A Convex Formulation for Learning Scale-Free Networks via Submodular Relaxation
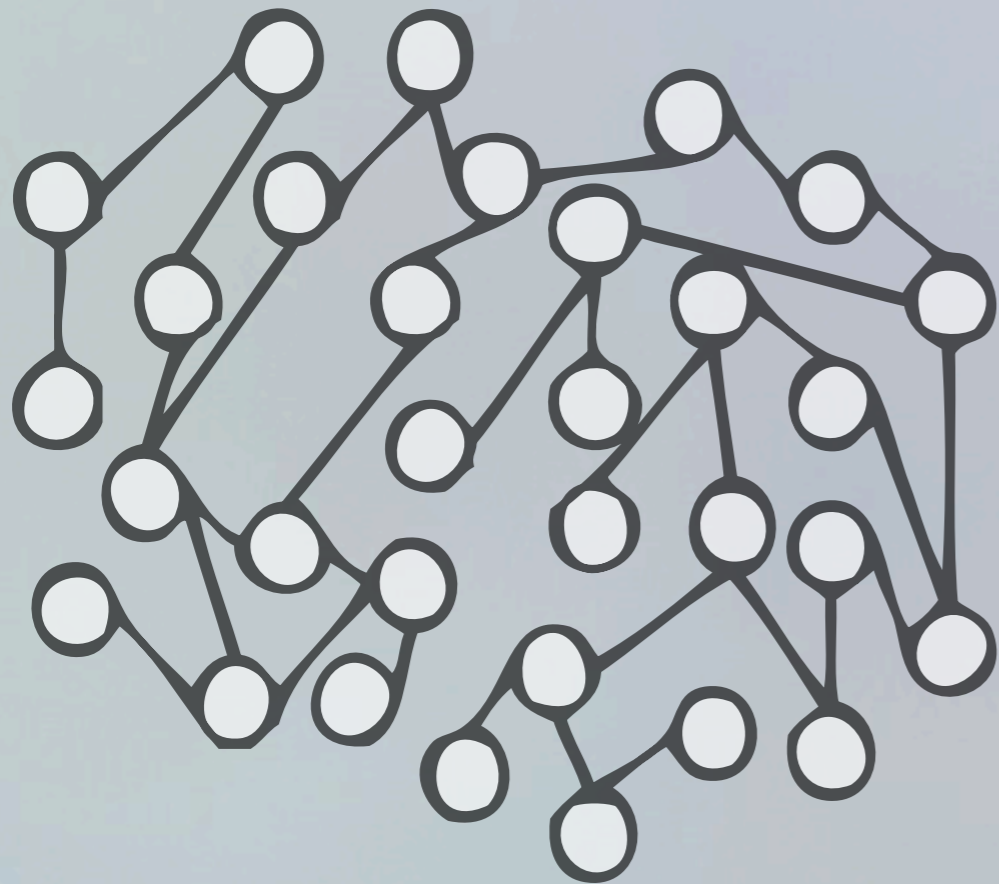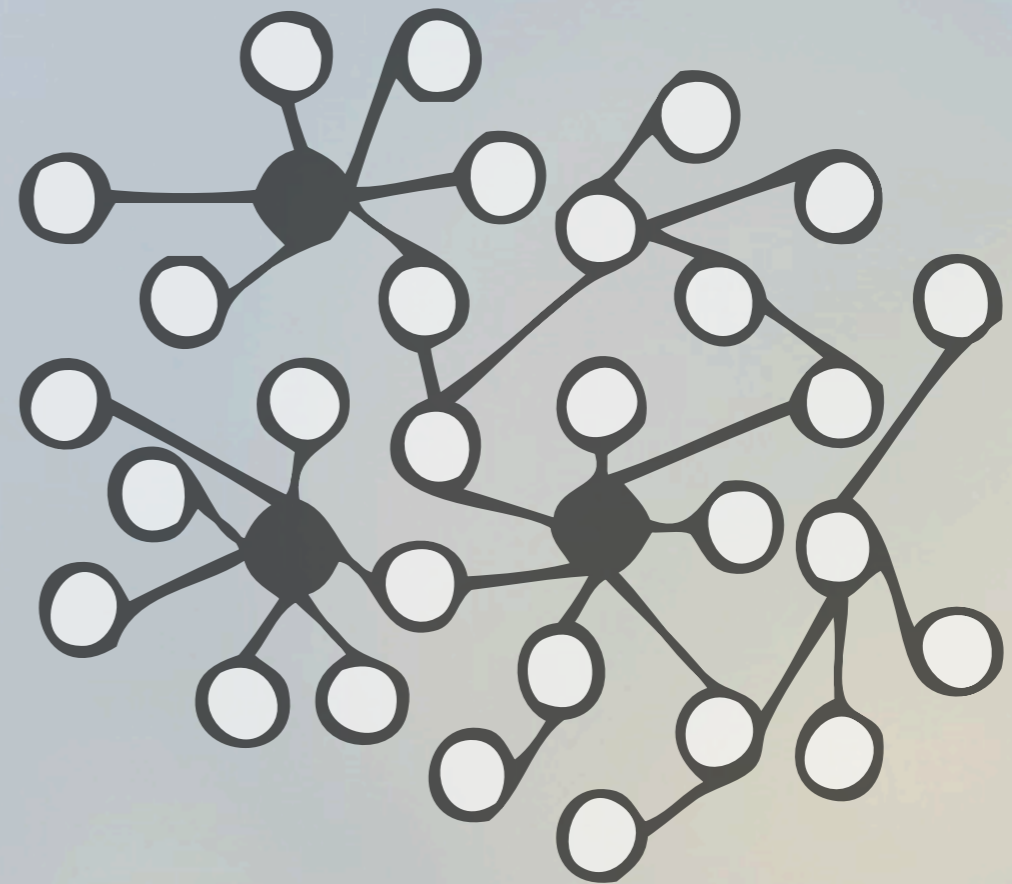
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We construct a convex regularizer for structure learning of Gauss-Markov random fields that encourages scale-free structures

Independent edges

Scale-free

Scale-free: Heavy tailed degree distribution

Key Ideas

- Formulate a submodular function on the edge set of the network

- Relax to a convex non-differentiable regularizer

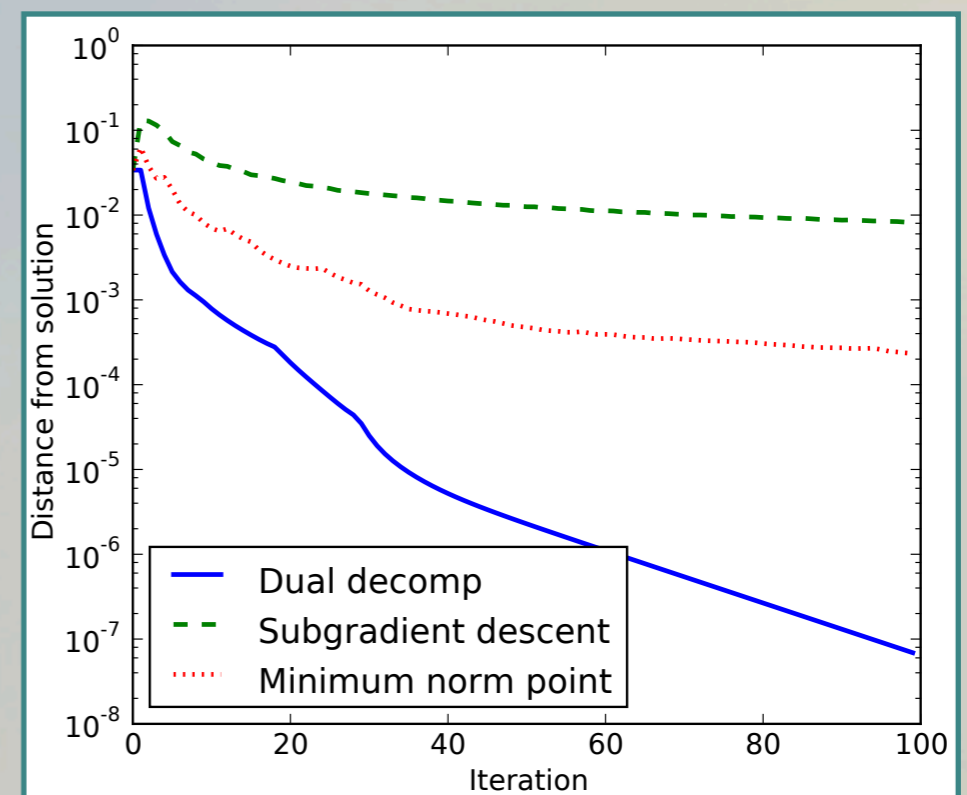- Optimize regularized objective using proximal methods (ADMM)

- Proximal operator has interesting structure, we give an efficient optimization method for computing it.

$$\Omega(X) = \sum_{i=0}^{n} \sum_{k=0}^{n-1} (h(k+1) - h(k)) \left| X_{i,(k)} \right|$$
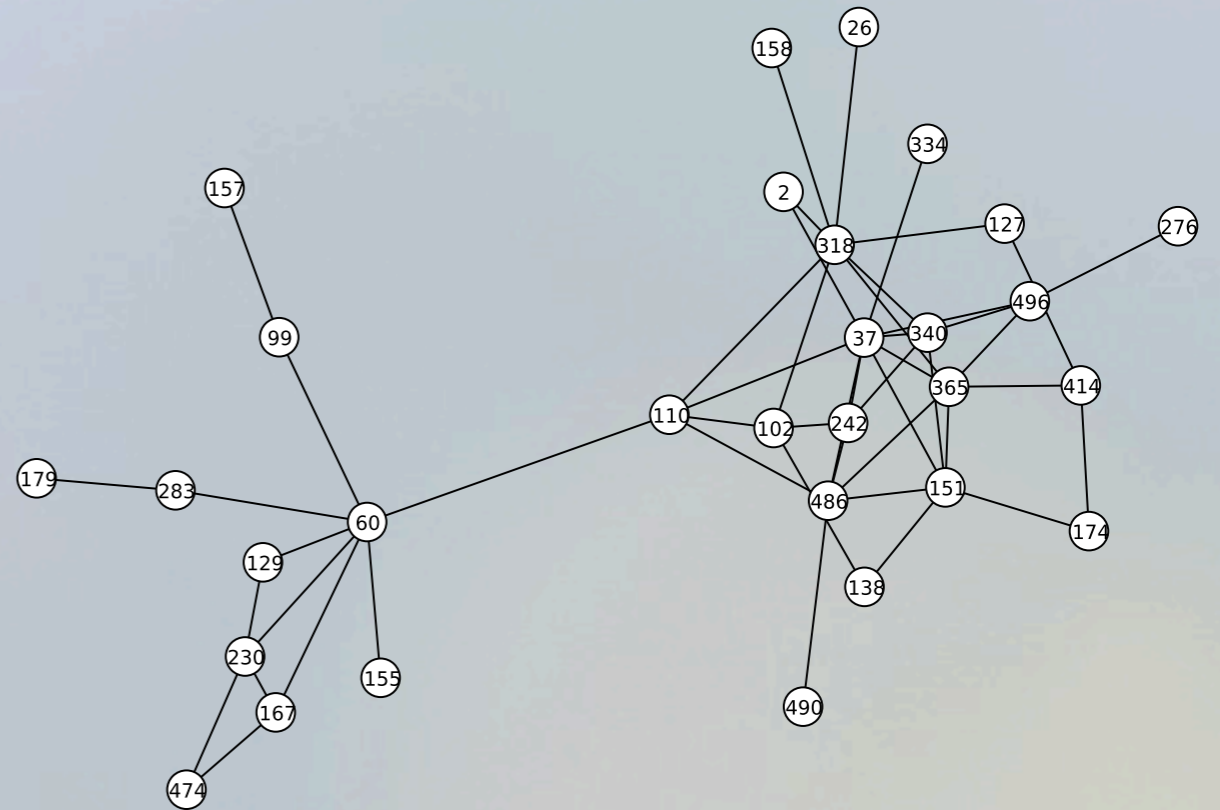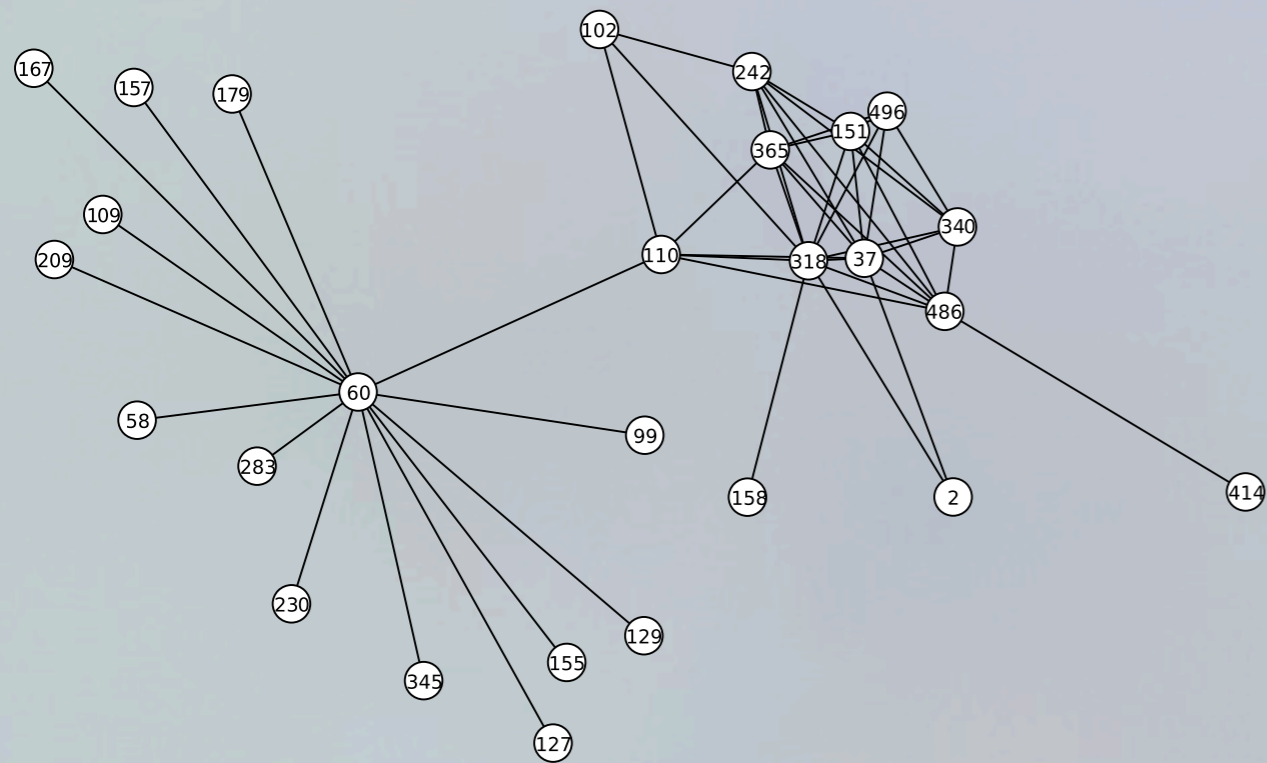
h degree weight function
X Symmetric edge weight matrix
(k) kth element in decreasing order by absolute value

Gene network reconstructions

L1 regularizer

Our regularizer

Come see our poster: W47