CS 147:
Computer Systems Performance Analysis
Workload Selection

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Overview

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Workload Types
What is a Workload?
Instruction Workloads
Synthetic Workloads
Standard Benchmarks
Exercisers and Drivers

Workload Selection
Considerations
Example

What is a Workload?

- *Workload*: anything a computer is asked to do
- *Test* workload: any workload used to analyze performance
- *Real* workload: any observed during normal operations
- *Synthetic* workload: created for controlled testing

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- Disadvantage: uncontrolled
  - Can't be repeated
  - Can't be described simply
  - Difficult to analyze
- Nevertheless, often useful for "final analysis" papers
  - E.g., "We ran system foo and it works well"

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- Development over decades
  - “Typical” instruction (`ADD`)
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    - Still used today (GFLOPS)
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  - Pipelining
  - Data/instruction caching
  - Prefetching
- *Kernel* is inner loop that does useful work:
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Concern is that real-world benchmarks represent only a specific problem.
Concern is that exercisers may not stress system the same way as real programs (e.g., page faults).

Real-World Benchmarks

- Pick a representative application
- Pick sample data
- Run it on system to be tested
- Modified Andrew Benchmark, MAB, is a real-world benchmark
- Easy to do, accurate for that sample data
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Application Benchmarks

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- Choose most important subset of functions
- Write benchmark to test those functions
- Tests what computer will be used for
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  - E.g., should I buy an AMD or Intel CPU?
  - Tougher: Mac or PC?
- Desire for an easy, comprehensive answer
- People writing articles may need to compare tens of machines
- Often need to make comparisons over time
  - Is this year’s PowerPC faster than last year’s Pentium?
    - Probably yes, but by how much?
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Popular “Standard” Benchmarks

- Sieve, 8 queens, etc.
- Whetstone
- Linpack
- Dhrystone
- Debit/credit
- TPC
- SPEC
- MAB
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- Based on real observed instruction frequencies
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- Now controlled by Transaction Processing Council
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- Audited
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Jim Gray and 24 others: “A Measure of Transaction Processing Power.”

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  - Results are audited
  - Can be *very* expensive to run
- Addresses flaws in existing benchmarks
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Winstone, Webstone, etc.

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  - Too many to review here
  - Important to understand strengths & drawbacks
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- Generate a workload, feed to internal or external measured system
  - I/O on local OS
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- Considerations in selecting a workload
- Example of workload selection

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  - Network performance useless for matrix work
- What metrics measure these services?
  - MIPS/GIPS for CPU speed
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  - Effect of interactions hard to predict
  - So must be sure to test *entire* system
- Important to understand balance between components
  - I.e., don't use 90% CPU mix to evaluate I/O-bound application

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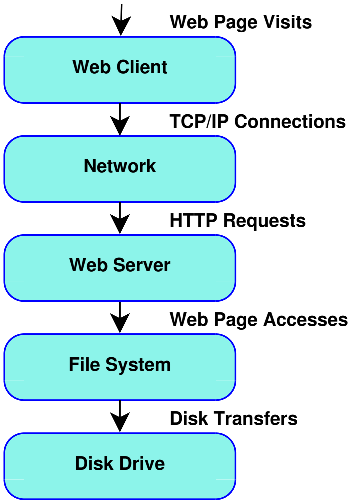
Example: Web Server



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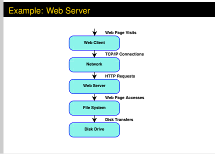

Web Client Analysis

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