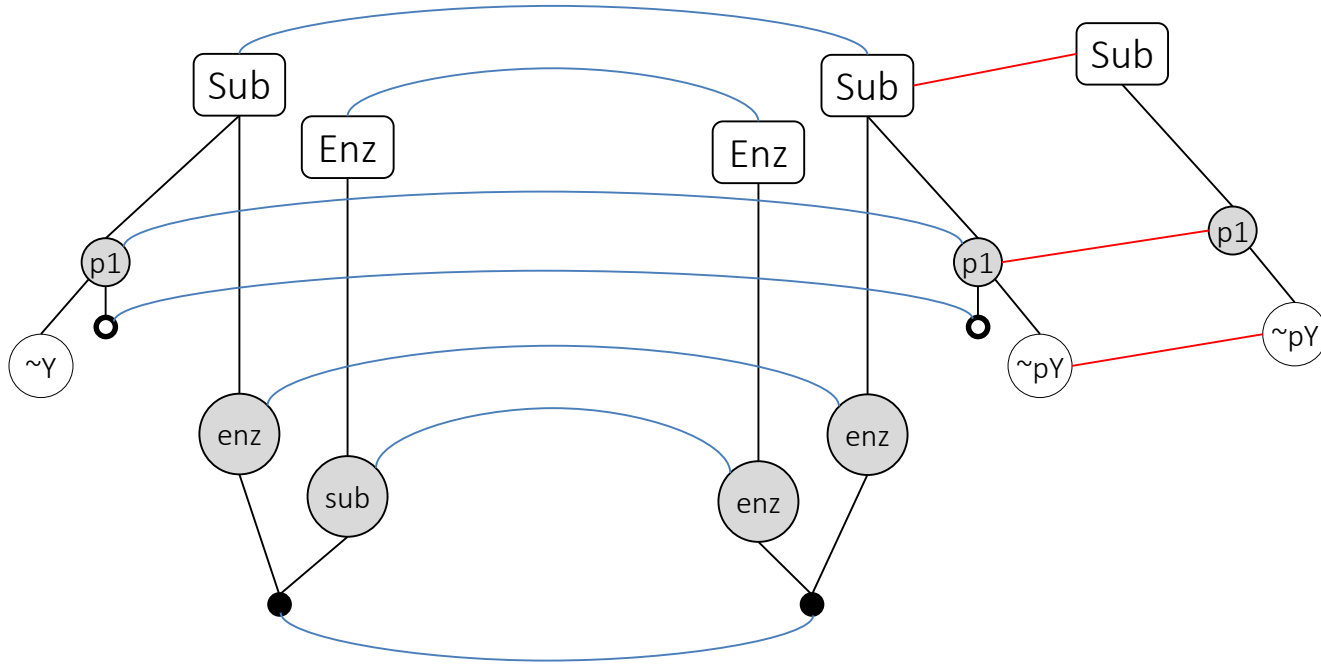
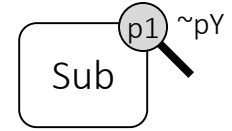
Procedure

- Take some pattern.
- Look for matches on left and right sides of the rule.
- See if correspondence map preserves a match.

Rule consumes a pattern

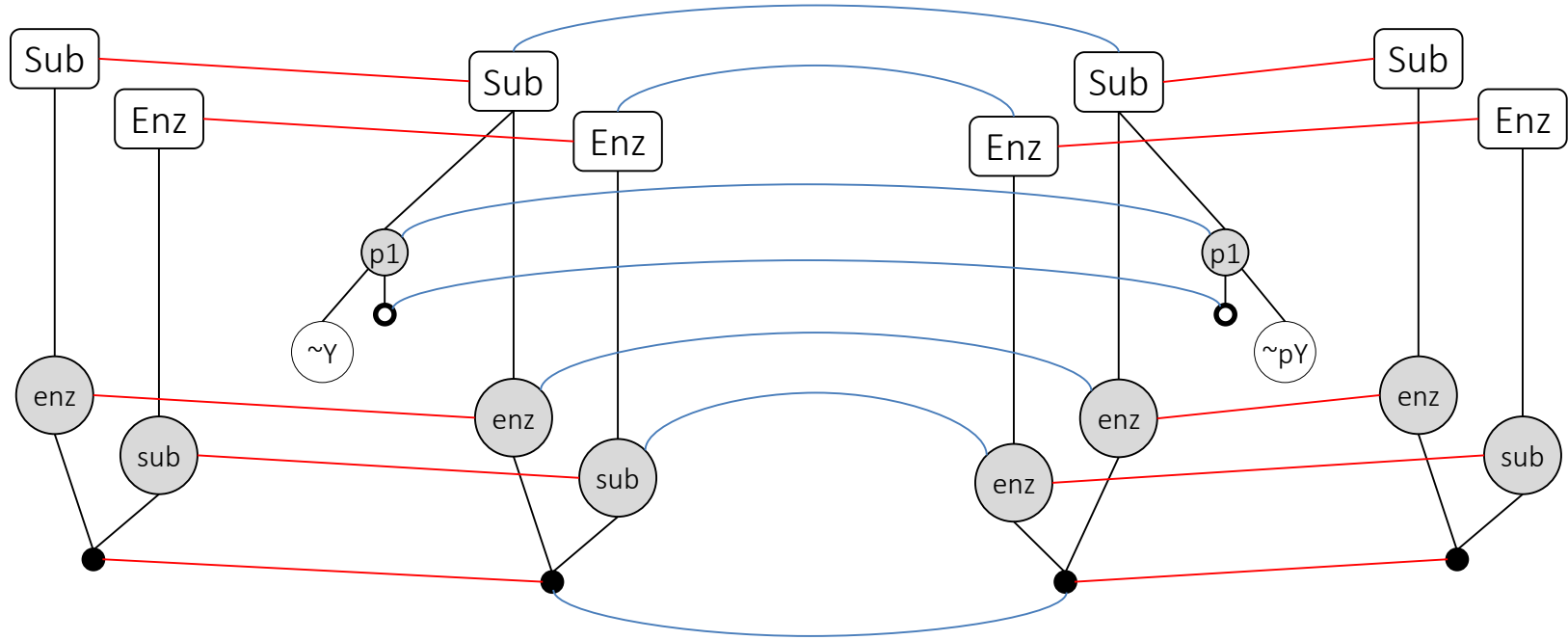
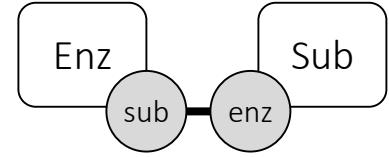


Rule produces a pattern



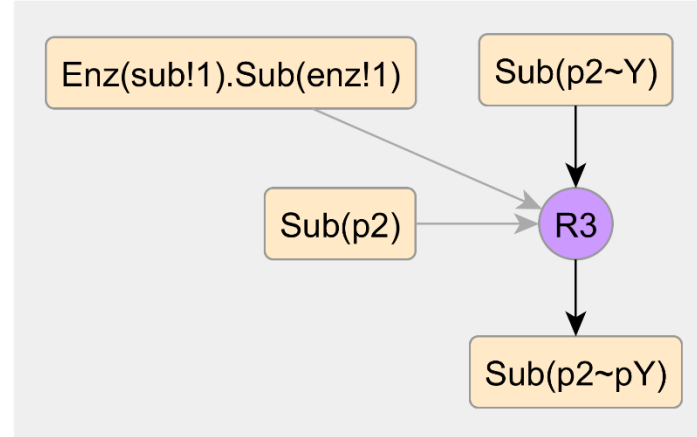
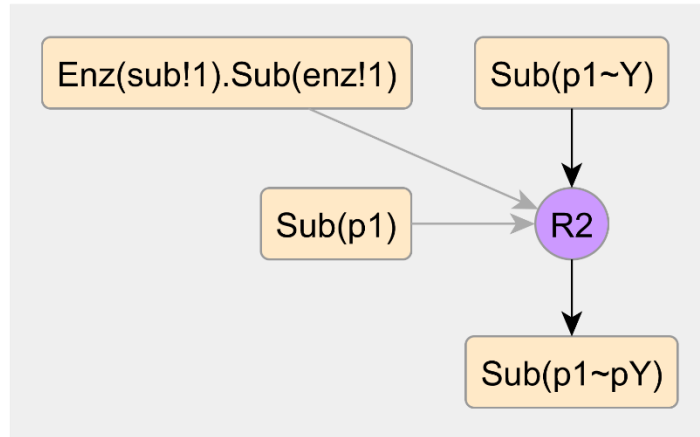
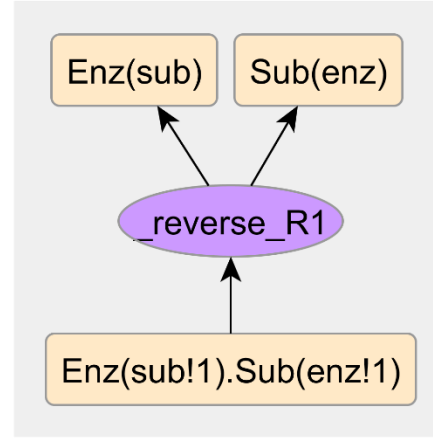
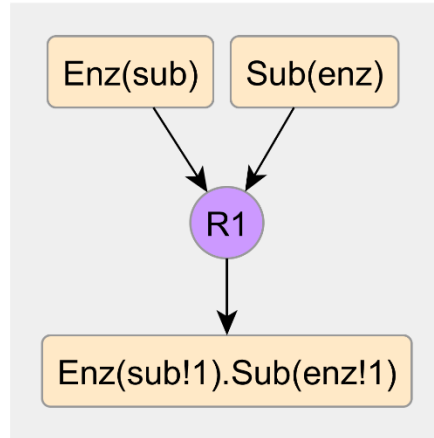
?

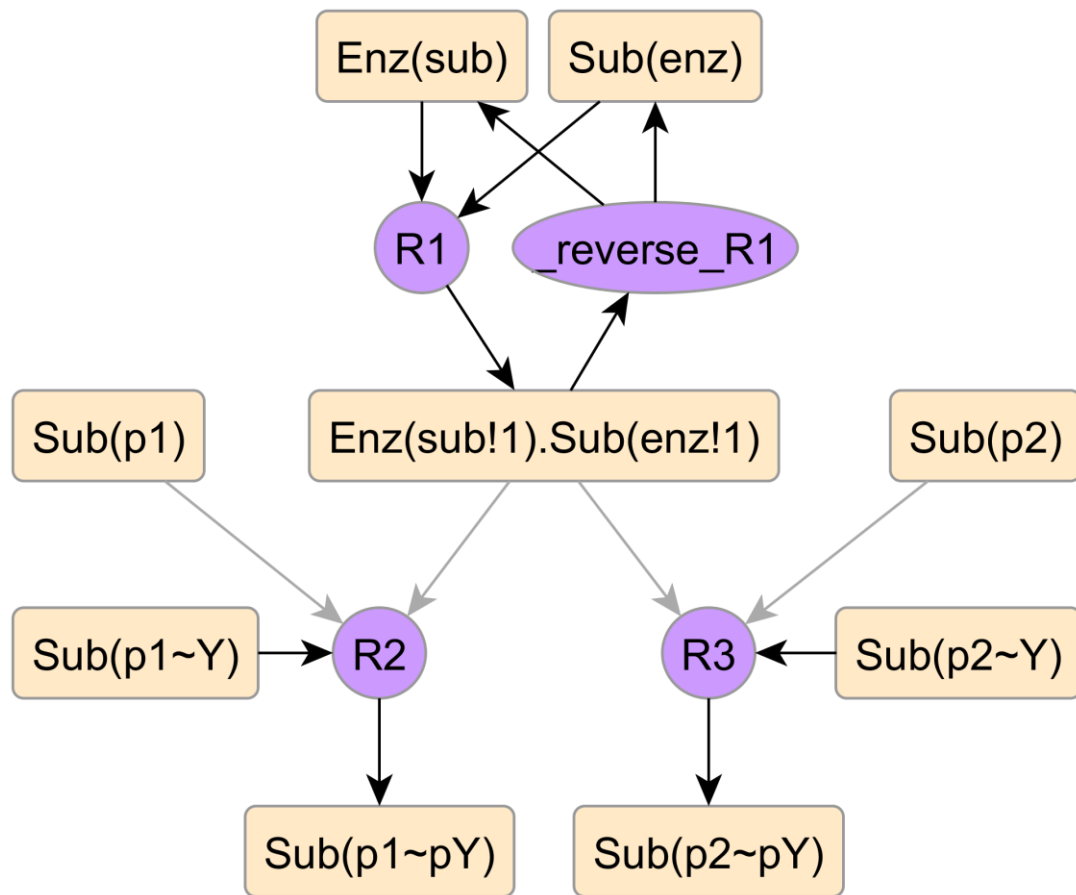
Rule requires a pattern



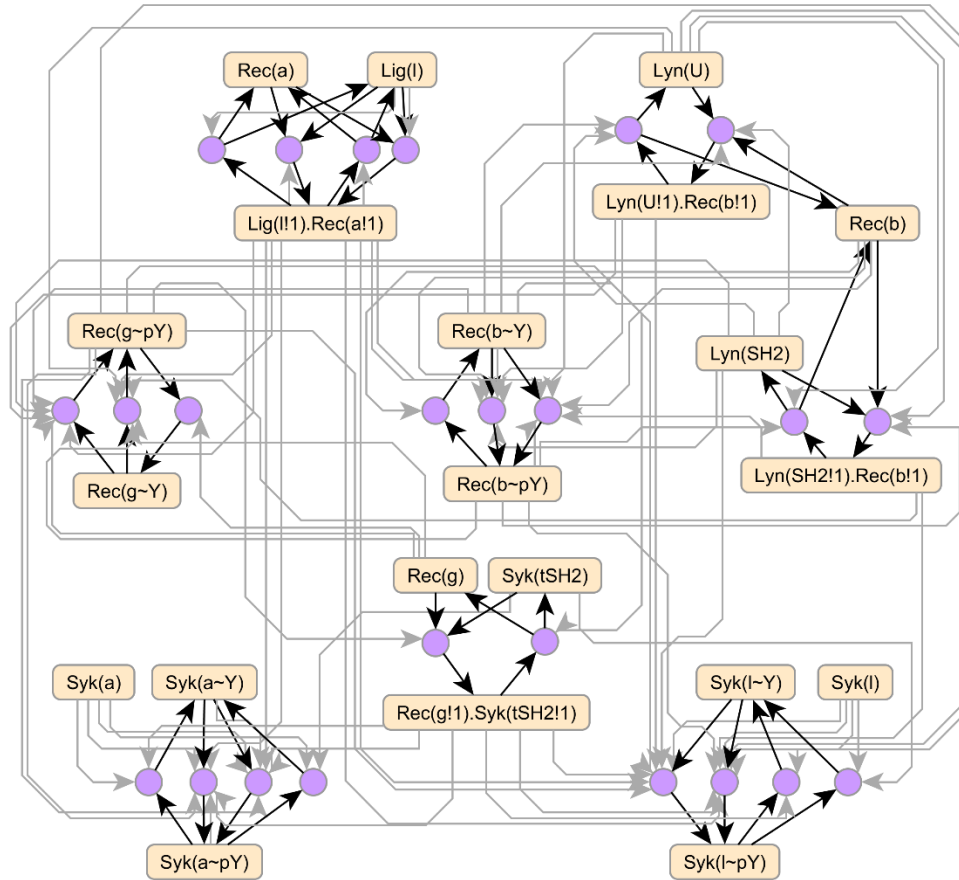
Atom-Rule Graph

- Choose 1st order non-overlapping patterns (atoms).
 - Specific types of internal states on sites
 - Specific types of free binding sites
 - Specific types of bonds
- Compute their relationships with the rule.
 - consumes, produces and/or requires
- Represent as a bipartite graph.





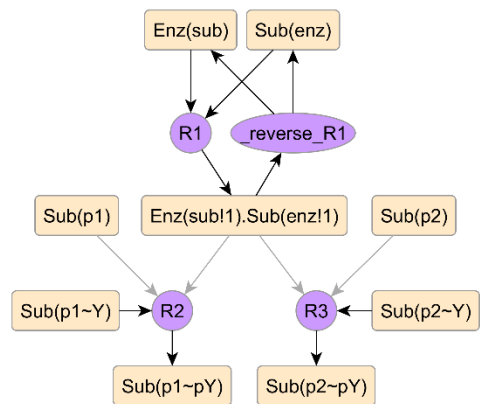
AR of FceRI model with 24 rules



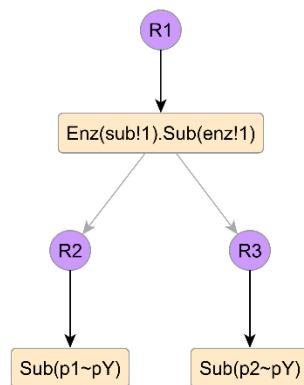
Compression Pipeline

- Can we make the Atom-Rule Graph
 - more informative?
 - less complex?
- 4-step, automated, can integrate user-input
 - Remove nodes
 - Group atoms
 - Group rules
 - Compress groups

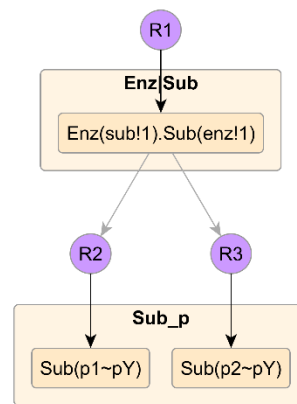
Atom-Rule Graph



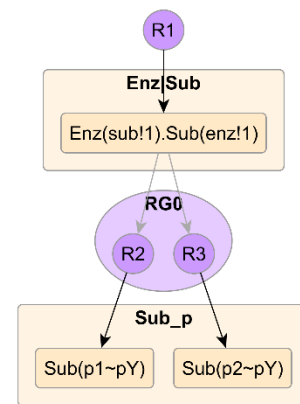
Prioritization



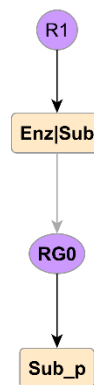
Grouping Structures



Grouping Rules



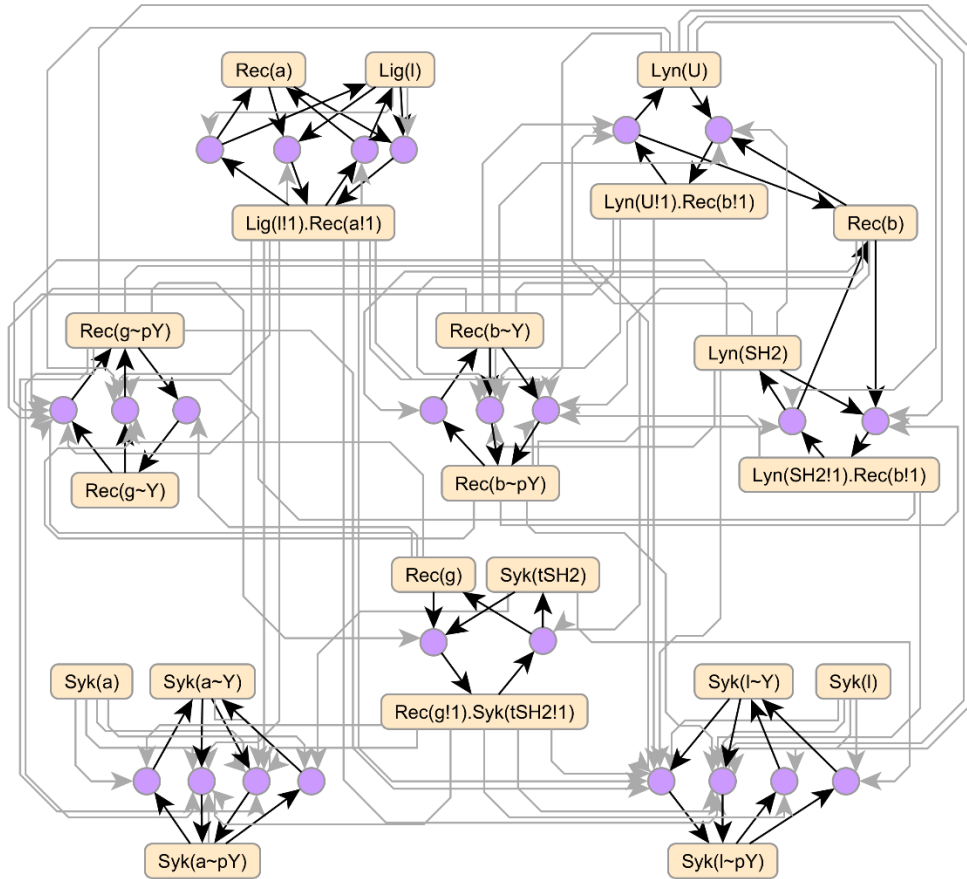
Compression



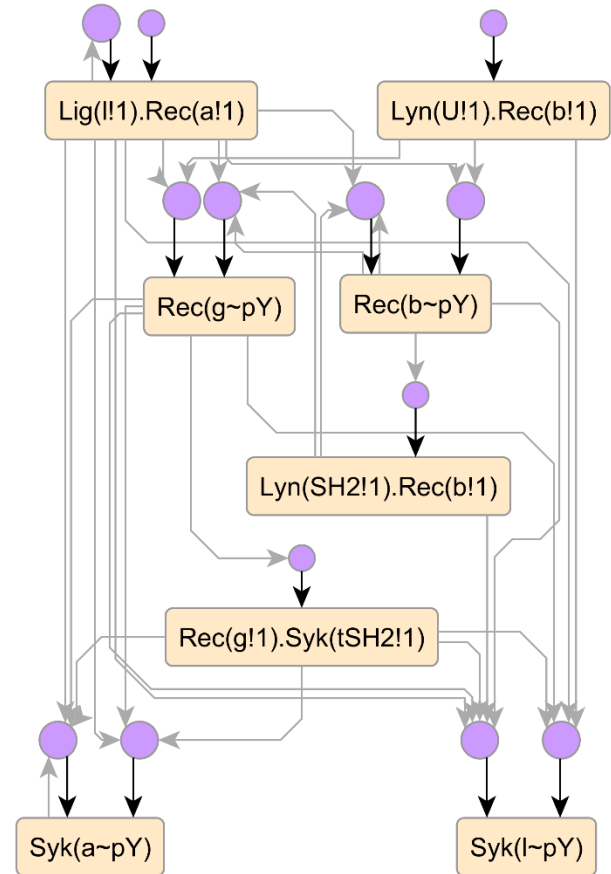
System-specific complexity

Universal principles

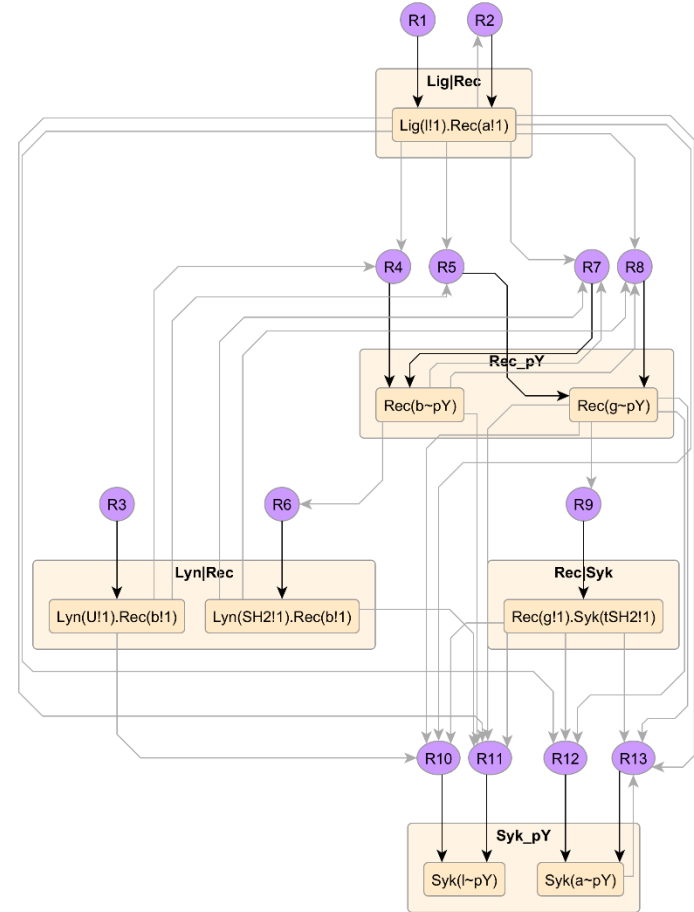
Full AR Graph



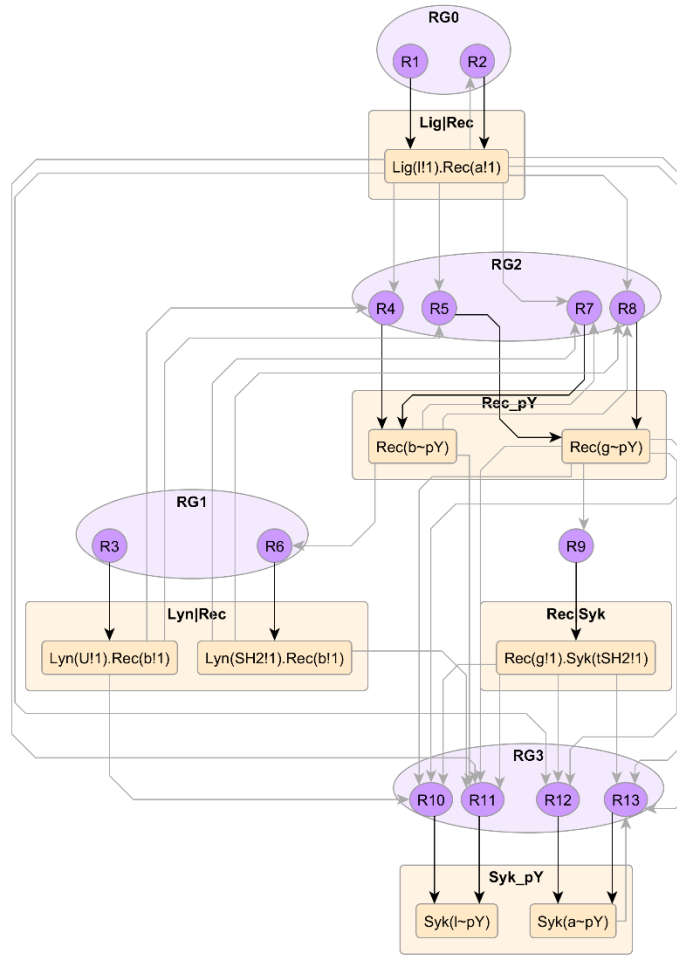
Prioritized Nodes



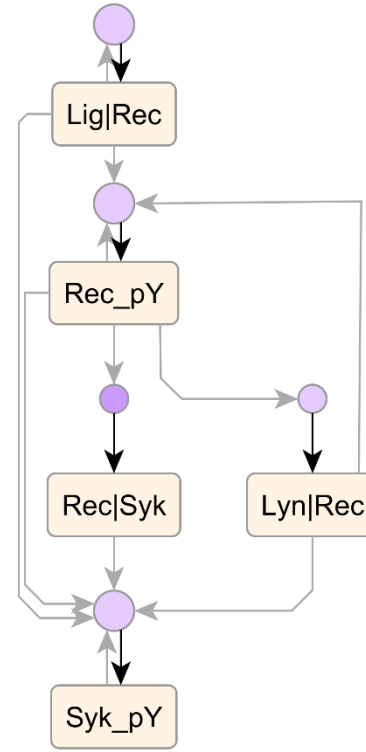
Grouping Structures



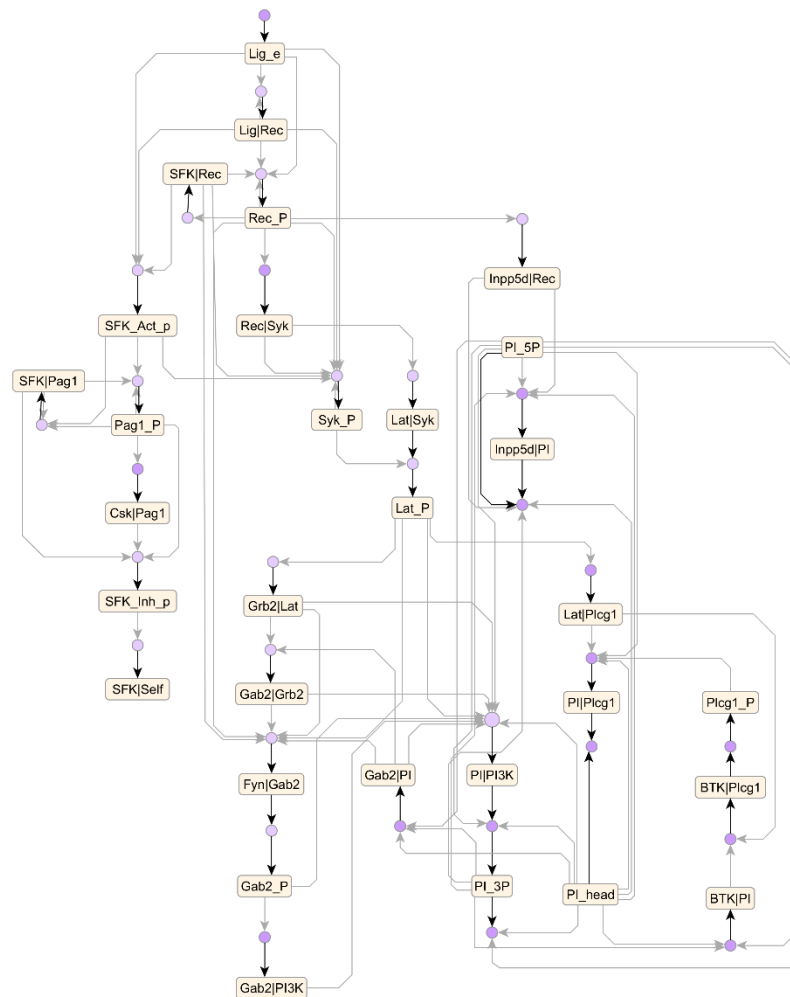
Grouping Rules



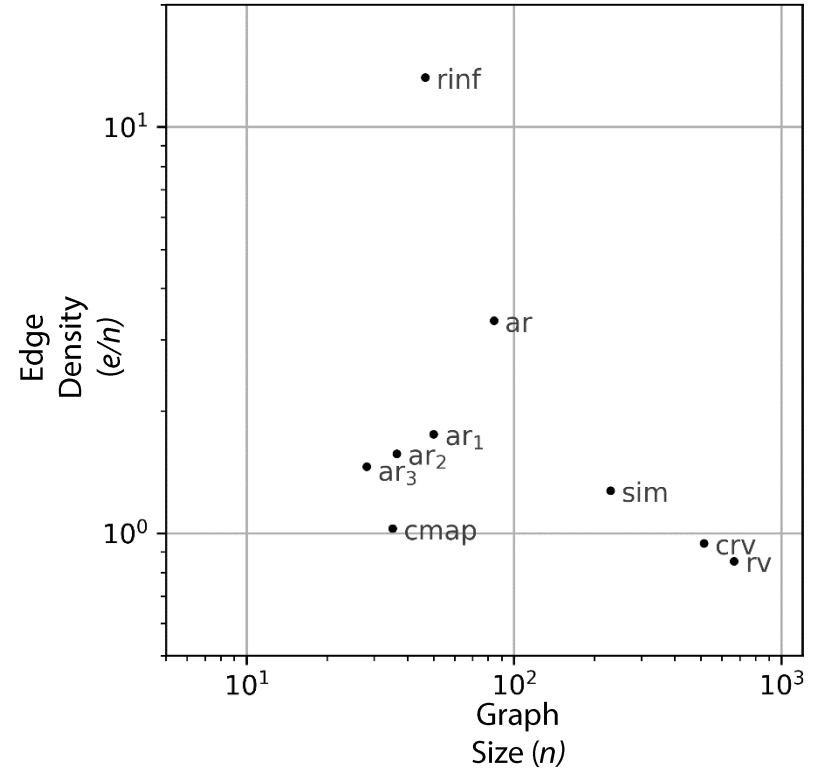
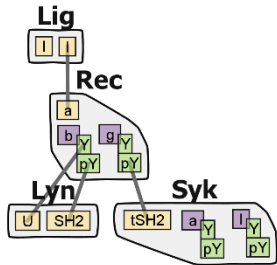
Compression



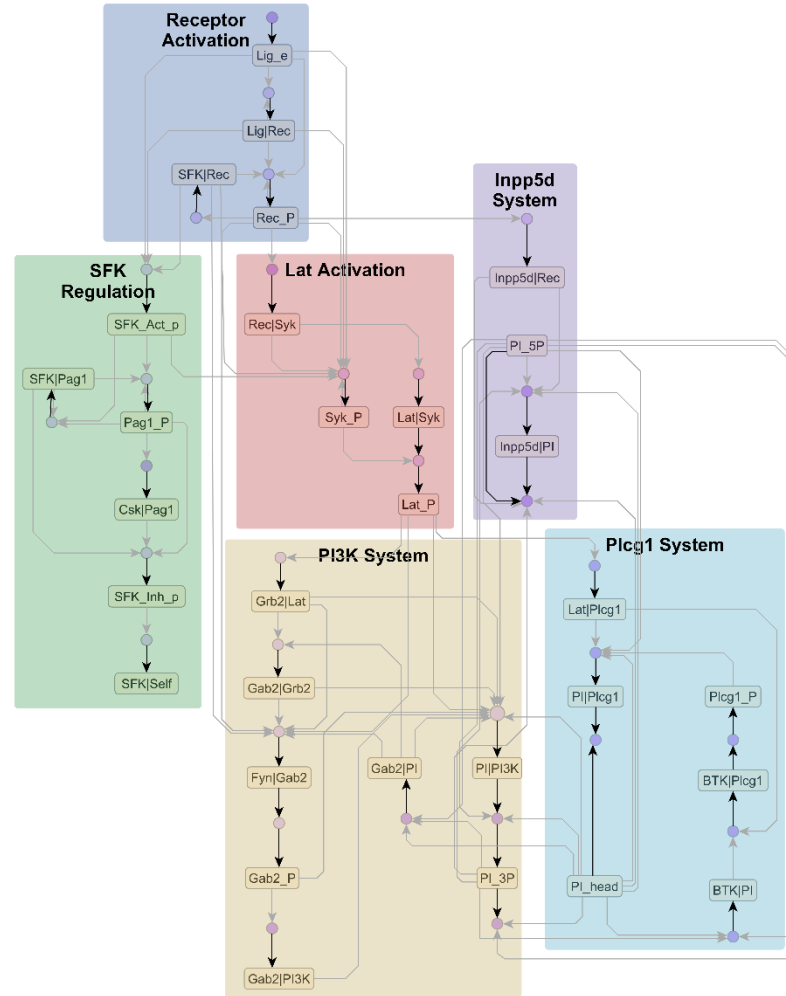
Larger Model



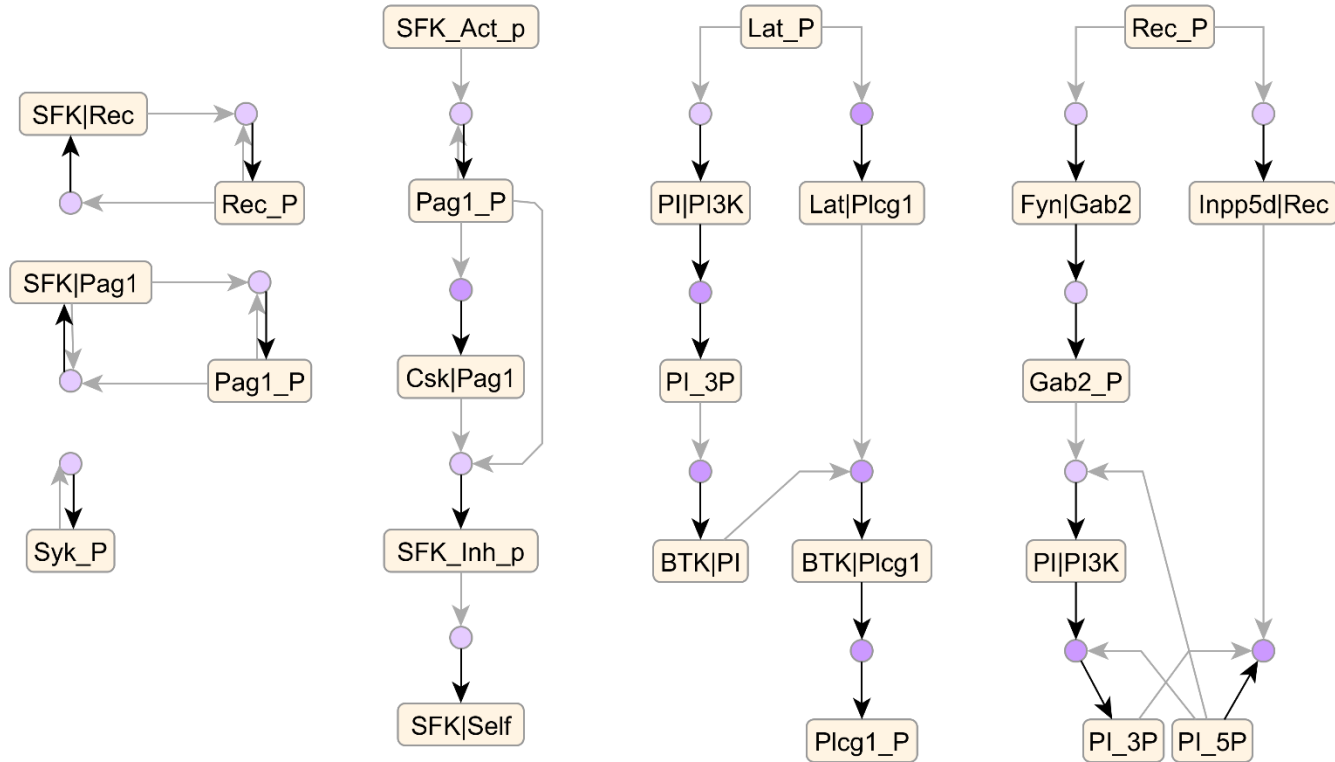
Relative Compactness



Future Tools



Future Tools



Summary

- Atom-Rule graphs are bipartite representations of signal flow in rule-based models.
- AR graphs can be compressed to produce pathway diagrams.
- ML/Graph tools can be applied to the AR graph (future work)

Acknowledgements

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(www.karrlab.org)

References

Under Review

Sekar *et al.* PLoS Comput. Biol.

Visualized Models

Faeder *et al.* (2003) J. Immunol.

Chylek *et al.* (2014) Front. Immunol.