Lecture Introduction to Network Science
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Solution 9

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Question 1

a) Multiple clustering levels in dendrogram; parameter k in spectral clustering

b) Modularity measures if the actual number of edges within clusters is higher than expected by chance. Measure is agnostic of number of clusters k.

c) Use as criterion to obtain best clusters from dendrogram; directly optimize for modularity, as done in the Louvain algorithm

d) Nodes are initially assigned to individual cluster each; nodes iteratively update their community memberships based on the most frequent label in their neighbourhood; run until convergence of labels

e) Asynchronous vs. synchronous label update; different neighborhood structures; label update rule

Question 2

a) The labels of the nodes after synchronous label update are $A : 1,\ B : 1,\ C : 3,\ D : 3,\ E : 3$.

For parts b) and c) there is no unique solution due to randomized tiebreaks and asynchronous label update, we discuss possible solutions in the exercise session.

Question 3

See exemplary implementation in `girvan_modularity.ipynb`.