Infocom networks cheat sheet

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Abstract

I am too retarded.

- Exam topics:
  - History, operation, measurement and topology of the Internet.
  - Models of Internet network topology.
  - Robustness of the Internet against random and deliberate attacks.
  - Virtual and social networks over the Internet.
  - Search, diffusion and epidemics in the Internet.
  - Modeling Internet packet traffic.
- The Internet itself is a network of heterogeneous networks mutually interconnected.
- Local Area Networks (buildings, university departments, etc.), Metropolitan Area Networks, Wide Area Networks (connect computers which are scattered over wide geographical areas).
- Routers choose the best routing for data. The router handles the packet by looking at the destination address and sending it to the neighboring router. The way the router decides which is the next hop router is determined by the routing protocol algorithms
- The Internet is built on a whole family of cooperative protocols often referred to as the Internet protocol suite
- The Internet is a packet switched network (all the communications between two hosts are mixed together with everyone else's data, put in common pipes, delivered to the specified destination address)
- Transmission Control Protocol and Internet Protocol
- The main role of the TCP is to break the information down into packets of small and manageable size, stamped with the origin and destination IP.
- These protocols ensure that if a connection is broken, the system will find another path and send the packet to the destination.
- The path on which a packet will be going through is mostly unpredictable
- The Internet can be partitioned into autonomously administered domains, called autonomous systems (AS), which vary in size, geographical extent, and function.
- There are Transit ASs and Stub ASs (leaves).
- The Internet can be modeled as an undirected graph where each edge represents a physical connection and each node represents a router.
- **MEASURES of the internet graph**:
- Vertices can be characterized by:
  - l_{ij} shortest path length
  - b_i betweenness of defines the total number of shortest paths among pairs of vertices in the network that pass through that vertex.

$$b_i = \frac{\sum_{j \neq i \neq k} \sigma_{jk}(i)}{\sigma_j k},$$

    where $\sigma_{jk}(i)$ is the number of shortest paths between j and k that pass through i and $\sigma_j k$ is the total number of shortest paths between j and k.

– c_i Clustering coefficient of the vertex i is defined as the ratio between the number of edges e_i among its nearest neighbors and its maximum possible value $k_i(k_i-1)/2$:

$$c_i = \frac{2e_i}{k_i(k_i-1)}$$

- The network itself can be characterized by the averages

$$\langle k\rangle, \langle c_i\rangle, \langle l_{ij}\rangle, \langle b_i\rangle$$

- The average shortest path length $\langle l_{ij}\rangle$ among vertices found in Internet maps is very small if compared with the size of the graphs.
- The distribution $P_l(l)$ is sharply peaked around $\langle l\rangle \approx 15$.
- The small separation among Internet routers and ASs is a striking example of the so-called small-world effect.
- The small-world effect goes along with a high level of clustering.
- The degree distribution $p(k) \propto k^{-\gamma}$, $\gamma = 2.1$. Power-law with $2 < \gamma < 3 \implies$ scale-free network.
- The cumulative degree distribution $P^c(k) = \int_k^\infty P(k')dk' = a\exp -(k/k_c)^\beta$, k_c is the cutoff degree.
- This means that a $k \to \lambda k$ transformation does not change the distribution.
- The level of heterogeneity of networks can be characterized by

$$\kappa = \frac{\langle k^2\rangle}{\langle k\rangle}.$$

- For scale free networks $\kappa >> \langle k\rangle$.
- The betweenness distribution $P_b(b) \propto b^{-\gamma_b}$ with $\gamma_b \approx 2$. The cumuative distribution $P_b^c(b) = \int_b^\infty P_b(b')db' \propto b^{1-\gamma_b}$
- The hierarchical nature of the Internet is represented by the tendency of high degree nodes to be well interconnected among each other. *Rich club phenomenon.*
- Further analysis can be made by inspecting the degree correlation function $P(k'|k)$ which is the probability that a vertex with degree k is connected to a vertex with degree k'.