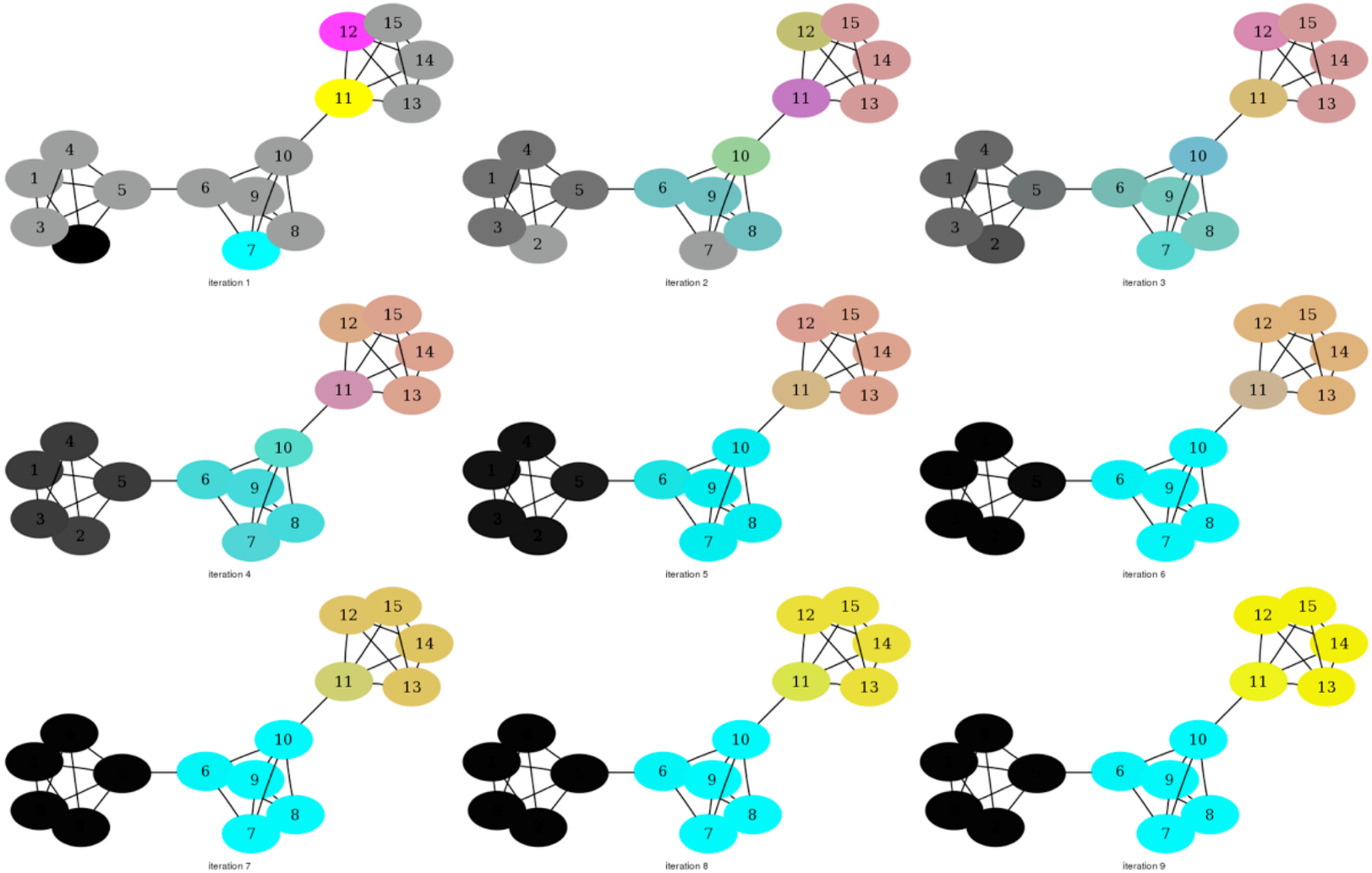
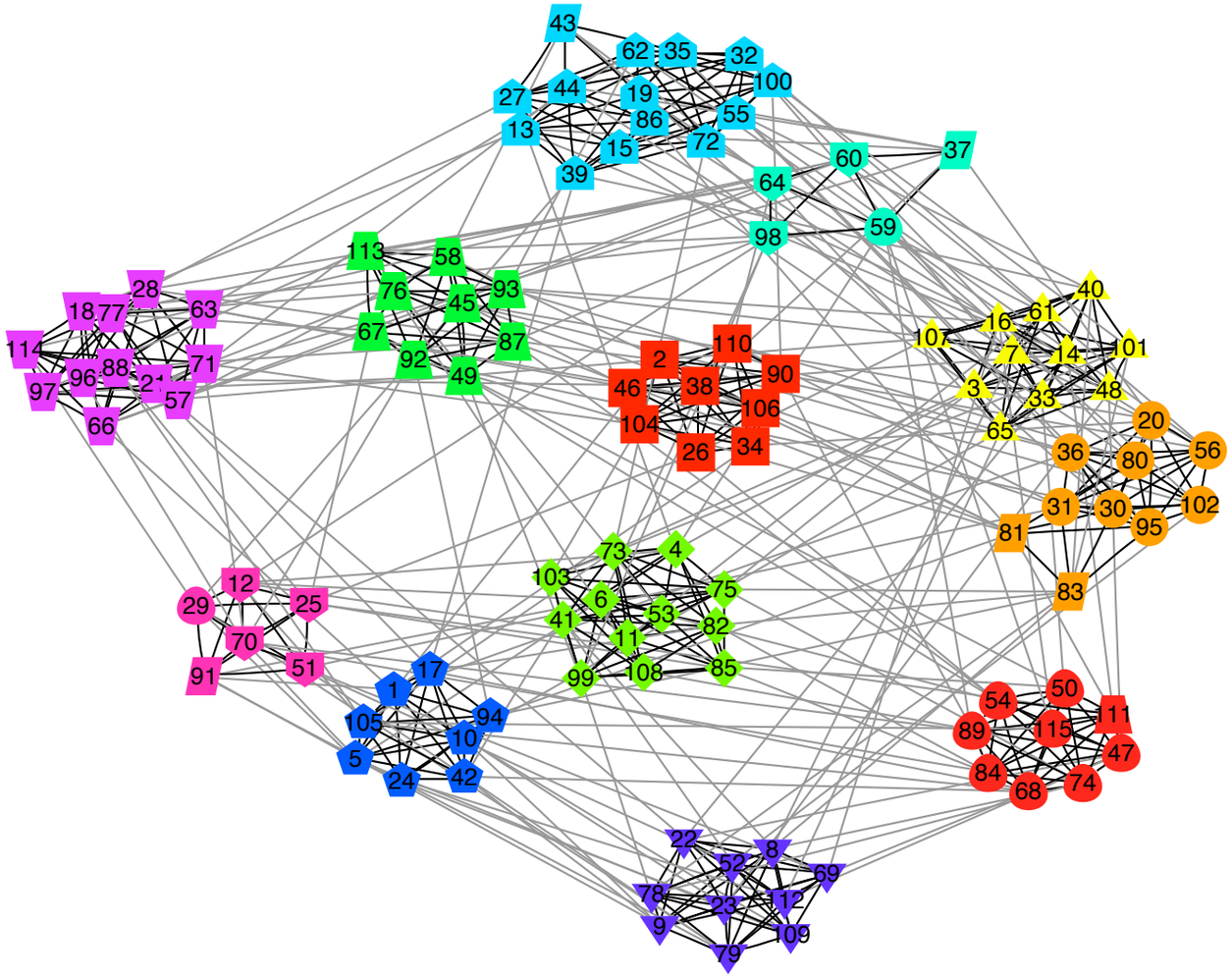
A Bayesian approach to network modularity

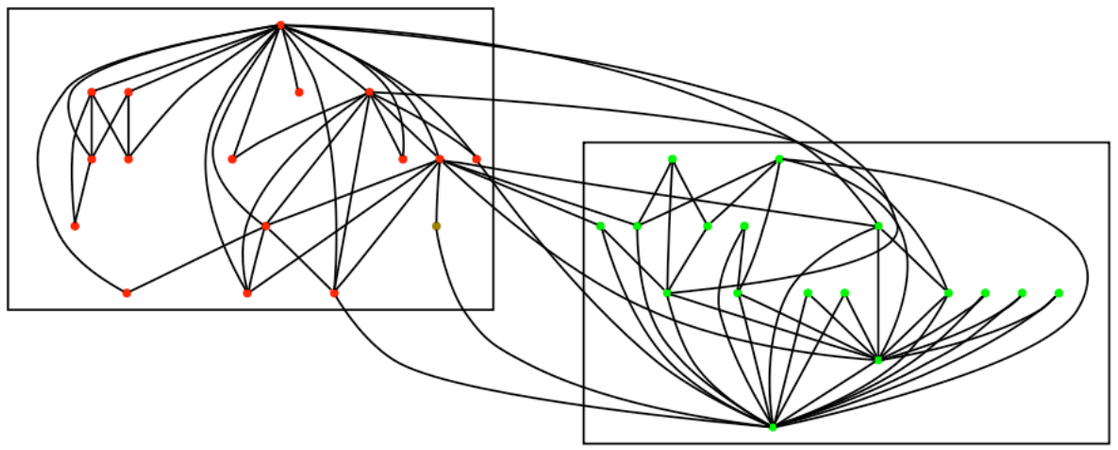
- Generative model: die rolling for module assignments, coin-flipping for edges
- Inference: variational Bayes for approximations to posteriors + complexity control



- Stochastic Block Model (Holland & Leinhardt 1975, Wasserman); Network inference (Reichardt, Hastings, Newman, Miele, Xing, Aukia); Variational Bayes (MacKay 1995, Jordan, Ghahramani, Beal)



2000 NCAA football schedule (Newman)
nodes: teams, edges: games played
shapes: conferences, colors: inferred modules



Karate network (Zachary)
nodes: people, edges: alliance
boxes: faction, colors: inferred modules

$K_{\mathrm{True}}/K_{\mathrm{VB}}$

	2	3	4	5	6
3	0	**99**	1	0	0
4	0	0	**90**	10	0
5	0	1	5	**91**	3

$K_{\mathrm{True}}/K_{\mathrm{ICL}}$

	2	3	4	5	6
3	0	**100**	0	0	0
4	4	25	**71**	0	0
5	26	55	17	**2**	0

Comparison of VB to ICL (Miele) for synthetic N=60 node networks and KTrue=3,4,5 modules