DISCRETE NETWORK DYNAMICS ANALYSIS USING NETWORK WORKBENCH

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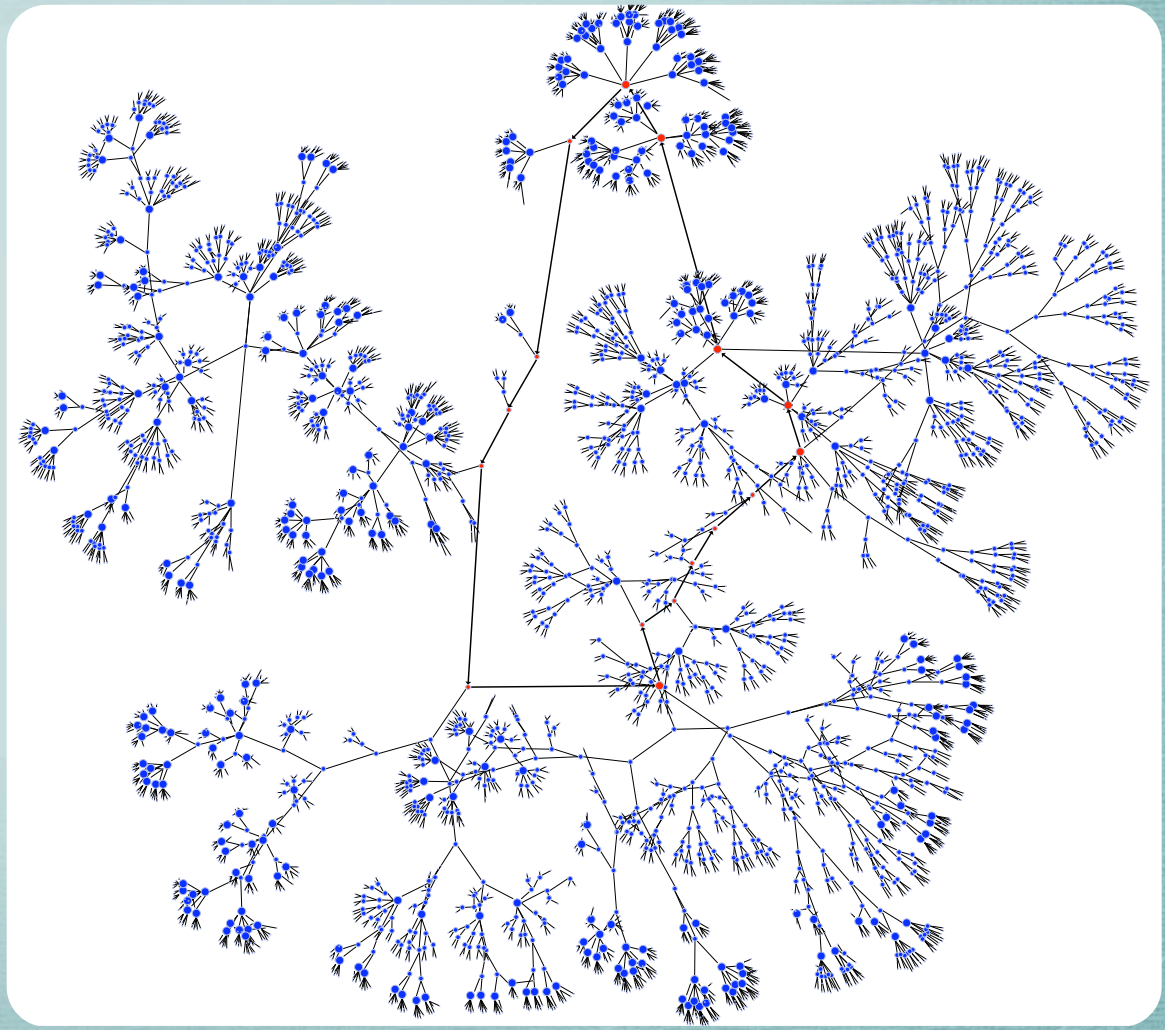
Network Workbench
http://nwb.slis.indiana.edu/



The lack of widely available tools for discrete network analysis limits the usefulness of a powerful analytical technique.

- What is a discrete network model?
  - How might it be applied to Bioinformatics?
- Building a tool for analyzing discrete networks
  - How does one analyze and construct a discrete network model for biological data?
    - Sample application as applied to the segmentation clock

A Boolean network model is an abstract way of viewing interactions.

- Many events can be seen as occurring or not occurring. Whether or not those events occur or do not occur influence other events.
  - I present at the McGill Summer Sessions
    - People listened to my presentation
      - People were bored
        - People found my presentation helpful or relevant
- This same abstraction can be applied to interactions between genes, mRNAs, and proteins.

Interaction between cellular entities is complex, but we want to understand the dynamics.

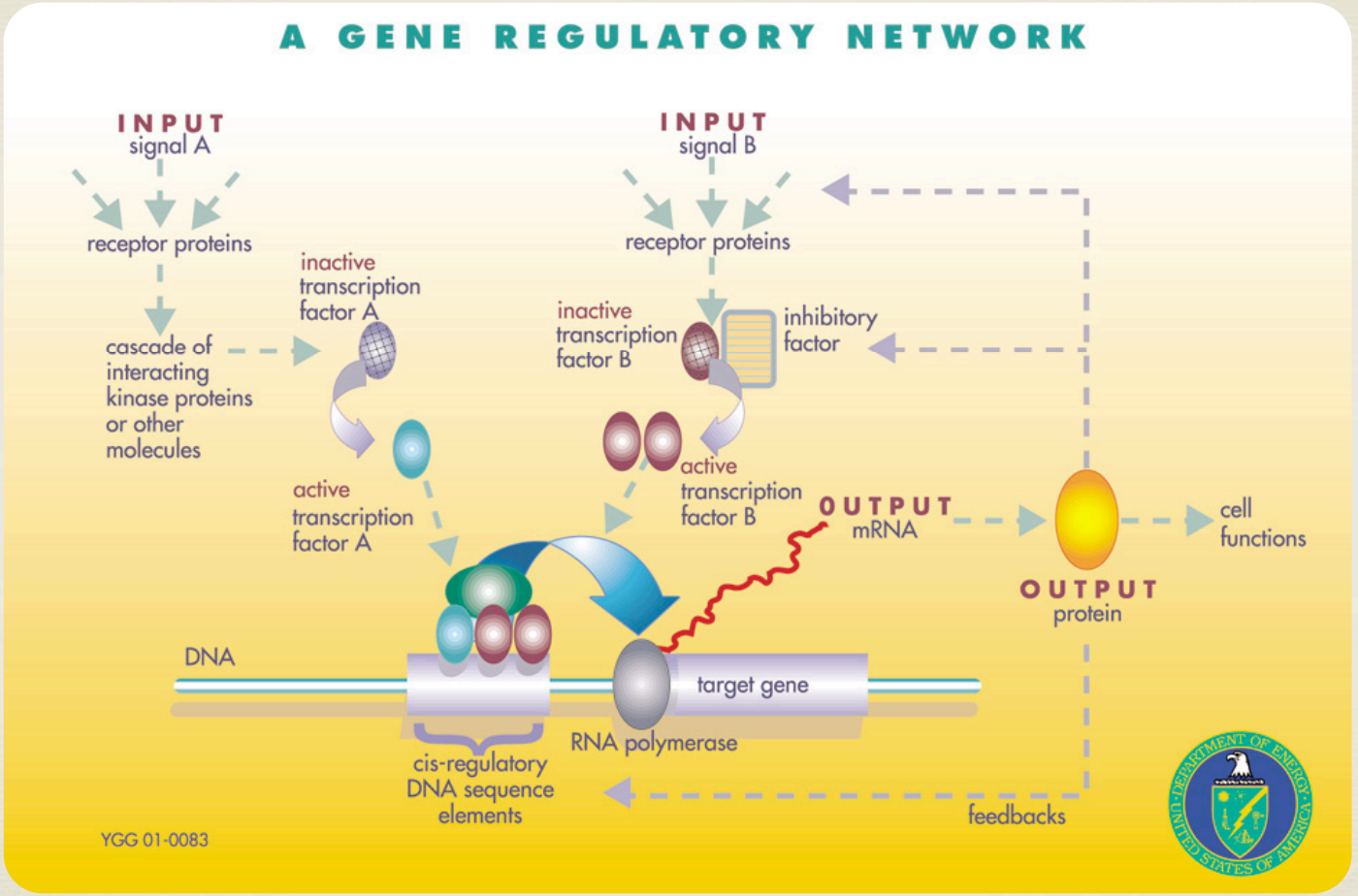


Image from http://genomics.energy.gov/gallery/systems_biology/detail.np/HGPI_HiRes/REGNET.jpg

Boolean network models are powerful analysis tools.

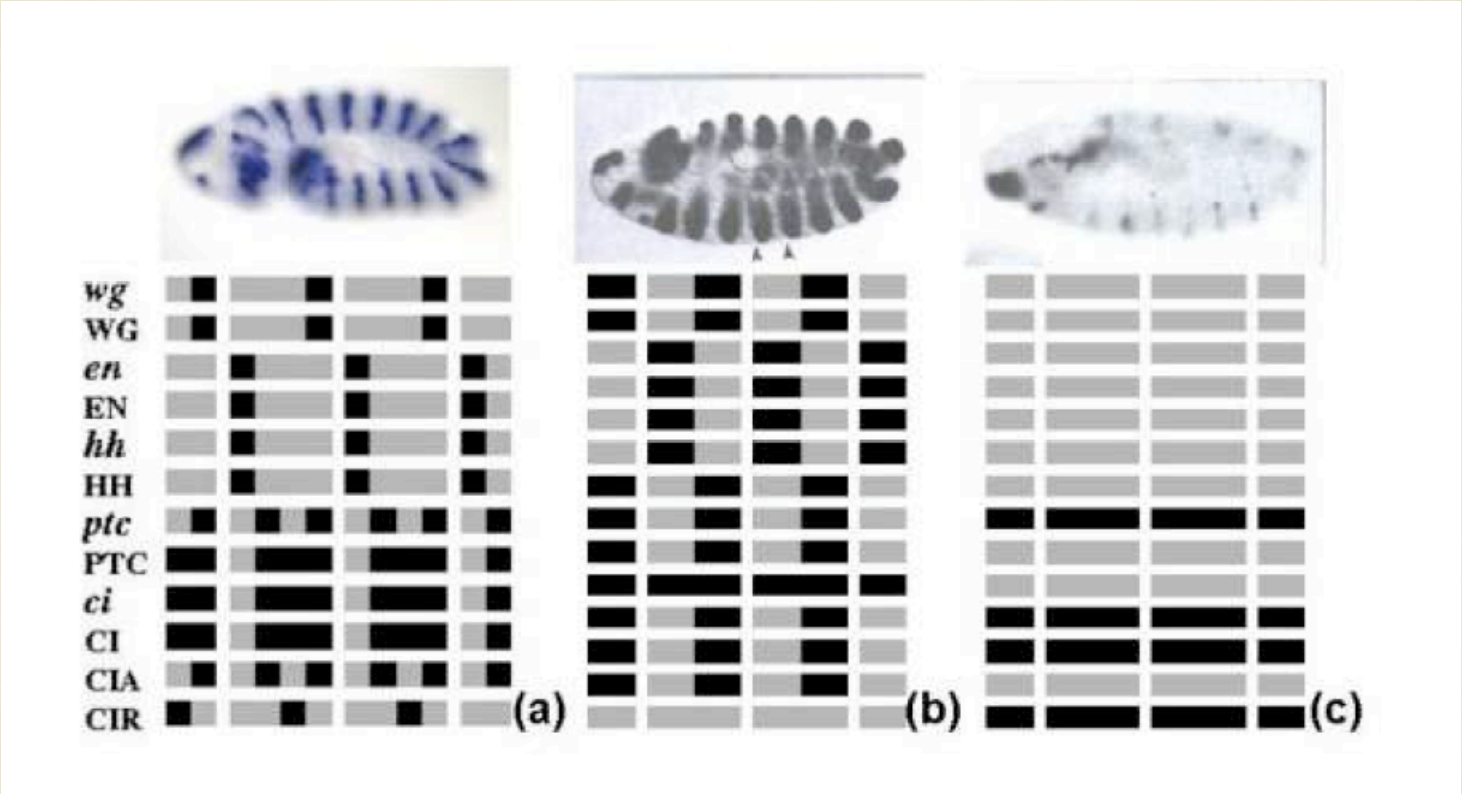


Image from M. Chaves, R. Albert, and E.D. Sontag. *Robustness and fragility of Boolean models for genetic regulatory networks*. Journal of Theoretical Biology, 2005. Vol 235.

Analyzing large networks is computationally intractable and there are few tools for analyzing smaller networks.

Analyzing the displayed network of 401 proteins on a 3.0 GHz computer would take 5.458×10^{103} years, approximately 10^{94} times longer than the age of the Earth and 4×10^{93} times longer than the age of the universe.

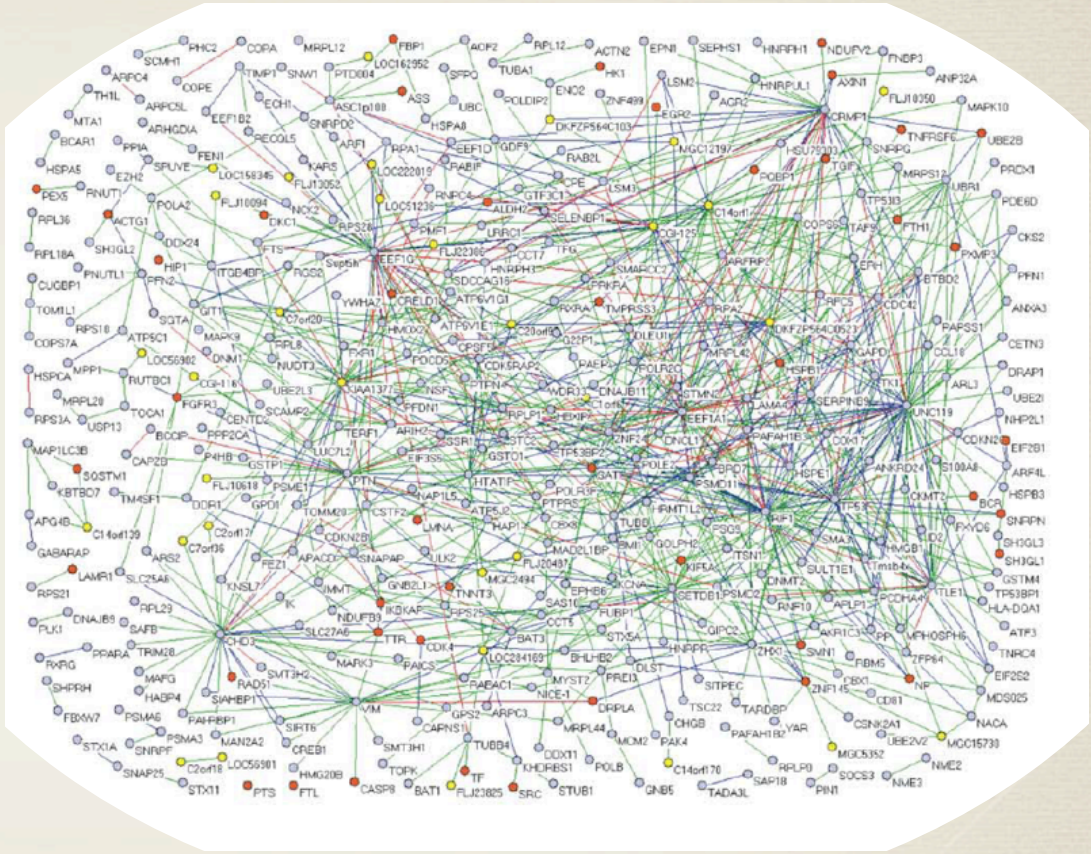
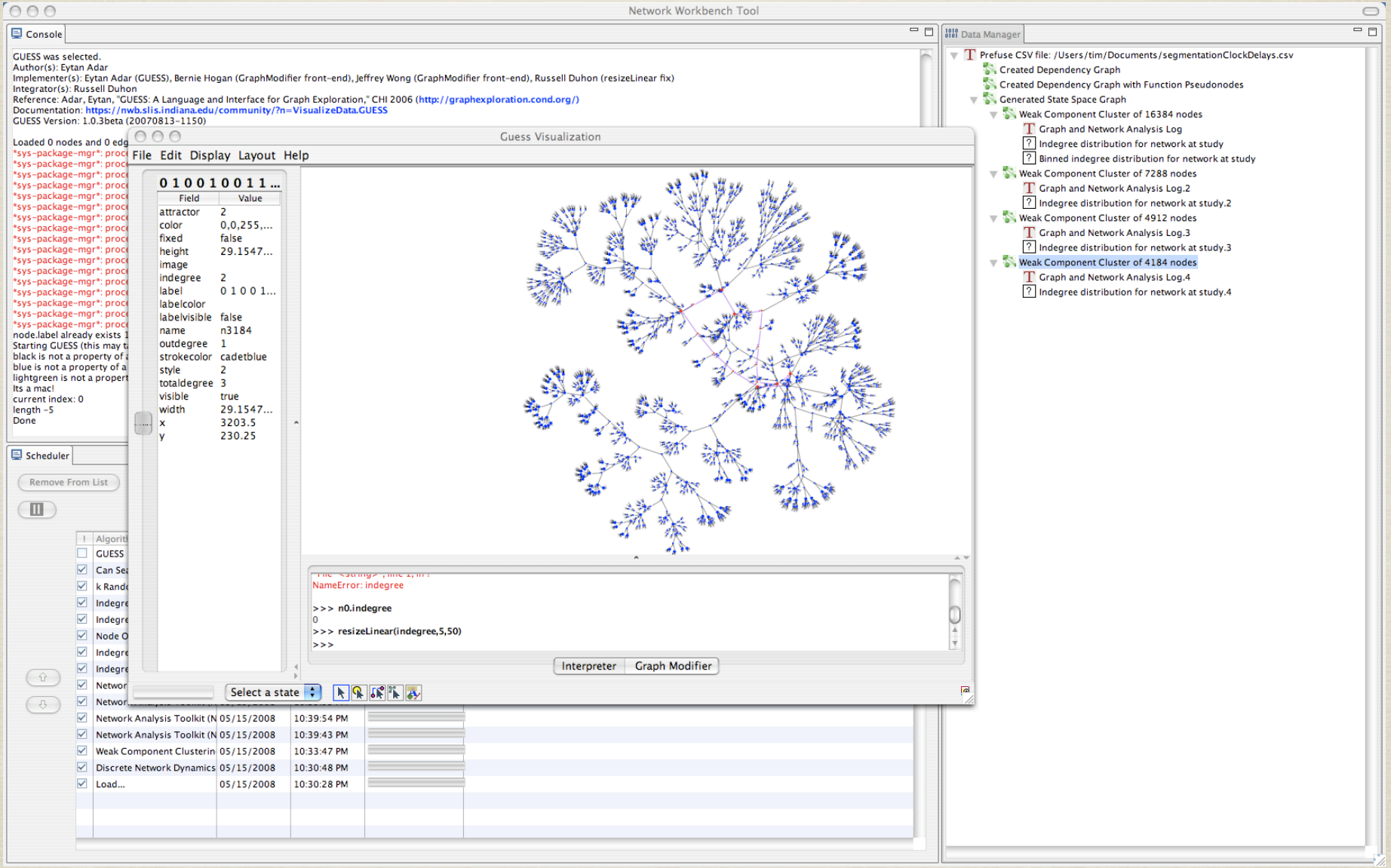
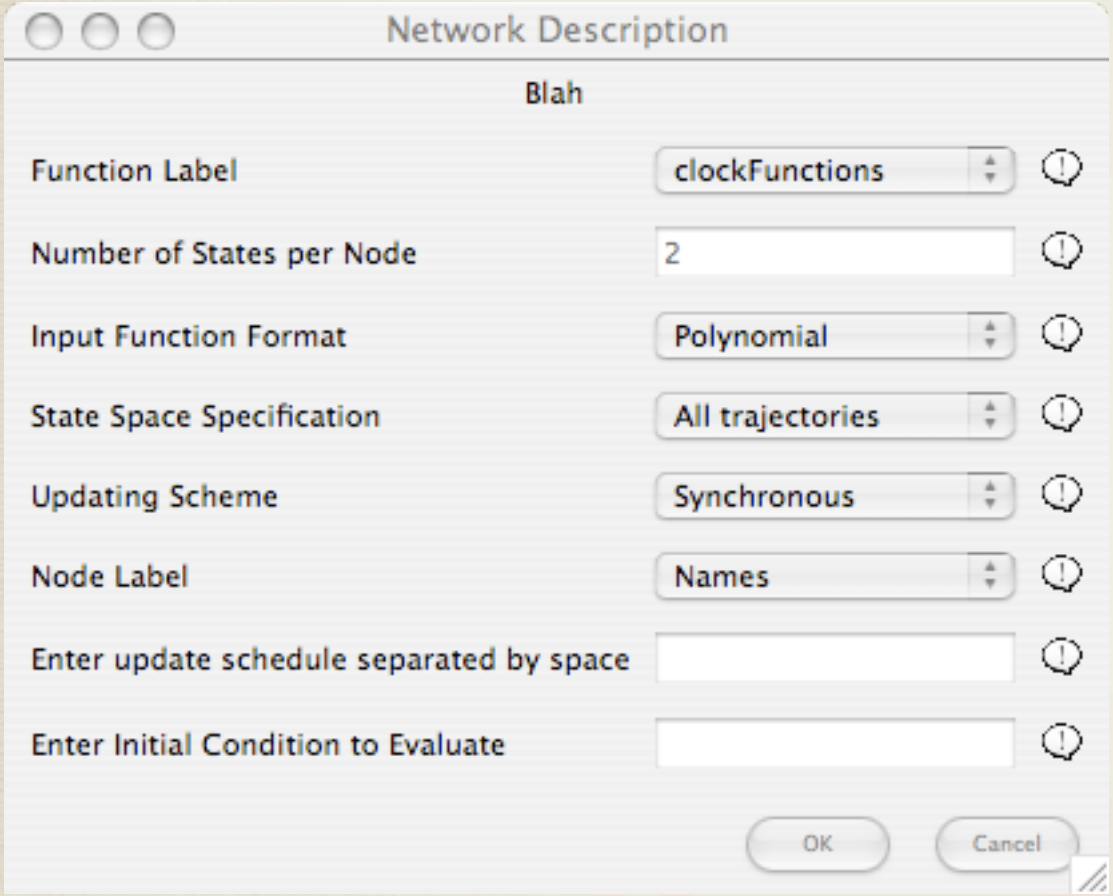


Image from *A human protein-protein interaction network: a resource for annotating the proteome.* Cell, 2005. Vol 122:6.

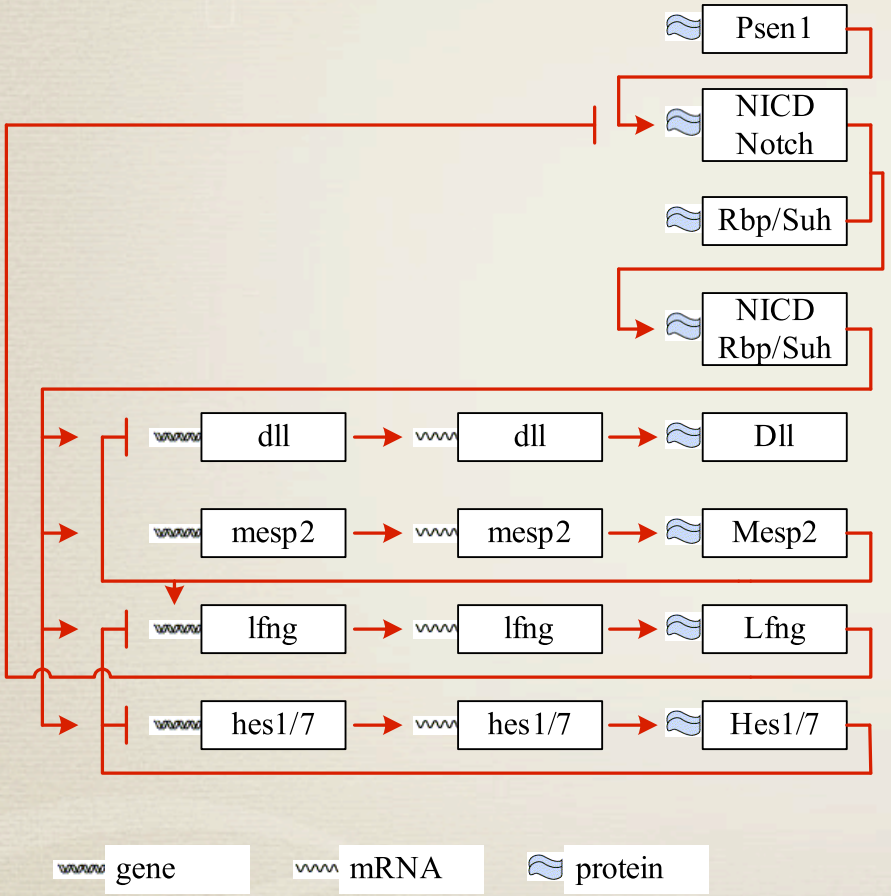
Network Workbench is a widely available tool for network analysis built on the OSGi framework.

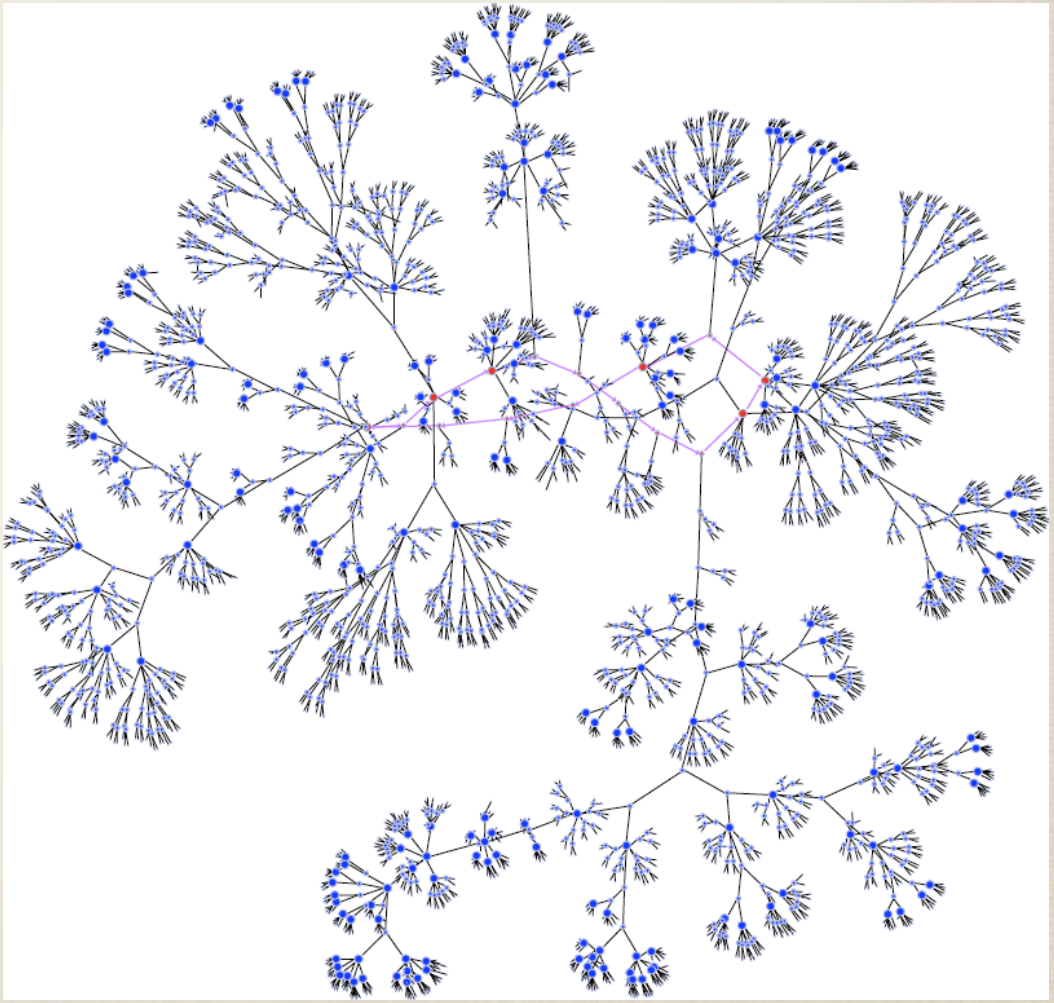


The Discrete Network Dynamics plugin allows for a large range of model analysis techniques while minimizing the computational time costs.



Analyzing the state space of the segmentation clock using the Discrete Network Dynamics plugin reveals that the network topology drives oscillations.





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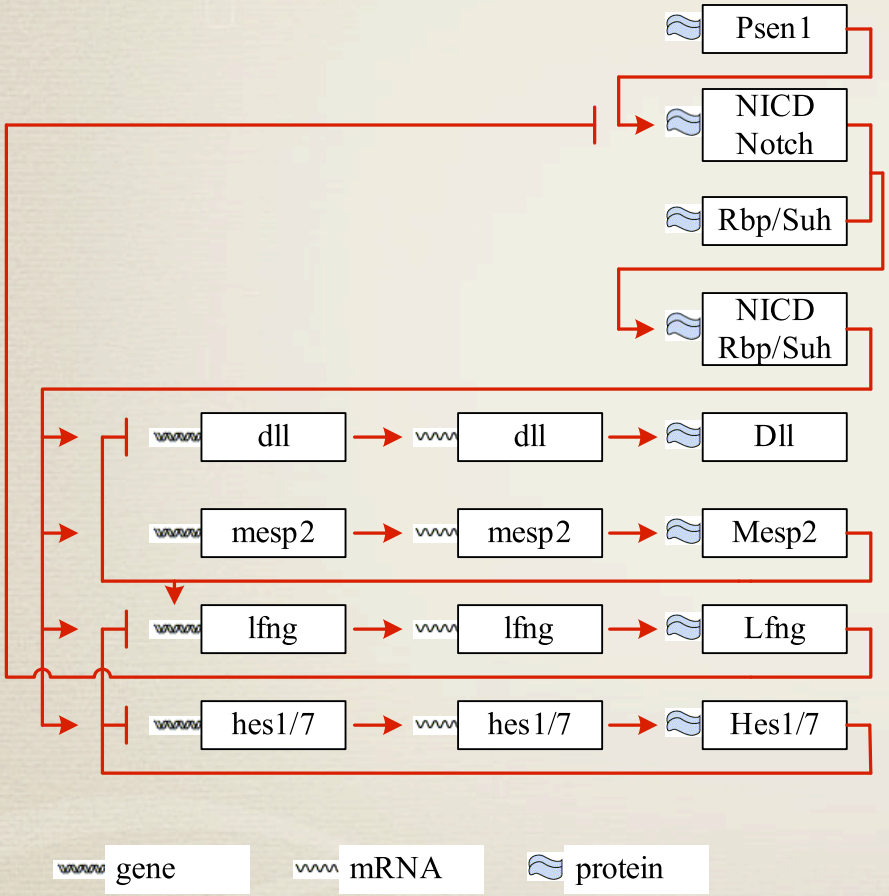

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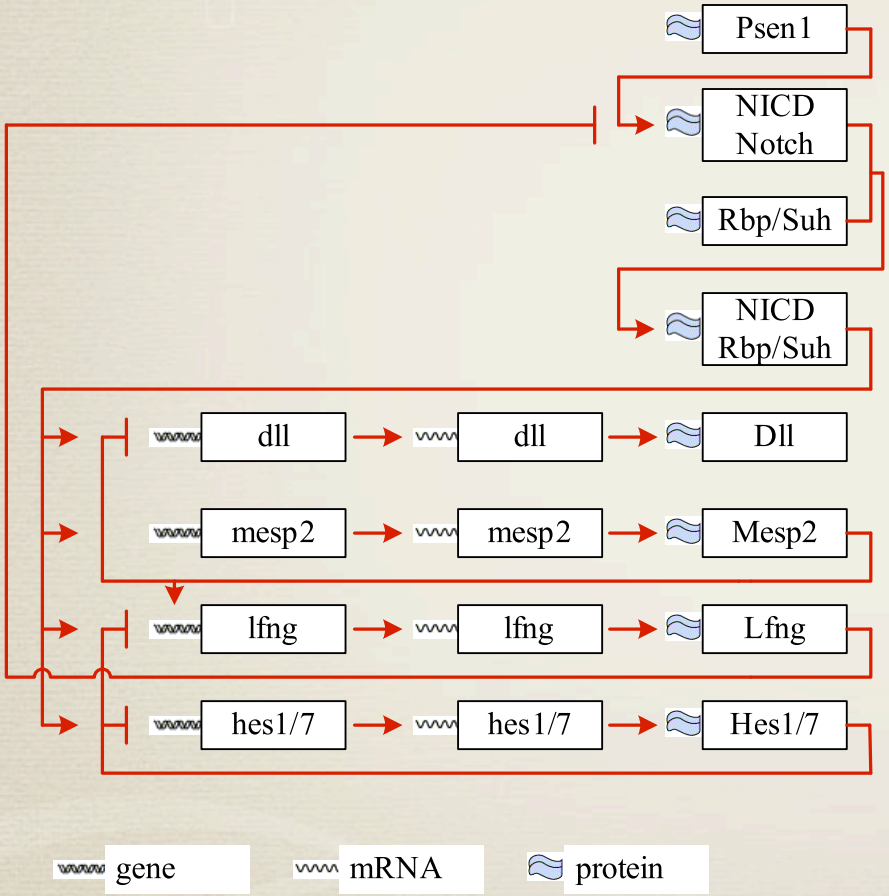

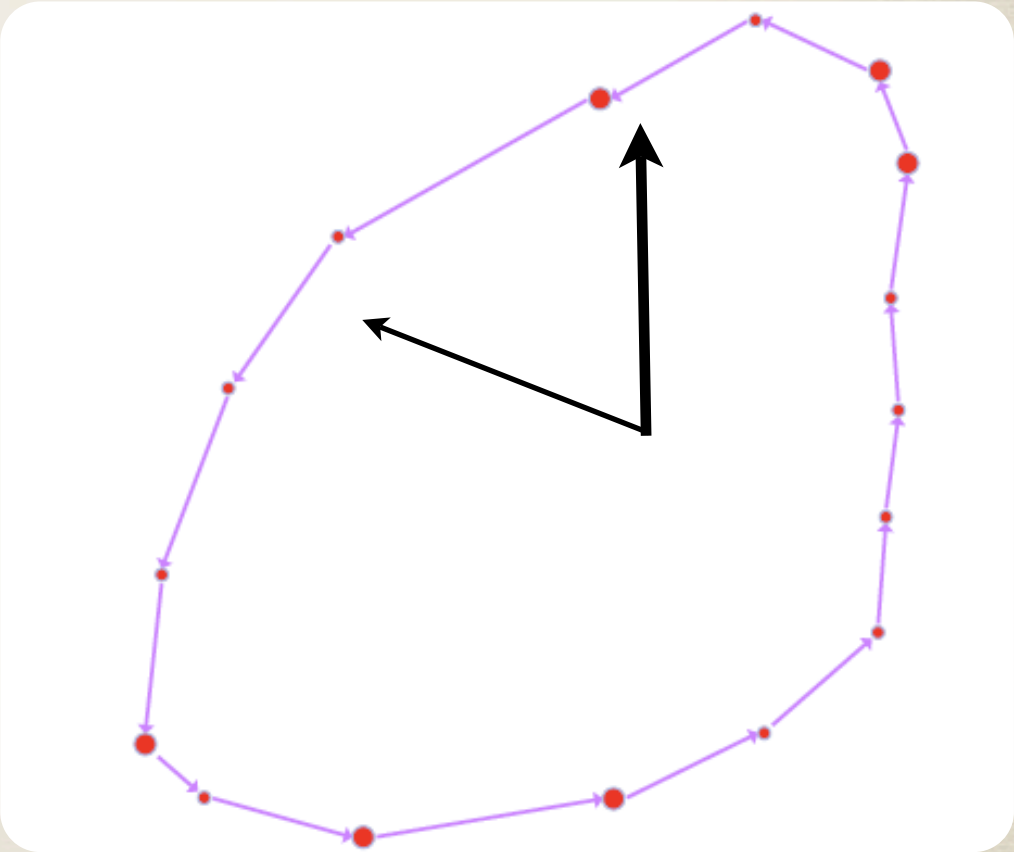

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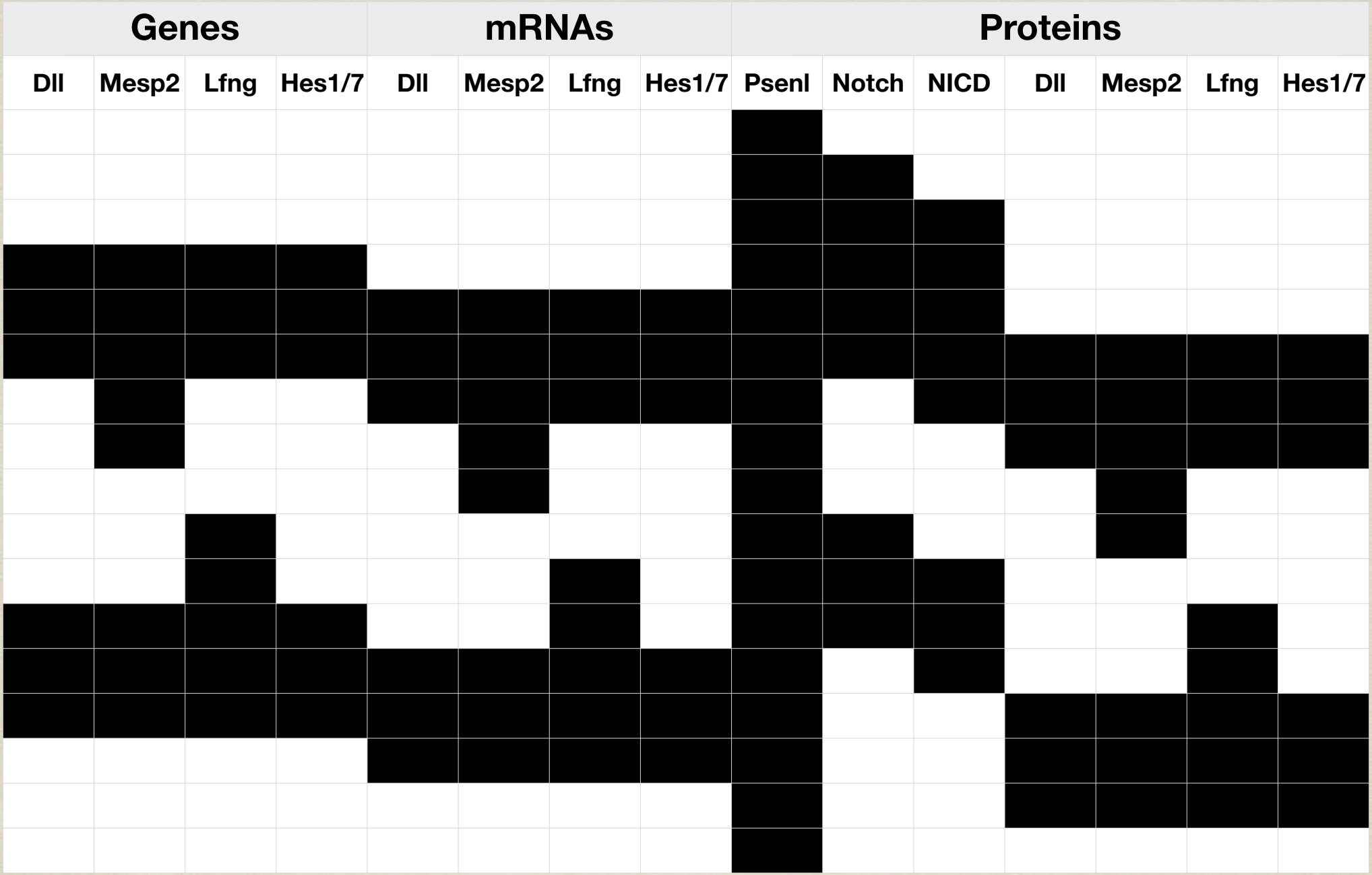
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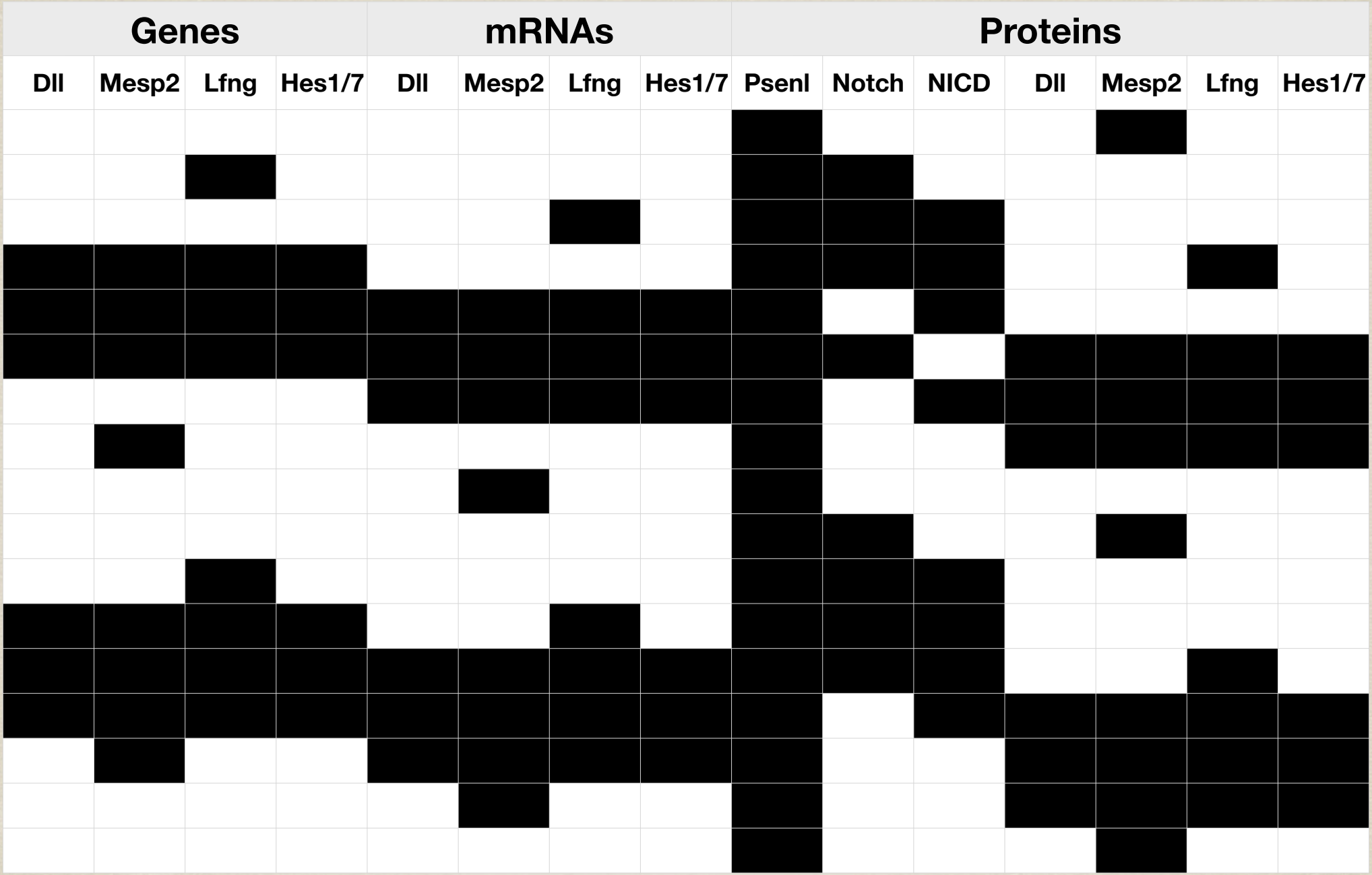
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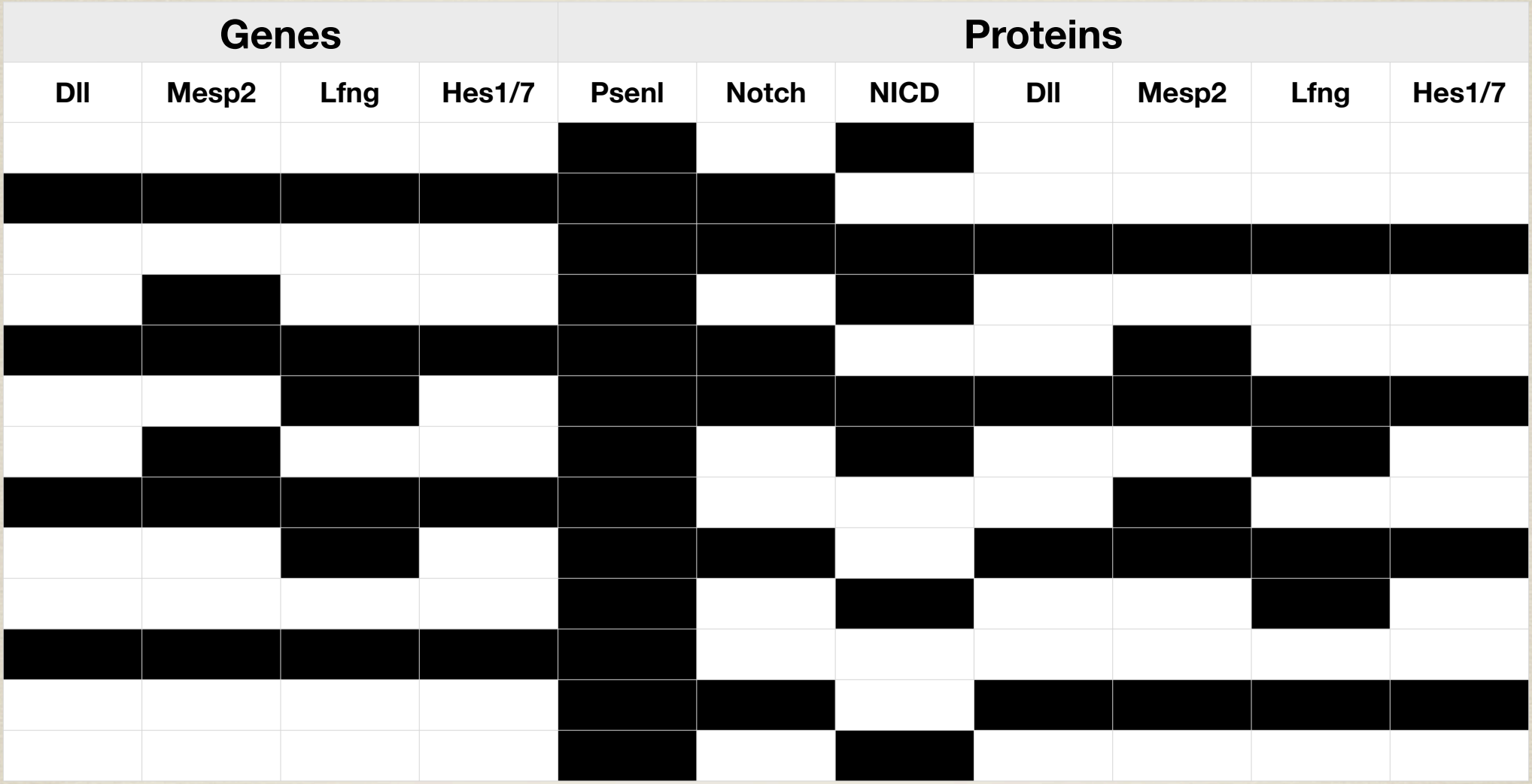
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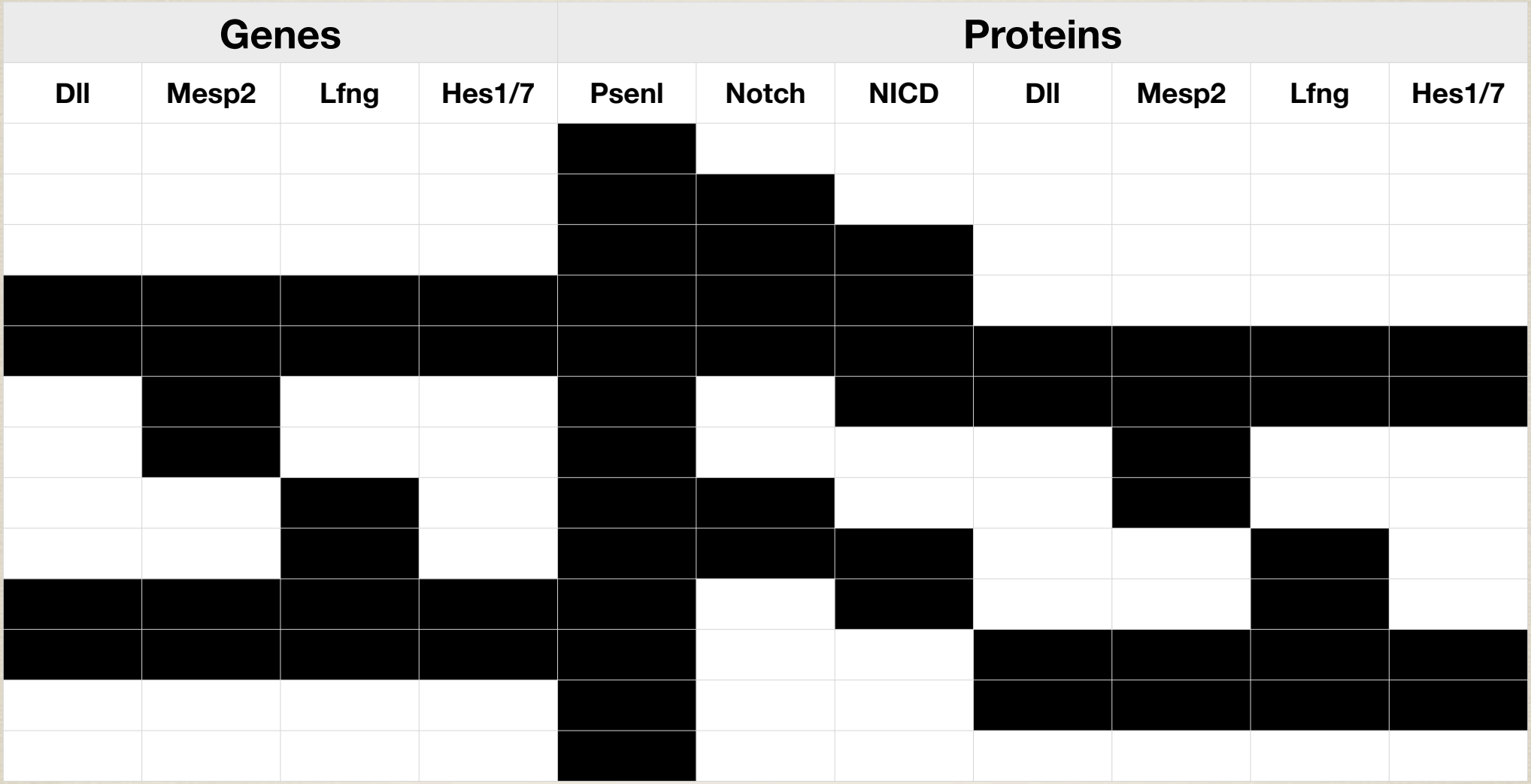
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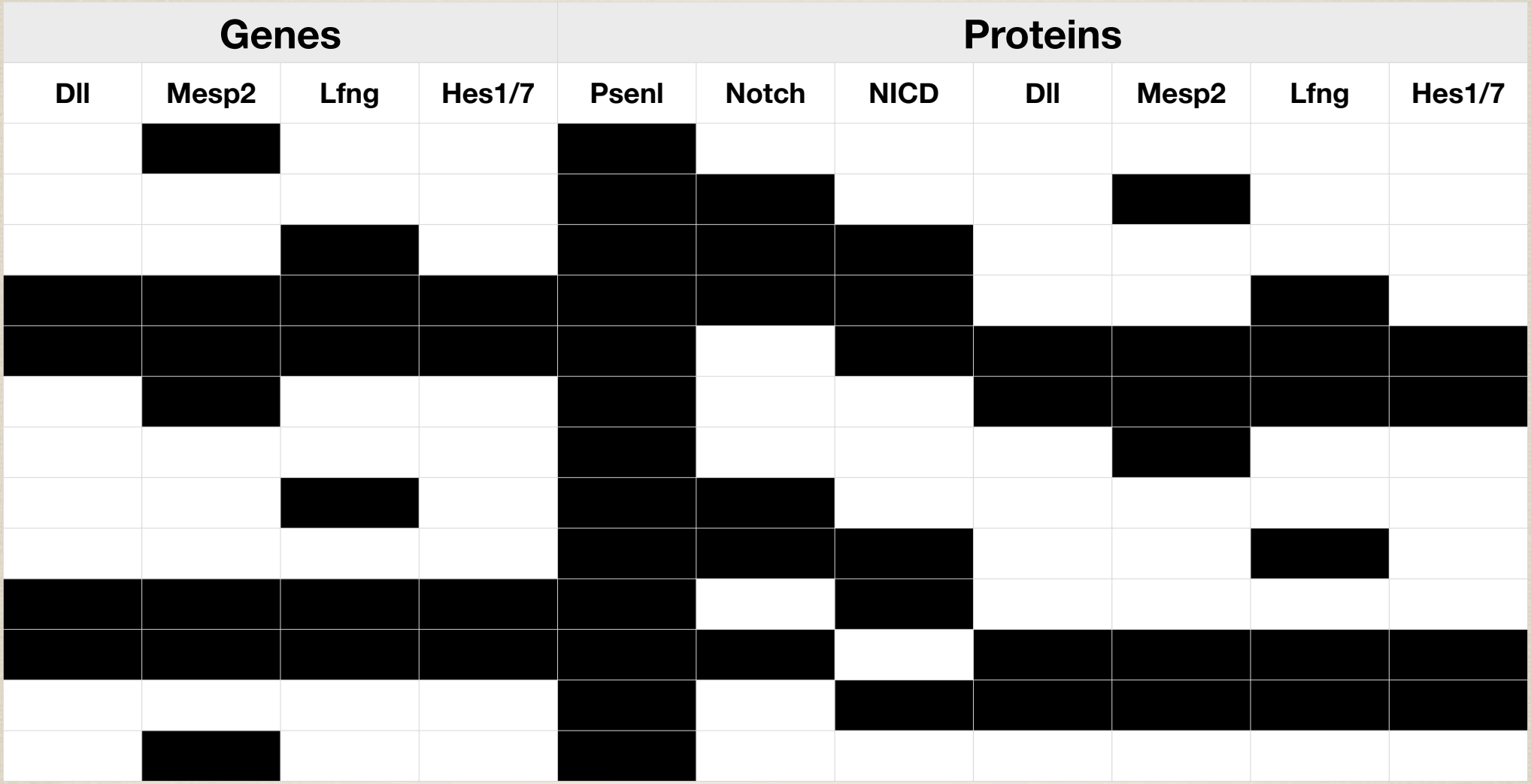
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