

# Experimental Approaches in Computer Science

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Lecture 13:  
Experimentation and Performance Evaluation

# Performance Evaluation

- Designing and implementing systems
  - Compare designs
  - Compare implementations
  - What you measure you can improve
- Optimization of parameter settings
- Capacity planning
- Understanding what works and why
  - Making it scientific

# Methodologies

- Mathematical analysis
- Simulations
- Measurements
  - How to perform reliable measurements
  - How to make intelligent decisions about what data to use
  - How to look at and analyze the results
  - This course

# Analysis

- Create a mathematical model of the system and solve it
  - Example: queueing network model
- Model is abstract and may be simplistic
  - Danger of oversimplification in order to achieve mathematical tractability
  - May not be solvable or expressible with all desired details
- Provides insights and not just numbers

# Simulation

- Write a program that simulates system behavior and run it
- Allows for a spectrum of options from a very simplistic model to a very detailed model
  - Easy to compare alternatives
  - Different parts of the system can be modeled at different levels of detail
- Subject to the regular correctness problems
  - Validation: does the model reflect reality?
  - Verification: does the program reflect the model?
- Creates a pile of numbers that need to be interpreted

# Measurement

- Instrument a real system and measure it
  - Preferably when working on a real workload
- Limited to available system and configuration
  - Often impossible to compare alternatives
- Not easy to isolate the desired attributes
- Creates a few numbers

# Experimentation

- Part of the scientific method
- Learn something we didn't know about nature
  - Including man-made nature like the Internet
  - Including humans themselves and how they interact with computer systems
- Collect data and shape a world view
  - Know what is relevant in real life
  - Handle the general case rather than focusing on extreme cases
- Not just measurement of an existing artifact for performance evaluation

# Advice for Life

- Make sound measurements and collect good data
- Look at the data and figure out what it is trying to tell you
- Be skeptical and don't believe well-known assumptions