

# Networking and Theory

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“Theory”: a supposition or a **system of ideas** intended to explain something, especially one based on **general principles** independent of the thing to be explained;

# A gap between experience and theory in networking?

- IETF is a unique SDO with many contributions from universities
  - We even have an IRTF!
- But there seems a gap in networking area(as a whole)
  - Innovations and designs rely heavily on experience
  - I don't find a well-defined body of knowledge, or a systematic set of approaches, which can guide us to
    - Make design choices
    - Understand tradeoffs behind decisions

# “The Networking Philosopher’s Problem”, Jennifer Rexford, 2011

- **Doubts quoted:** “What is networking? “
  - “Is it just a **plethora of protocols acronyms**, mostly consisting of three or four letters.”
  - “Or, are we a **heap of header formats**, for Ethernet frames, IP packets, TCP segments and UDP messages, and application-layer messages?”
  - “So, perhaps we are a **big bunch of boxes** that perform various functions on packets, flows, or TCP connections?”
- **Appeals**
  - Our field is all about change, ... But, while we continue to embrace change, I hope that we can **make the questions we ask more precise, and the way we answer them more rigorous**, so we can put networking ...on a stronger foundation.
  - I fear **we err too far on the side of valuing new problems over deeper answers to existing questions**. We need to fight this urge, to **encourage more thorough, complete, and deeper research** that truly helps the field “grow up,” without losing its child-like sense of wonder.

# Why IETF?

- **Why adding some “theory” ingredients helps IETF**

- Explain the existing designs
- Predict the outcomes from new designs for new problems
- ...
- Make it easy for the new generation/new comers
  - to inherit
  - to make their contributions

- **Why IETF can help**

- We have both rich successful experiences and expertise in theory --we have so many academic participants.

# Why now?

- We may require more theoretical analysis than before, facing new requirements
  - “Deterministic” or “bounded delay” services beyond “best effort”
  - New methods beside “per-hop & per-flow” reservation?

## Application of Network Calculus to the TSN Problem Space

Jean-Yves Le Boudec<sup>1,2,3</sup>

EPFL

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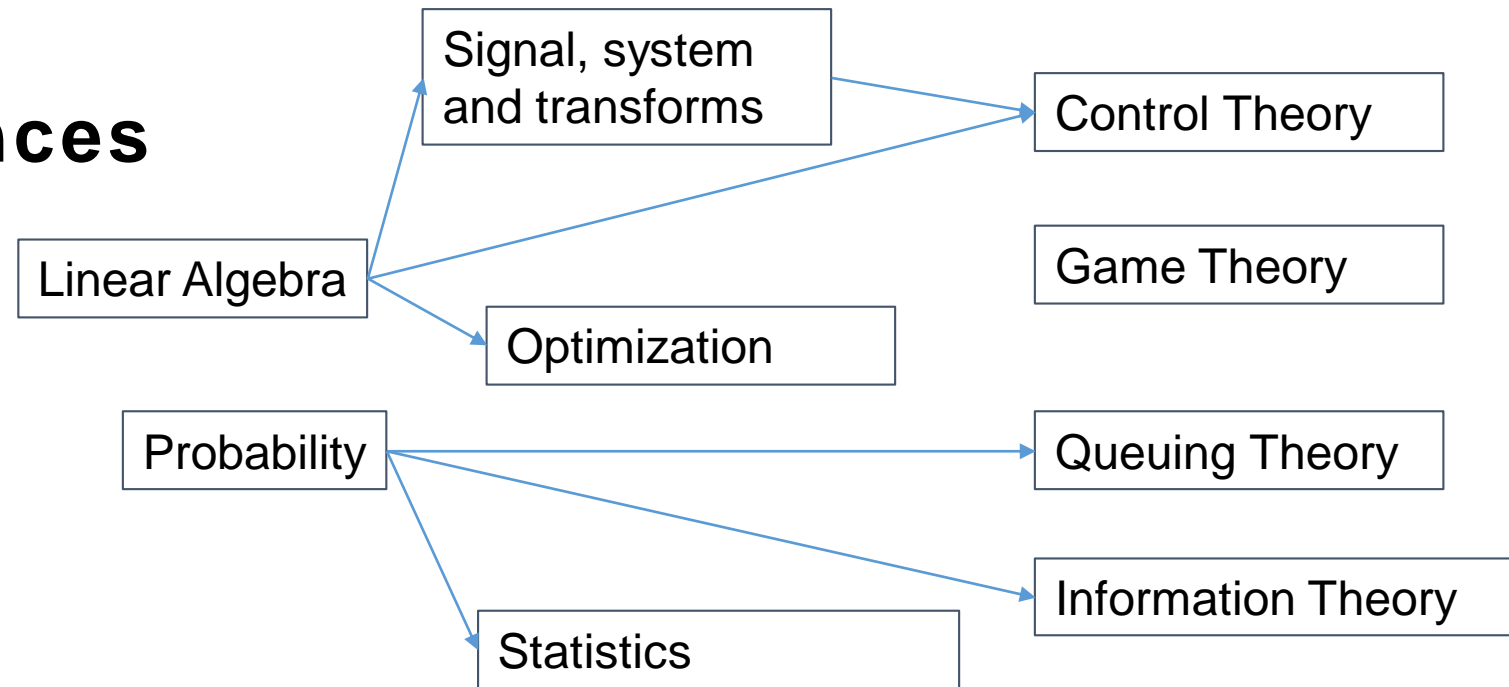
# Several useful references

(1) **Mathematical Foundations of Computer Networking**, Srinivasan Keshav, Waterloo University

(2) **The Sciences of the Artificial**, Herbert A. Simon, 1996

“there already exist today a number of components of a **theory of design** and a **substantial body of knowledge, theoretical and empirical, relating to each.**”

It includes at least the **following topics:**



## THE EVALUATION OF DESIGNS

1. Theory of evaluation: utility theory, statistical decision theory
2. Computational methods:
  - a. Algorithms for choosing *optimal* alternatives such as linear programming computations, control theory, dynamic programming
  - b. Algorithms and heuristics for choosing *satisfactory* alternatives

3. THE FORMAL LOGIC OF DESIGN: imperative and declarative logics

## THE SEARCH FOR ALTERNATIVES

4. Heuristic search: factorization and means-ends analysis

5. Allocation of resources for search

6. THEORY OF STRUCTURE AND DESIGN ORGANIZATION: hierarchic systems

7. REPRESENTATION OF DESIGN PROBLEMS

## Actions?

- Folks, who find this interesting, please contact us to share your views, and let's see what will happen...

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Thank You