Notes for network study group

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Main presentation: Today's talk mainly given by Dan explains the mechanism of gene co-expression. Dan introduces 7 gene co-express mechanisms from the perspective of genetics:

- neighbor effect: two similar genes may be packed nearby in DNA;
- gene may serve as transcription factors;
- multiple genes may form a causal chain;
- centrality-lethality rule;
- external environmental signal may active a series of gene expression;
- same household: different cells may have differnt gene expressions;
- functionally unrelated genes can be inherited together.

See the slides (I think Dan will provide later) or recording for detailed explanation. Also see Serin et al. (2016) for reference.

Discussion: Tina says that we can generate a multi-layer network in the tensor form rather than focus on a single gene co-expression network. In the multi-layer network, each slice represents the network corresponding to a particular co-expression mechanism. Then, we can use different thresholds or prior knowledge to the networks for different mechanisms. Tina also mentions two papers Kivelä et al. (2014) and Torres et al. (2021) which may be helpful.

References

Kivelä, M., Arenas, A., Barthelemy, M., Gleeson, J. P., Moreno, Y., and Porter, M. A. (2014). Multilayer networks. *Journal of complex networks*, 2(3):203–271.

Serin, E. A., Nijveen, H., Hilhorst, H. W., and Ligterink, W. (2016). Learning from co-expression networks: possibilities and challenges. *Frontiers in plant science*, 7:444.

Torres, L., Blevins, A. S., Bassett, D., and Eliassi-Rad, T. (2021). The why, how, and when of representations for complex systems. *SIAM Review*, 63(3):435–485.