CS5239 Computer System Performance Evaluation
2016/17 – Semester I
www.comp.nus.edu.sg/~teoym/cs5239-16

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What I do

Teach
- Parallel Computing
- Cloud Computing
- Systems Modeling & Simulation
- Distributed Systems
- Applied Parallel Computing (joint teaching with MIT)
- Computer Systems Engineering (joint teaching with MIT)
- ....

Research - parallel & distributed computing
- Performance evaluation
- Heterogeneous, Cloud Computing
- Modeling and Simulation
Faster is better
Outline

• What, why and how
• Learning objective
• What we cover
• Module Assessment
• Course Schedule & Webpage
• Resources
What is Performance

• Concept of work
  • Latency (time)
  • Bandwidth (rate)

• How well a computer system performs a given job or activity?

• Why do we care about computer performance?

• What is hard?
  • Performance of a computer system is multidimensional
    • Complex component interactions
    • Hard to predict how it will scale
    • …
1. What is the average time it takes a job to complete service?
2. What is the **throughput** of the system (number of jobs completed per unit time)?
3. If arrival rate is doubled ($\lambda \rightarrow 2\lambda$), how much should $\mu$ increase? Do we do nothing or do we need another CPU?

If we need more server capacity, what are our options?

- a. buy a new server with the needed capacity
- b. buy a few smaller servers that adds up to the required capacity
  - a. one queue for **all** servers
  - b. one queue for **each** server
  - c. does it matters?
Performance Evaluation: How

- **Measurements** of actual systems
- **Simulations** using software models
- **Mathematical modeling** using techniques as queuing analysis
Performance Evaluation: How

Complexity and Cost

Low

Rules of Thumb

Trend Analysis

Performance Models

Analytical

Simulation

Measurement

High

after-the-fact / prediction analysis

CS5239 Computer System Performance Evaluation
CS5271 Performance Analysis of Embedded Systems
CS6211 Analytical Performance Modelling for Computer Systems

CS5233 Simulation and Modelling Techniques
CS6205 Advanced Modelling and Simulation
Course Catalogue

CS5239 Computer System Performance Analysis

Modular Credits: 4
Workload: 2-1-0-3-4
Prerequisite(s): CS1020 or its equivalent

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 characterise present and future workload to perform capacity planning activities. Topics include: performance analysis overview; measurement techniques and tools including workload characterisation, instrumentation, benchmarking, analytical modelling techniques including operational analysis, stochastic queuing network analysis; performance of client-server architectures; capacity planning; case studies.
Prerequisites

- CS1020 Data Structures and Algorithms I or its equivalent
- ST2334 Probability and Statistics (preferred)
Learning Objective

• performance analysis of computer systems
  - capacity planning
  - bottleneck and modification analyses
  - measurement and analytic model analyses
  - scalability analysis
What we cover

Capacity Planning

Performance Measurement

Operational Analysis & Analytic Models

Case Studies
Measurements are not to provide numbers but insights.

*Ingrid Bucher*
OPERATIONAL ANALYSIS & ANALYTIC MODELS

L#06: Introduction & Notation
L#07-09: Techniques
L#10: Performance Laws & Scalability
L#11-12 Case Studies

L#07: Operational Analysis
- bottleneck analysis
- performance bounds
L#08: Analysis of Single Queue
L#09: Analysis of Queuing Networks / Multiple Classes
- System - open, closed, hybrid
- Component - fixed capacity, delay, load-dependent
- Workload - single, multiple classes
Module Assessment

1. Continuous Assessment (60%)
   - Test (20%)
   - Assignment 1 (20%)
   - Assignment 2 (20%)

2. Open Book Exam (40%)
   - 2 hrs
Course Schedule & Webpage

• Lecture: Tue, 6.30-8.30pm, Com1, 02-02
• Tutor: Sunimal Rathnayake (Com2, #B1-01)
• Consultation: Wed, 10-12am

• Webpage:
  ▪ IVLE for course announcement
  ▪ www.comp.nus.edu.sg/~teoym/cs5239-16 for lecture slides, assignments, etc
Resources

Main Textbooks

Reference Books
Raj Jain
ISBN: 978-0-471-50336-1
720 pages
April 1991
Problems

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