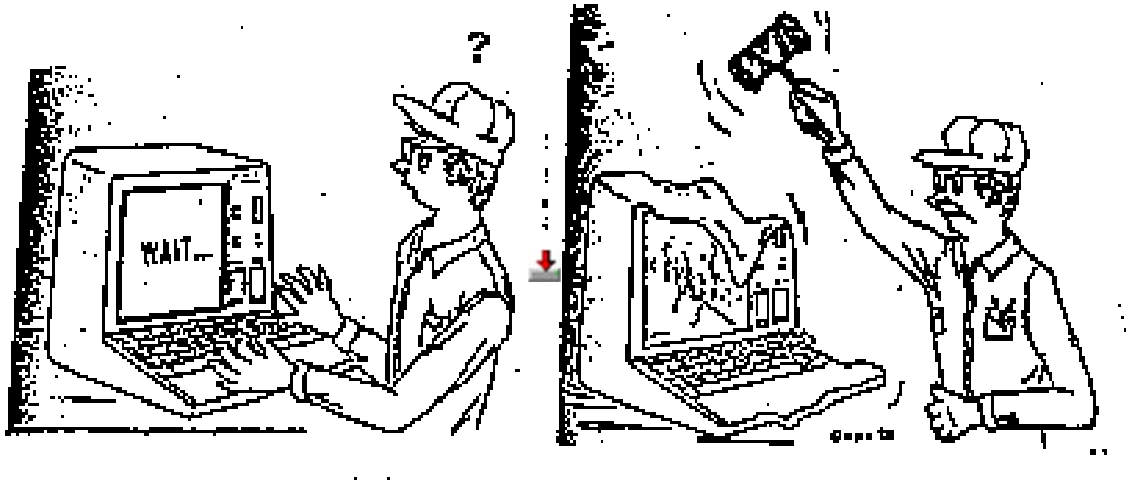
CS5239 Computer System Performance Evaluation

2020/21 – Semester I

www.comp.nus.edu.sg/~teoym/cs5239-20



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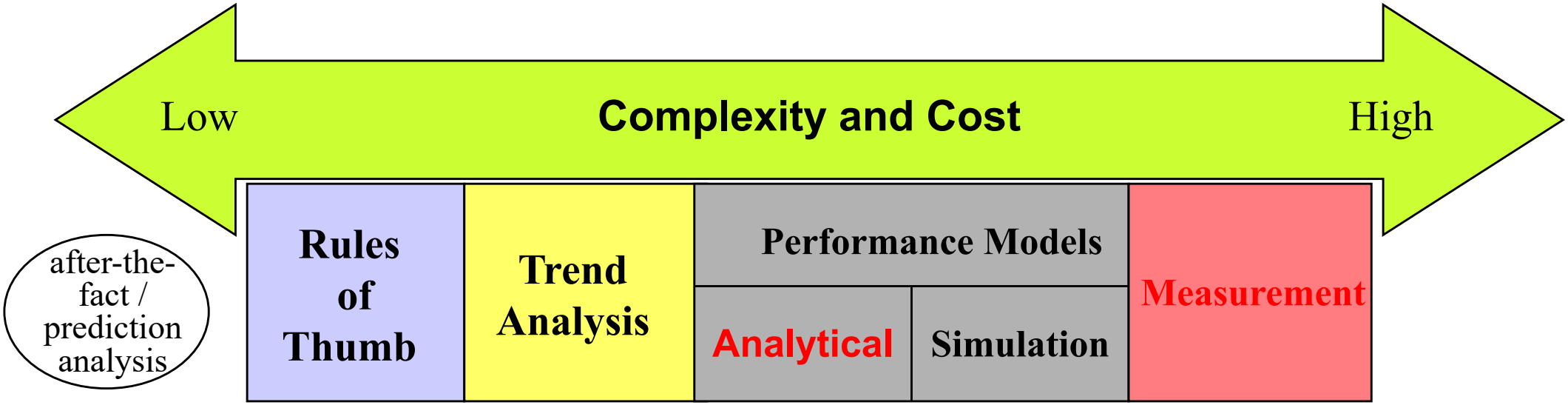
performance

faster is better

Time, cost, energy, …

Performance Evaluation



CS5239 Computer System Performance Evaluation – this module

CS6211 Analytical Performance Modelling for Computer Systems
CS5233 Simulation and Modelling Techniques

Course Catalogue

CS5239 Computer System Performance Analysis

Modular Credits: 4
Workload: 2-1-0-3-4
Prerequisite(s): ((CS1020 or its equivalent) or CS2020 or (CS2030 or its equivalent) or CS2113/T) and (EE2012/A or ST2132 or ST2334 or ((MA2216 or ST2131) and (ST1131/A or ST1232 or DSC2008)))

The objective of this module is to provide students a working knowledge of computer performance evaluation and capacity planning. Students will be able to identify performance bottlenecks, to predict when performance limits of a system will be exceeded, and to characterize present and future workload to perform capacity planning activities. Topics include: performance analysis overview; measurement techniques and tools including workload characterization, instrumentation, benchmarking, analytical modelling techniques including operational analysis, stochastic queuing network analysis; performance of client-server architectures; capacity planning; case studies.

Prerequisites

undergraduate: ((CS1020 or its equivalent) or CS2020 or (CS2030 or its equivalent) or CS2113/T) and (EE2012/A or ST2132 or ST2334 or ((MA2216 or ST2131) and (ST1131/A or ST1232 or DSC2008)))

graduate: knowledge of computer organization/architecture and statistics/probabilities

if you are not comfortable with Math, this module is not suitable for you

Math, Probabilities & Statistics

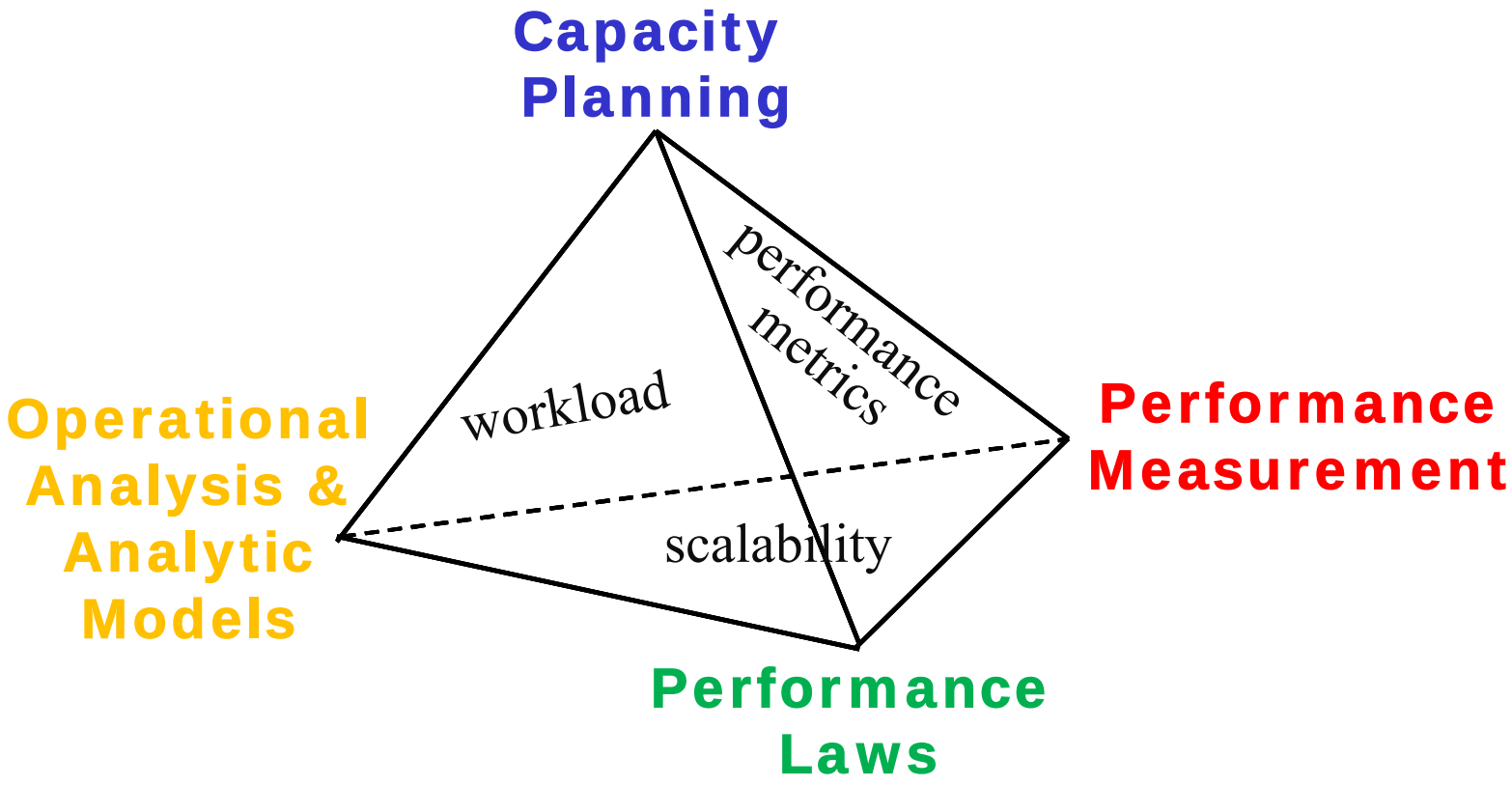
- analytical (mathematical) modelling approach
- focus is on application “not theory” but important to know how the laws/equations are obtained
  - problem with known models: use known equations to solve a given problem
  - problem with no (or cannot fit) known models: formulate equations to solve the problem
- probabilities – many known models are build/derive based on probability distributions
- if you are not comfortable with Math, this module is not suitable for you

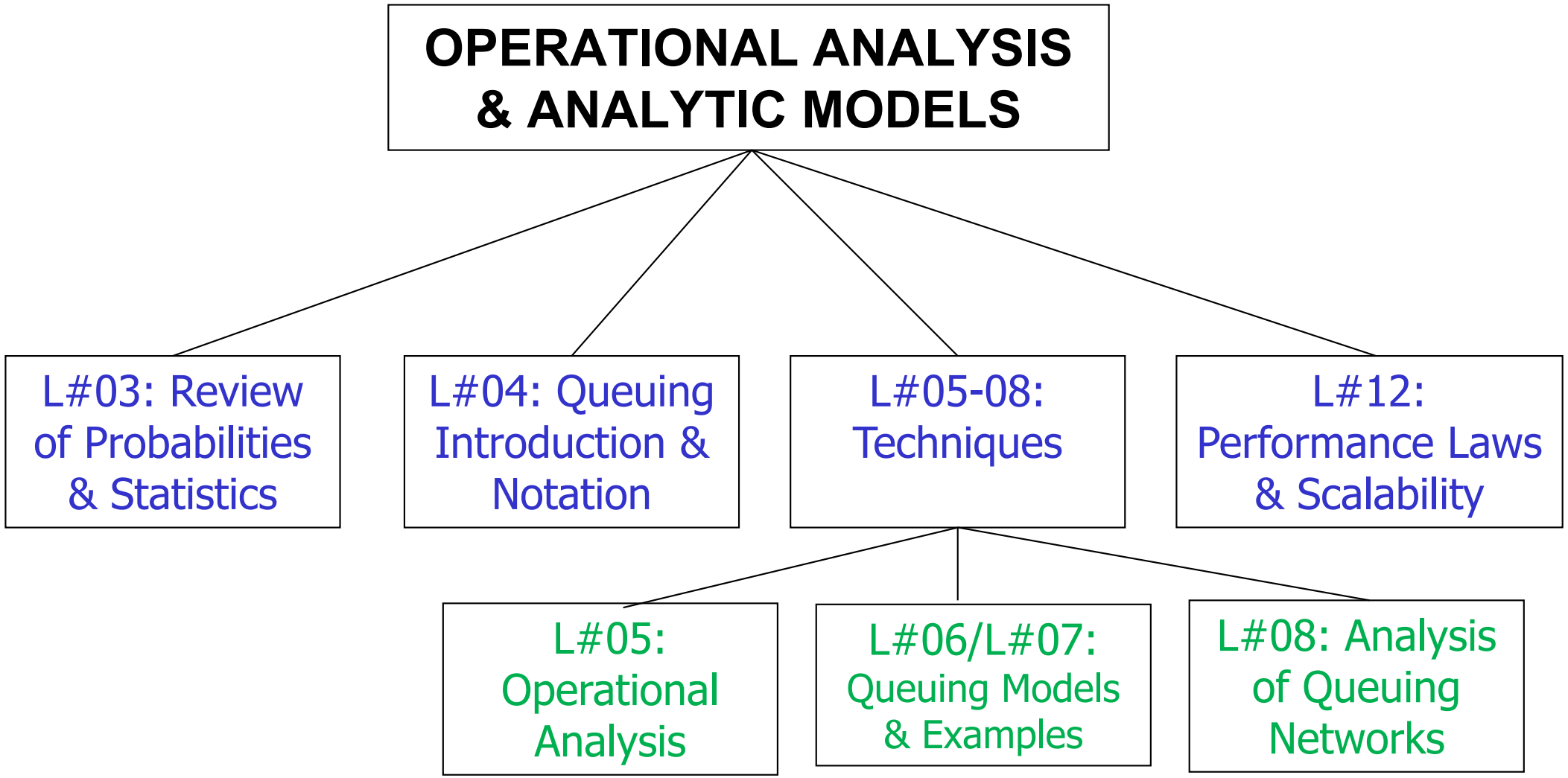
Learning Objectives

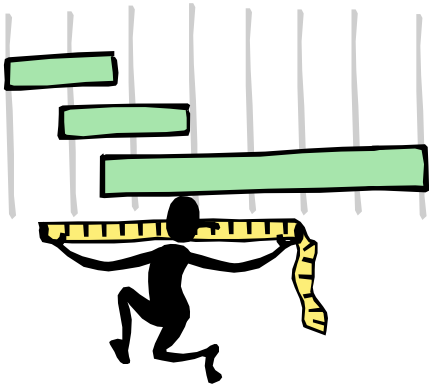
performance analysis of computer systems

1. capacity planning
2. bottleneck and modification analyses
3. measurement and analytic model analyses
4. scalability analysis

What we cover




OPERATIONAL ANALYSIS & ANALYTIC MODELS
L#03: Review of Probabilities & Statistics
L#04: Queuing Introduction & Notation
L#05-08: Techniques
L#12: Performance Laws & Scalability
L#05: Operational Analysis
L#06/L#07: Queuing Models & Examples
L#08: Analysis of Queuing Networks
- bottleneck analysis
- performance bounds
System - open, closed, hybrid
Component - fixed capacity, delay, load-dependent
Workload - single, multiple classes



PERFORMANCE MEASUREMENT

- L#09: Performance Metrics
- L#10: Workload Modeling
- L#11: Instrumentation & Representation of Measurement Data

"Measurements are not to provide numbers but insights."
Ingrid Bucher

Module Assessment

Continuous Assessment (100%)

- Homework (Luminus Quiz) (20%)
- Mid-term test (30%)
- Assignment (20%)
- Open Book Test (30%)

Homework (Luminus Quiz): 20%

- 7 quizzes @ 10 marks per quiz (takes best 5 of 7)
- Each quiz: 3 attempts only; mark by the system
- all quizzes completed by 18 Nov 2020

Course Schedule & Webpage

- Lecture: Mon, 6.30-8.30pm, online synchronous (zoom)
- Tutor: Zhang Han (Com2, #B1-01)

- Consultation: Wed, 10-12am
- Webpage:
  - LumiNUS for course announcement
  - www.comp.nus.edu.sg/~teoym/cs5239-20 for lecture slides, assignments, etc.

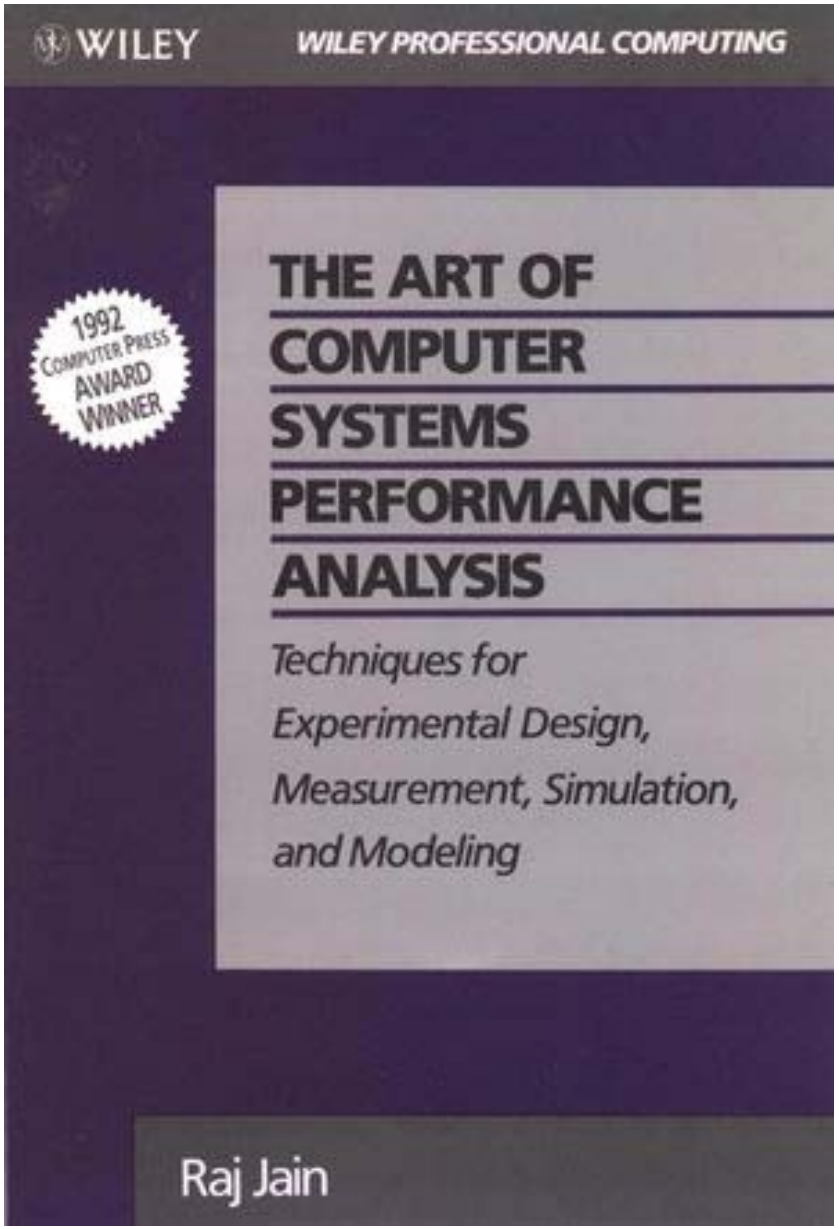
Resources

Main Textbooks

- **The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling**, R. Jain, John-Wiley, 1991.
- Quantitative System Performance, E.D. Lazowska et al., Prentice-Hall, 1984, http://www.cs.washington.edu/homes/lazowska/qsp/.
- Measuring Computer Performance - A Practitioner's Guide, D.J. Lilja, Cambridge University Press, 2000.

Reference Books

- Capacity Planning and Performance Modeling - From Mainframes to Client-Server Systems, Daniel A. Menasce, et al., Prentice-Hall, 1994.
- Capacity Planning for Web Performance – Metrics, Models and Methods, D.A. Menasce, et al., Prentice-Hall, 1998.
- Simulation Modeling and Analysis, A.M. Law and W.D. Kelton, McGraw Hill, 3rd edition, 2000.
- Introduction to Parallel Computing, A. Grama, et al., Addison-Wesley, 2nd Edition, 2003.



The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling

Raj Jain

ISBN: 978-0-471-50336-1
720 pages
April 1991

Problems

- consultation hours – Wed, 10-12, catch me after lectures, email ….