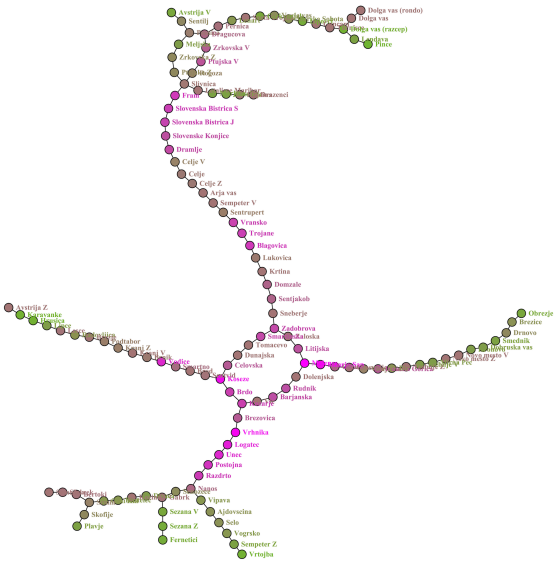
Measures of bridging, small-world networks and model

You are given six networks in Pajek format (edge list and LNA formats are also available).

- Zachary karate club network (small)
- Slovenian highways network (small)
- European highways network (smallish)
- Map of Darknet from Tor network (medium)
- iMDB actors collaboration network (medium)
- A part of Google web graph (large)

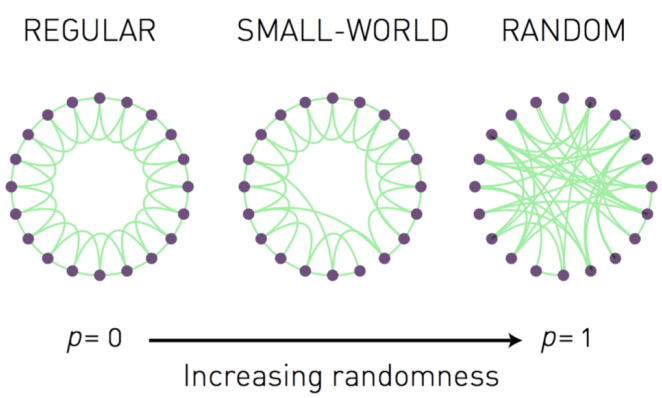
I. Betweenness in transportation networks

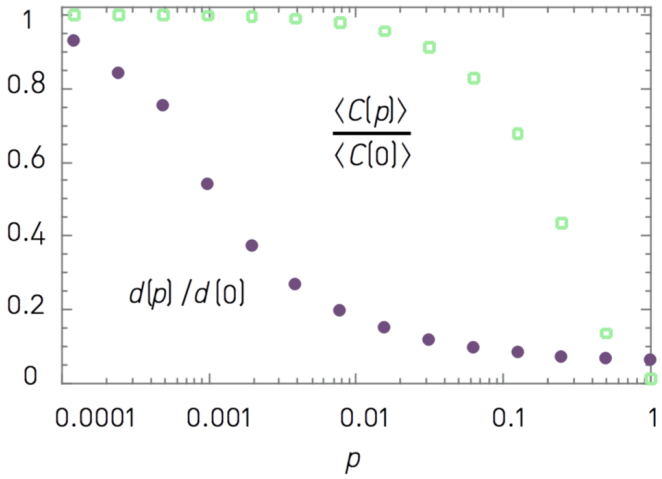
(code) Consider Slovenian and European highways networks above. Find the most important highways according to link betweenness centrality $\sigma_{ij} = \sum_{st \notin \{i,j\}} \frac{g_{st}^{ij}}{g_{st}}$, where g_{st} is the number of geodesic paths between nodes s and t, and g_{st}^{ij} is the number of such paths through the link between nodes i and j. Which highways have the highest σ_{ij}? Are the results expected or are they surprising?



II. Watts-Strogatz small-world graphs

1. **(answer)** Study the algorithm for generating Watts-Strogatz small-world graphs $G(n, k, p)$ introduced in lectures. Does the algorithm generate networks with realistic structure? What is the time complexity of the algorithm?





1. **(code)** Implement the algorithm and generate Watts-Strogatz small-world graphs that best match non-transportation networks above. *(Set k to $\langle k \rangle$ rounded to the nearest even number and try to find the value of p that best reproduces $\langle C \rangle$.)* Compute their average node clustering coefficient $\langle C \rangle$ and approximate average distance between the nodes $\approx \langle d \rangle$. Are the results expected or are they surprising?

III. Homework #1 review

(Write solutions on the blackboard.)