

“Starting each class with humor helps students relax and creates a positive atmosphere.”

Loomans & Kolberg, 1993

“I think there is a world market for maybe five computers.”

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Thomas Watson, chairman of IBM, 1943

“Where a calculator on the ENIAC is equipped with 18000 vacuum tubes and weighs 30 tons, computers of the future may have only 1000 vacuum tubes and perhaps weigh 1½ tons.”

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Popular Mechanics, March 1949

Homework for you

Count the number of vacuum tubes in your laptops...

“There is no reason for any individual to have a computer in their home.”

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*Ken Olson, president and founder of Digital Equipment Corp.,
World Future Society Convention, 1977*



Network modeling problems: New challenges for old laws

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“Network” (1755)

“**Network:** Any thing reticulated or decussated, at equal distances, with interstices between the intersections.”

Dictionary of the English Language, 1755

“Network” (1996)

“When I took office, only high energy physicists had ever heard of what is called the World Wide Web. Now even my cat has its own page.”

Bill Clinton, announcement of Next Generation Internet Initiative, 1996

Invention of the telephone

“The method of, and apparatus for, transmitting vocal or other sounds telegraphically by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sound.”

*US Patent #174465 issued to Alexander Graham Bell
on March 7, 1876*

Future of telephony...

“This ‘telephone’ has too many shortcomings to be seriously considered as a means of communication.”

Western Union internal memo, 1876

Telephone network dimensioning

- How to measure telephone traffic?
- Given traffic A offered from source S to destination D , what's the capacity of the link between S and D to meet GOS requirements?
- Erlang loss formula

Basic works by Agner Krarup *Erlang*

- “The Theory of Probabilities and Telephone Conversations” (1919)
- “Solution of some Problems in the Theory of Probabilities of Significance in Automatic Telephone Exchanges” (1917)

Do they have anything to do with Internet research?

- Isaac Newton (1643-1727)
The universal law of gravitation
- Siméon Denis Poisson (1781-1840)
The probability distribution applied to the deliberations of juries (1838)
- Vilfredo Pareto (1848-1923)
Probability distribution of wealth, the 80-20 rule
- George Kingsley Zipf (1902-1950)
Statistical occurrences in different languages
- D. Lavalette
Statistical analysis of numerical values of the Journal Impact Factor

New applications for old laws

- Gravity models used to model the volume of $S \rightarrow D$ traffic in a network (PSTN, Internet)
- Poisson distribution: telephone call arrivals, packet arrivals, web transaction arrivals
- Zipf's law, Pareto distribution: file size distribution, Internet topology, file access requests, website visitors
- Modified Lavalette's law: wireless Internet access

Network modeling and teletraffic analysis

- Nondeterministic models
- Do we need a crystal ball?
- Probability distributions
- Measurement data

Sample projects

- Analysis of wireless Internet access sessions
- Synthesis of Internet traffic matrices
- Profiling various categories of Wi-Fi hotspot network users by applying clustering techniques
- Generation of cell dwell time residuum

Sample projects (cont'd)

- Website visitor traffic analysis
- Video on demand and time shifted TV traffic analysis

Teaching

- CS-455 Data Communications (Spring 2011)
- CS-542 Computer Networks I (Spring 2011)
- CS-544 Computer Networks II (Fall 2010)
- CS-555 Modeling and Simulation (Fall 2010)

“Errare humanum est”
 (“To err is human”)

Seneca (c. 4 BC-65 AD)

*21st century updated version of
Seneca's quotation*

To err is human but ...

21st century updated version of
Seneca's quotation

To err is human but ... to make
real mess you need a computer

Enjoy studying at our CS Department!