CS147 5015-06-15

CS 147: omputer Systems Performance Analysis Approaching Performance Projects

CS 147: Computer Systems Performance Analysis Approaching Performance Projects

Overview

Common Mistakes

Planning Errors Measurement Errors Design Errors Analysis Errors Presentation Errors

Systematic Approach

Pre-Planning Planning Post-Experiment



Common Mistakes

Some Common Mistakes in Performance Evaluation



- List is long (nearly infinite)
- We'll cover the most common ones ... and how to avoid them

No Goals

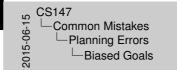
- If you don't know what you want to learn, you won't learn anything
- Hard to design good general-purpose experiments and frameworks
- So know what you want to discover
- Think before you start
- This is the most common mistake in this class!



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Biased Goals



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 Bases you breads using certain metrics, workloads, and techniques
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- Don't set out to show OUR system is better than THEIR system
 - Biases you towards using certain metrics, workloads, and techniques
 - ... which may not be the right ones
- Don't let your prejudices dictate how you measure
- Instead, try to disprove your hypotheses
 - If you fail, that's much stronger evidence

Unsystematic Approach

- nsystematic Approach
- Avoid scattershot approaches
- Work from a plan
 Follow through on it
- Otherwise, you're likely to miss something
 And in the end, everything will take longe

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Incorrect Performance Metrics



- If you don't measure right stuff, results won't shed much light Example: instruction rates of CPUs with different architectures Example: seek then on daix vs. SSD Example: power consumed by mouse Avoid choosing matric Taffs seary to measure but isn't helpful
 - Better to struggle to measure, but correctly capture performance

- If you don't measure right stuff, results won't shed much light
 - Example: instruction rates of CPUs with different architectures
 - Example: seek time on disk vs. SSD
 - Example: power consumed by mouse
- Avoid choosing metric that's easy to measure but isn't helpful
- Better to struggle to measure, but correctly capture performance

Unrepresentative Workload



sentative Workload

Just text papers

Just pages stored on local serve

- If workload isn't like what normally happens, results aren't useful
- ▶ E.g., for Web browser, it's wrong to measure
 - Just text pages
 - Just pages stored on local server

Wrong Evaluation Technique



 Measurement isn't right for every performance proble E.g. issues of scaling, or testing for tare cases Measurement is labor-intensive

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- Sometimes hard to measure peak or unusual condition
- Decide whether to model or simulate before designin measurement experiment

- Measurement isn't right for every performance problem
 - E.g., issues of scaling, or testing for rare cases
- Measurement is labor-intensive
- Sometimes hard to measure peak or unusual conditions
- Decide whether to model or simulate before designing a measurement experiment

Overlooking Important Parameters

- Try to make complete list of characteristics that affect performance
 - System
 - Workload
- Don't just guess at a couple of interesting parameters
- Despite your best efforts, you may miss one anyway
 - But the better you understand the system, the less likely you will



Ignoring Significant Factors



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- Factor: parameter you vary
 Not all parameters equally important
- More factors -> experiment takes more work
 But make sure you don't ignore significant ones
 Give preference to these that users can vary

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Inappropriate Experiment Design



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 Instructing basics can complicate proper design of
 applications
 Oceance based on of clean

opropriate Experiment Design

- Too few test runs
- Or runs with wrong parameter values
- Interacting factors can complicate proper design of experiments
 - Covered toward end of class

Inappropriate Level of Detail



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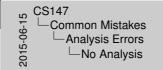
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 Examining at too high a level may oversimplify or miss important flactors
 Going too low wastes time and may cause you to miss forest for trees

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Common Mistakes

takes Analysis Errors

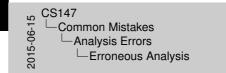
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 Common mistake in this class
 - Trying to satisfy page minimum in final report

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- ▶ Remember, final result is *analysis* that describes performance
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Erroneous Analysis

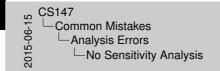


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- Often caused by misunderstanding of how to handle statistics
 Or by not understanding transient effects in experiments
 Or by careless handling of the data
- Many other possible problems in this area

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No Sensitivity Analysis

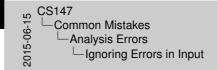


to Sensitivity Analysis

 Rarely does one number or one curve truly describe a system's performance
 How different will things be it parameters are varied?
 Sensibility analysis addresses this problem

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Ignoring Errors in Input

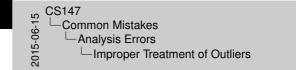




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 If you can't measure an input parameter directly, need to understand any bias in indirect measurement

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Improper Treatment of Outliers

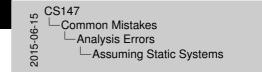


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 Your must determine which are which

oper Treatment of Outliers

- Sometimes particular data points are far outside range of all others
 - Sometimes they're purely statistical
 - Sometimes indicate a true, different behavior of system
- You must determine which are which

Assuming Static Systems



A previous experiment may be useless if workload changes
 ...or if key system parameters change
 Don't rely bindly on old results
 E.g. browser measurements from before the rise of HTML5

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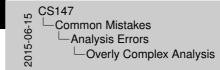
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Ignoring Variability



- Often, showing only mean does not paint true picture of a system
- If variability is high, analysis and data presentation must make that clear
- We'll talk quite a bit about this issue

Overly Complex Analysis



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Occam wins!

- Choose simple explanations over complicated one
- Choose simple experiments over complicated ones
 Choose simple explanations of phenomena
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 Choose simple presentations of data
- But don't go overboard the other way

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Improper Presentation of Results



- Real performance experiments are run to convince others
 - Or help them make decisions
- If your results don't convince or assist, you haven't done any good
- Often, manner of presenting results makes the difference

Ignoring Social Aspects



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- Need clear explanations Present in terms your audience understands
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- Need clear explanations
- Present in terms your audience understands
- Be especially careful if going against audience's prejudices!

Omitting Assumptions and Limitations



- Assumptions and limitations are usually unavoidable in real performance studies
- But:
 - Recognize them
 - Be honest about them
 - Try to understand how they affect results
 - ► Tell your audience about them

A Systematic Approach To Performance Evaluation

- 1. State goals and define the system
- 2. List services and outcomes
- 3. Select metrics
- 4. List parameters
- 5. Select factors to study
- 6. Select evaluation technique(s)
- 7. Select workload
- 8. Design experiments
- 9. Analyze and interpret data
- 10. Present results

Usually, it is necessary to repeat some steps to get necessary answers

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Systematic Approach

State Goals and Define the System

CS147 ß -Systematic Approach 2015-06--Pre-Planning -State Goals and Define the System

 Decide what you want to find out Put boundaries around what you're going to consider This is critical step Everything afterwards is built on this foundation

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List Services and Outcomes



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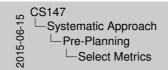
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Systematic Approach

bach Pre-Plannin

Select Metrics



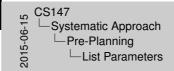
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List Parameters

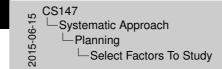


What system characteristics affect performance?
 System parameters
 Workload parameters
 Try to make list complete
 But execut you'll add to it later

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Select Factors To Study



	Factors: parameters that will be varied during study
1	Best to choose those most likely to be key to performanc - Requires knowledge, experience, insight - Or perhaps quick pre-experiment
	Select levels for each factor • Defined as what settings you'll test
	Keep factor list and number of levels short Because it directly affects work involved

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Select Evaluation Technique

- Analytic modeling?
- Simulation?
- Measurement?
- Or perhaps some combination
- Right choice depends on many issues

CS147 Systematic Approach Planning Solution Technique elect Evaluation Technique

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Select Workload

CS147 Systematic Approach Planning Select Workload

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 List of service requests to be presented to system
 For measurement, workload is often list of actual requests to system
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Design Experiments

CS147 Systematic Approach Planning Design Experiments

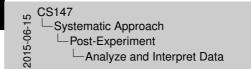


- How to apply chosen workload?
- How to vary factors to their various levels?
 How to measure metrics?
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 All with minimal effort
- Pay attention to interaction of factors
 And remember Heisenberg

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Analyze and Interpret Data

- Data from measurement almost always has random component
- > You must extract real information from the random noise
- Interpretation is key to getting value from an experiment
 - And is not at all mechanical
 - Do this well in your project



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CS147 Systematic Approach Post-Experiment CS CS147 Systematic Approach Present Results

- Present Results
- Make them easy to understand
 For the broadest possible audience
- For the providest possible audience
 Focus on most important results
- Use graphics—effectively
- Give maximum information with minimum presentation
 Make sure you explain actual implications
- Anybody can draw a graph
 Insight is what matters

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