CS 147:
Computer Systems Performance Analysis
Test Loads

Overview

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Designing Test Loads
Load Types
Applying Loads

Common Benchmarking Mistakes

Test Load Design

- Most experiments require applying test loads to system
- General characteristics of test loads already discussed
- How do we design test loads?

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Types of Test Loads

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- Traces
- Load-generation programs

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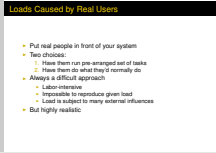
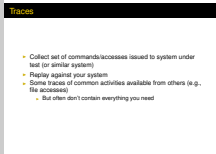
Loads Caused by Real Users

- Put real people in front of your system
- Two choices:
  1. Have them run pre-arranged set of tasks
  2. Have them do what they'd normally do
- Always a difficult approach
  - Labor-intensive
  - Impossible to reproduce given load
  - Load is subject to many external influences
- But highly realistic



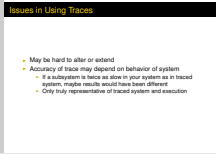
Traces

- Collect set of commands/accesses issued to system under test (or similar system)
- Replay against your system
- Some traces of common activities available from others (e.g., file accesses)
  - But often don't contain everything you need



Issues in Using Traces

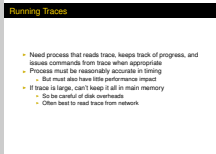
- May be hard to alter or extend
- Accuracy of trace may depend on behavior of system
  - If a subsystem is twice as slow in your system as in traced system, maybe results would have been different
  - Only truly representative of traced system and execution



E.g., processes might run at different rates depending on I/O vs. CPU mix

Running Traces

- Need process that reads trace, keeps track of progress, and issues commands from trace when appropriate
- Process must be reasonably accurate in timing
  - But must also have little performance impact
- If trace is large, can't keep it all in main memory
  - So be careful of disk overheads
  - Often best to read trace from network



Load-Generation Programs

- Create model for load you want to apply
- Write program implementing that model
- Program issues commands & requests synthesized from model
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- Tradeoff between ease of creation and use of model vs. its accuracy
- Base model on everything you can find out about the real system behavior
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- Consider whether model can be memoryless, or requires keeping track of what's already happened (Markov)

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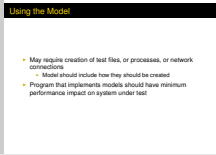
Using the Model

- May require creation of test files, or processes, or network connections
  - Model should include how they should be created
- Program that implements models should have minimum performance impact on system under test



Applying Test Loads

- Most experiments will need multiple repetitions
  - Details covered later in course
- Results most accurate if each repetition runs in identical conditions

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Example of Applying Test Loads

- Using Ficus experiments discussed earlier, want performance impact of update propagation for multiple replicas
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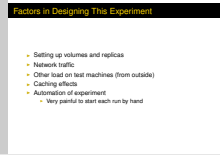
Factors in Designing This Experiment

- Setting up volumes and replicas
- Network traffic
- Other load on test machines (from outside)
- Caching effects
- Automation of experiment
  - Very painful to start each run by hand



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Network Traffic Issues

- If experiment is distributed (like ours), how is it affected by other traffic on network?
- Is traffic seen on network used in test similar to traffic expected on network you would actually use?
- If not, do you need to run on isolated network? And/or generate appropriate background network load?

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Controlling Other Load

- Generally, want to have as much control as possible over other processes running on test machines
- Ideally, use dedicated machines
- But also be careful about background and periodic jobs
  - In Unix context, check carefully on `cron` and network-related daemons
  - Tough question: use realistic environment or kill all interfering processes?

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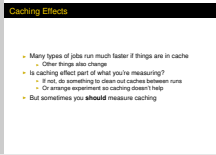
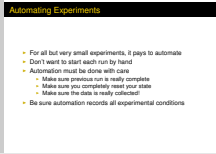
Caching Effects

- Many types of jobs run much faster if things are in cache
  - Other things also change
- Is caching effect part of what you're measuring?
  - If not, do something to clean out caches between runs
  - Or arrange experiment so caching doesn't help
- But sometimes you **should** measure caching



Automating Experiments

- For all but very small experiments, it pays to automate
- Don't want to start each run by hand
- Automation must be done with care
  - Make sure previous run is really complete
  - Make sure you completely reset your state
  - Make sure the data is really collected!
- Be sure automation records all experimental conditions



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- Must understand how cache works
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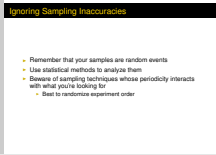
Ignoring Sampling Inaccuracies

- Remember that your samples are random events
- Use statistical methods to analyze them
- Beware of sampling techniques whose periodicity interacts with what you're looking for
  - Best to randomize experiment order



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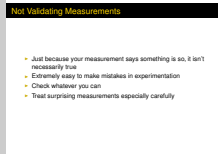
Not Validating Measurements

- Just because your measurement says something is so, it isn't necessarily true
- Extremely easy to make mistakes in experimentation
- Check whatever you can
- Treat surprising measurements especially carefully



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