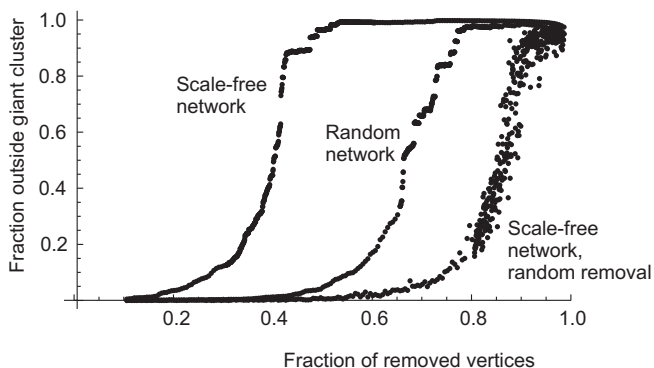


systematically disabling hubs should quickly partition a network into several disjoint components, a highly undesirable situation.

To illustrate these matters, Figure 7.12 shows what happens when we systematically remove vertices from a scale-free graph in comparison to removing the best-connected vertices from an ER random graph. We also show the effect of removing randomly selected vertices from a scale-free graph (which is very similar to randomly removing vertices from an ER graph). A scale-free network is thus seen to be sensitive to a targeted attack, but just as robust as an ER random graph in the case of a random attack.



**Figure 7.12:** The fraction of vertices outside the giant component when removing hubs from a scale-free graph, and those from an ER random graph.

### Related networks

As we mentioned, the Barabási-Albert approach for constructing a scale-free graph has one important shortcoming when comparing it to real-world networks: its relatively low clustering coefficient. A better understanding of real-world phenomena should normally be reflected by better models and in this sense, a BA random graph is difficult to validate against many real-world data. Therefore, researchers have been seeking solutions for constructing scale-free graphs that have a high clustering coefficient.

As argued by Dorogovtsev et al. [2003], constructing such graphs is actually quite simple. The trick is to make sure that there are many triangles. This can be achieved, for example, by adding an edge to a triple at each step of the growing process. (Recall that a triple was a subgraph with 3 vertices and 2 edges.) Holme and Kim [2002] provide a scheme that combines scale-freeness and at the same time allows to tune to what extent clustering is to be provided. Their algorithm proceeds as follows: