Common Mistakes and How to Avoid Them

Overview

- Common Mistakes in Evaluation
- Checklist for Avoiding Common Mistakes
- A Systematic Approach to Performance Evaluation
- Case Study: Remote Pipes vs RPC

Common Mistakes in Evaluation

1. No Goals
   - No general purpose model
   - Goals $\Rightarrow$ Techniques, Metrics, Workload
   - Not trivial
2. Biased Goals
   - ``To show that OUR system is better than THEIRS''
   - Analysts = Jury
3. Unsystematic Approach
4. Analysis Without Understanding the Problem
5. Incorrect Performance Metrics
6. Unrepresentative Workload
7. Wrong Evaluation Technique

Common Mistakes (Cont)

8. Overlook Important Parameters
9. Ignore Significant Factors
10. Inappropriate Experimental Design
11. Inappropriate Level of Detail
12. No Analysis
13. Erroneous Analysis
14. No Sensitivity Analysis
15. Ignoring Errors in Input
16. Improper Treatment of Outliers
17. Assuming No Change in the Future
18. Ignoring Variability
19. Too Complex Analysis

Common Mistakes (Cont)

20. Improper Presentation of Results
21. Ignoring Social Aspects
22. Omitting Assumptions and Limitations

Checklist for Avoiding Common Mistakes

1. Is the system correctly defined and the goals clearly stated?
2. Are the goals stated in an unbiased manner?
3. Have all the steps of the analysis followed systematically?
4. Is the problem clearly understood before analyzing it?
5. Are the performance metrics relevant for this problem?
6. Is the workload correct for this problem?
7. Is the evaluation technique appropriate?
8. Is the list of parameters that affect performance complete?
9. Have all parameters that affect performance been chosen as factors to be varied?

Checklist (Cont)

10. Is the experimental design efficient in terms of time and results?
11. Is the level of detail proper?
12. Is the measured data presented with analysis and interpretation?
13. Is the analysis statistically correct?
14. Has the sensitivity analysis been done?
15. Would errors in the input cause an insignificant change in the results?
16. Have the outliers in the input or output been treated properly?
17. Have the future changes in the system and workload been modeled?
18. Has the variance of input been taken into account?

Checklist (Cont)

19. Has the variance of the results been analyzed?
20. Is the analysis easy to explain?
21. Is the presentation style suitable for its audience?
22. Have the results been presented graphically as much as possible?
23. Are the assumptions and limitations of the analysis clearly documented?

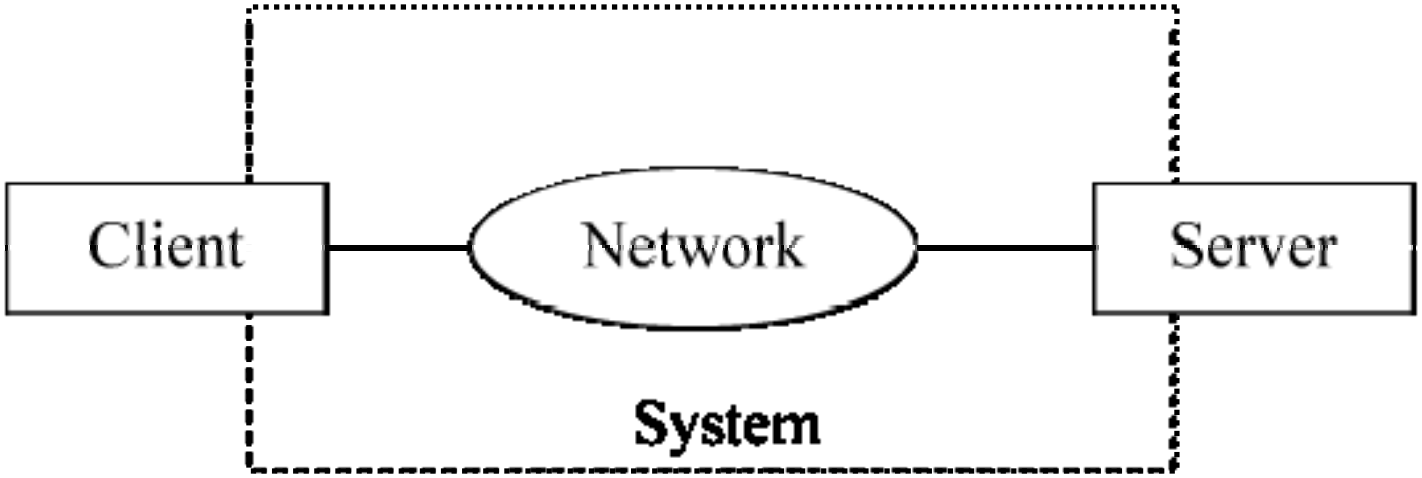
A Systematic Approach to Performance Evaluation

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
7. Select Workload
8. Design Experiments
9. Analyze and Interpret Data
10. Present Results

Repeat

Case Study: Remote Pipes vs RPC

- **System Definition:**



- **Services:** Small data transfer or large data transfer.

Case Study (Cont)

- **Metrics:**
  - No errors and failures. Correct operation only.
  - Rate, Time, Resource per service.
  - Resource = Client, Server, Network

This leads to:

- Elapsed time per call.
- Maximum call rate per unit of time, or equivalently, the time required to complete a block of *n* successive calls.
- Local CPU time per call.
- Remote CPU time per call.
- Number of bytes sent on the link per call.

Case Study (Cont)

- **System Parameters:**
  - Speed of the local CPU.
  - Speed of the remote CPU.
  - Speed of the network.
  - Operating system overhead for interfacing with the channels.
  - Operating system overhead for interfacing with the networks.
  - Reliability of the network affecting the number of retransmissions required.

Case Study (Cont)

- **Workload parameters:**
  - Time between successive calls.
  - Number and sizes of the call parameters.
  - Number and sizes of the results.
  - Type of channel.
  - Other loads on the local and remote CPUs.
  - Other loads on the network.

Case Study (Cont)

- **Factors:**
  - Type of channel: Remote pipes and remote procedure calls
  - Size of the Network: Short distance and long distance
  - Sizes of the call parameters: small and large.
  - Number *n* of consecutive calls=Block size: 1, 2, 4, 8, 16, 32, …, 512, and 1024.

Note:

- Fixed: type of CPUs and operating systems.
- Ignore retransmissions due to network errors
- Measure under no other load on the hosts and the network.

Case Study (Cont)

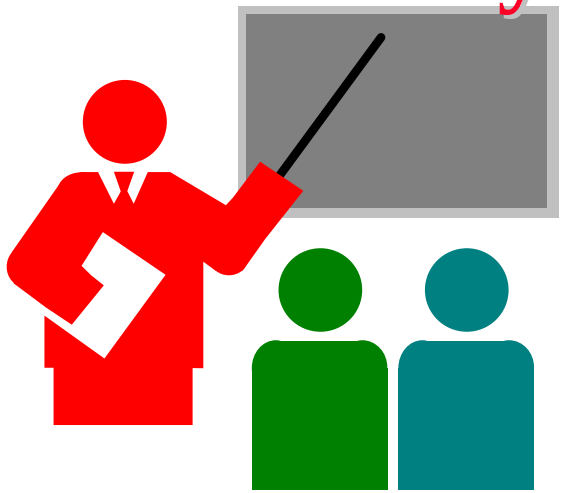
- **Evaluation Technique:**
  - Prototypes implemented ⇒ Measurements.
  - Use analytical modeling for validation.
- **Workload:**
  - Synthetic program generating the specified types of channel requests.
  - Null channel requests
    ⇒ Resources used in monitoring and logging.
- **Experimental Design:**
  - A full factorial experimental design with $2^3 \times 11 = 88$ experiments will be used.

Case Study (Cont)

- **Data Analysis:**
  - Analysis of Variance (ANOVA) for the first three factors
  - Regression for number *n* of successive calls.

- **Data Presentation:**
  - The final results will be plotted as a function of the block size *n*.

Summary



- The analysis technique, metrics, workloads depend upon the goal of the study
- Metrics are based on services provided by the system
- System and workload parameters determine the right set of experiments
- Correct analysis and presentation of results is important

Exercise 2.1

- From published literature, select an article or a report that presents results of a performance evaluation study. Make a list of good and bad points of the study. What would you do different, if you were asked to repeat the study?

Exercise 2.2

Choose a system for performance study. Briefly describe the system and list:

a. Services

b. Performance metrics

c. System parameters

d. Workload parameters

e. Factors and their ranges

f. Evaluation technique

g. Workload

Justify your choices.

- Suggestion: Each student should select a different system such as a network, database, processor, and so on.

Homework 1

- Read chapters 2
- Submit answers to
  - Exercise 2.2 assuming the system is a personal computer
  - The solution should be limited to 3 pages.

Common Mistakes in Homework 1

- Not defining the system
- List of metrics not based on services
- Mixing system and workload parameters

Project Homework 1

- Search web pages, books, and journal articles from ACM Digital Library, Applied Science, Compendex, ABI/INFORM Complete, and Knovel databases at Olin Library for one of the following topics:
  - Computer Systems Performance Analysis
  - Computer Systems Modeling
  - Computer Systems Simulation
  - Experimental Design
  - Queueing Theory
- On the web try the following search points:
  - http://scholar.google.com
  - http://books.google.com
  - http://a9.com/

Project Homework 1 (Cont)

- http://citeseer.ist.psu.edu/
- http://www.scirus.com/srsapp/
- http://searchnetworking.techtarget.com/bestWebLinks/
- See also http://www.searchengineguide.com/pages/Science/

- Ignore all entries dated 2003 or before. List others in the following format (up to 5 each):
  - Author, "Title," publisher, year. (for 5 books)
  - "Title," URL [One line description] (for 5 web pages)
  - Author, "Title," source (for 5 technical/magazine articles)
  - Title, publisher, URL (for 5 journals/magazines/periodicals)
- Make a list of other interesting search points and share with the class.

Common Mistakes in Project Homework #1

- Listing older books
- Listing books/Magazines/journals that have little to do with the topic – may show up in search engines because of a minor mention of the topic or words
- Web Pages – No one line descriptions