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Lehrstuhl Informatik VIII
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Assignment 1

Task 1 Plots and Basic Statistics

This task is about computing basic statistical values and the plotting of distributions. For Python, we recommend to use PyPlot (Documentation: http://matplotlib.org/api/pyplot_summary.html)[1].

a) Generate 3 graphs using networkx with each 50 nodes (0,1,..,49) and 100 edges.

- The generation rule for G1 shall be that: a) each node connects to a random other, b) 50 random edges.
- The generation rule for G2 shall be that: a) each node i connects to successor $i + 1$ and a quarter around the ring to $i + 12$.

Verify that G1 is connected. Use networkx to compute the shortest paths between all nodes. Ignore paths from a node to itself.

b) Compute mean, variance, standard deviation, and coefficient of variation for the average path length.[2]

c) Plot the path length distributions as bar plot (e.g. plt.bar(x,y)). Also cumulative.

d) Plot P-P and Q-Q plots for the distribution of G1 vs G2 (e.g. plt.plot(x,y)).

e) For G1 plot (e.g. plt.bar(x,y,'o')) each node with the x-axis as the number of edges of the node is adjacent to, and the y-axis being the average path length? Any visible correlation?

Solution: aufg_3_1.py

Task 2 Application of Little's Theorem

This task is about queuing systems. To refer more to networking, we call the jobs in a system packets.

a) Let us assume an $M/M/20 - \infty$ system. It's arrival rate is $\lambda = 0.4$ and the average time a packet stays in the system is E[T]=15s. What is the average number of packets E[X] in the system ?

Solution:
Little's Theorem $E[X] = E[T] * \lambda = 15s * 0.4\frac{1}{s} = 6$

[1] You can also generate scripts for Gnuplot or R if you like.
[2] To maximize learning,it is recommended to first use your own code to compute the values and optionally compare it with e.g. the results using libraries like Numpy or Scipy.

b) Little's Theorem is valid independent of the distributions. Now assume a $D/M/20-\infty$ system with the same arrival rate and processing rate. Will the average number of packets in the system be again the E[X] from a)? Give reasons for your claim.

Solution:
No. The reason is that the deterministic arrival rate removes one source of variation that could trigger a short-term overload and thus waiting time. Now, only long processing times can trigger the need to wait. Thus, the overall time a packet stays in the the system changes as the propability to wait changes. Thus, E[T] different and so E[X]. Both should be smaller.