Bab 1b- Performance Evaluation

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Performance Project

1. Measure and compare the performance of window systems of two AI systems.
2. Simulate and compare the performance of two processor interconnection networks.
3. Measure and analyze the performance of two microprocessors.
4. Characterize the workload of a campus timesharing system.
5. Compute the effects of various factors and their interactions on the performance of two text-formatting programs.
6. Measure and analyze the performance of a distributed information system.
7. Simulate the communications controllers for an intelligent terminal system.
8. Measure and analyze the performance of a computer-aided design tool.
9. Measure and identify the factors that affect the performance of an experimental garbage collection algorithm.
10. Measure and compare the performance of remote procedure calls and remote pipe calls.

Comparing

- The measured performance of two database systems on two different work-loads is shown in Table 1.6. Compare the performance of the two systems and show that **a.** System A is better **b.** System B is better

TABLE 1.6 Throughput in Queries per Second

System	Workload 1	Workload 2
A	30	10
B	10	30

The Reason of Performance Evaluation

- Trouble Shooting
    - Finding Failure
    - Fault Tolerant
- Optimization → tune up, good pattern
- Planning/testing
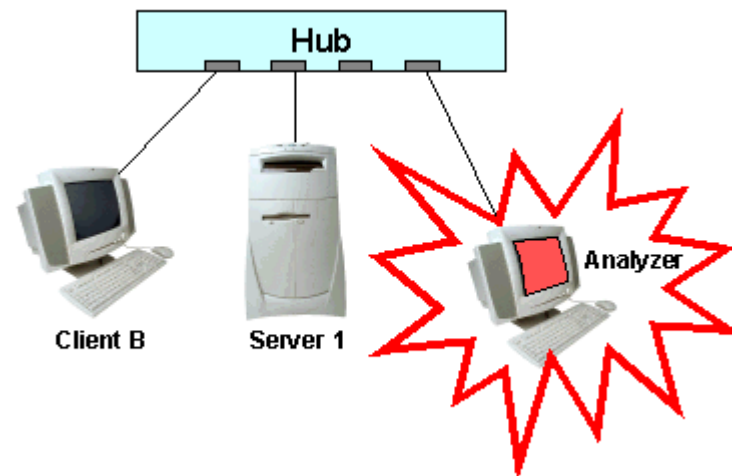
SYSTEMATIC APPROACH TO PERFORMANCE EVALUATION

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.*

SYSTEMATIC APPROACH TO PERFORMANCE EVALUATION

- **State goals and define the system**

  Given same hardware and software, definition varies depending upon the goals.

Example:

1. Given:two CPUs

Goal: impact on response time of interactive users

Wanted: better timesharing system

(external component)

2. Given:two CPUs with different ALUs

Goal: which ALU

Wanted: best implementation of an architecture (internal component)

What are the boundaries?

- **List services and outcomes**

Services:

- Network transports user packets
- Database system responds to queries

Outcomes:

- Packets are lost or delayed.
- Database queries are answered wrongly or hung due to a deadlock.
  Define what is acceptable - what not?

The list of services and outcomes helps later in selecting the metrics and workloads.

- **Select Metrics:**

Criteria to compare performance

- Speed
- Accuracy
- Availability of services

List parameters

System parameters:

Software and hardware characteristics which generally do not vary among various installations of the system.

Workload parameters:

Characteristics of the user's requests, that typically vary from one installation to another.

Keep the list as comprehensive as possible!

- **Select factors**

  Factors are the parameters that vary during evaluation, their values are called **levels.**

  Parameters with high impact on systems performance should be factors.

- **Select evaluation technique**
  - analytic modeling
  - Simulation or prototype
  - measuring a real system

- **Select workload**
  - Analytic model: Probability/Distribution of requests.
  - Simulation: Traces of requests.
  - Measurement:
  - User scripts, sample problem.

- **Design an experiment**

  Sequence of steps (simulations, measurements) that offer maximal information, maximal coverage with minimal effort.

  Fractional factorial experimental design.

  Two phases:

    1. many factors, few levels

    2. reduced factors, increased levels

- **Analyze and interpret data**

  - Deal with randomness and variability.

  - Interpret the results of the analysis.

  - Prepare to draw conclusions.

- **Present data properly**

  - Spreadsheets, charts and graphics

  - no statistical jargon

The complete project consists of severalcycles through theses steps

Case study :

- Consider the problem of comparing remote pipes with remote procedure calls. In a procedure call, the calling program is blocked, control is passed to the called procedure along with a few parameters, and when the procedure is complete, the results as well as the control return to the calling program. **A remote procedure call** is an extension of this concept to a distributed computer system. A program on one computer system calls a procedure object on another system. The calling program waits until the procedure is complete and the result is returned. Remote pipes are also procedure like objects, but when called, the caller is not blocked. The execution of the pipe occurs concurrently with the continued execution of the caller. The results, if any, are later returned asynchronously.

1. *System Definition*: The goal of the case study is to compare the performance of applications using remote pipes to those of similar applications using remote procedure calls. T

2. *Services*: The services offered by the system are the two types of channel calls—remote procedure call and remote pipe.

3. *Metrics*: Due to resource limitations, the errors and failures will not be studied. Thus, the study will be limited to correct operation only. For each service, the rate at which the service can be performed, the time taken for the service, and the resources consumed will be compared. The resources are the local computer (client), the remote computer (server), and the network link. This leads to the following performance metrics: **(a)** Elapsed time per call **(b)** Maximum call rate per unit of time, or equivalently, the time required to complete a block of n successive calls **(c)** Local CPU time per call **(d)** Remote CPU time per call **(e)** Number of bytes sent on the link per call

4. *Parameters*: The system parameters that affect the performance of a given application and data size are the following:

(a) Speed of the local CPU

(b) Speed of the remote CPU

(c) Speed of the network

(d) Operating system overhead for interfacing with the channels

(e) Operating system overhead for interfacing with the networks

(f) Reliability of the network affecting the number of retransmissions required

The workload parameters that affect the performance are the following:

(a) Time between successive calls

(b) Number and sizes of the call parameters

(c) Number and sizes of the results

(d) Type of channel

(e) Other loads on the local and remote CPUs

(f) Other loads on the network

5. *Factors*: The key factors chosen for this study are the following:

(a) Type of channel. Two types—remote pipes and remote procedure calls—will be compared.

(b) Speed of the network. Two locations of the remote hosts will be used—short distance (in the campus) and long distance (across the country).

(c) Sizes of the call parameters to be transferred. Two levels will be used—small and large.

(d) Number n of consecutive calls. Eleven different values of n—1, 2, 4, 8, 16, 32, ..., 512, 1024—will be used.

The factors have been selected based on resource availability and the interest of the sponsors. All other parameters will be fixed. Thus, the results will be valid only for the type of CPUs and operating systems used. The retransmissions due to network errors will be ignored (not included in the measurements). Experiments will be conducted when there is very little other load on the hosts and the network.

6. *Evaluation Technique*: Since prototypes of both types of channels have already been implemented, measurements will be used for evaluation. Analytical modeling will be used to justify the consistency of measured values for different parameters.

7. *Workload*: The workload will consist of a synthetic program generating the specified types of channel requests.

8. *Experimental Design*: A full factorial experimental design with $2^3 \times 11 = 88$ experiments will be used for the initial study.

9. *Data Analysis*: Analysis of Variance (explained in Section 20.5) will be used to quantify the effects of the first three factors and regression will be used to quantify the effects of the number n of successive calls.

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

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

How to avoid Common Mistake

General

1. **No goals**
2. **Biased goals**
3. **Unsystematic approach**
4. **Analysis without understanding the problem**
5. **Incorrect performance metrics**
6. **Unrepresentative workload**
7. **Wrong evaluation technique**
   - Measurement
   - Simulation
   - Analytical modeling

Engineering

8. **Overlooking important parameters**
9. **Ignoring significant factors**
10. **Inappropriate Experimental Design**
11. **Inappropriate Level of Detail**
12. **No Analysis**
13. **Erroneous Analysis**
14. **No Sensitivity Analysis**

Optional

15. **Ignoring Errors in Input**

16. **Improper Treatment of Outliers**

17. **Assuming No Change in the Future**

18. **Ignoring Variability**

19. **Too Complex Analysis**

20. **Improper Presentation of Results**

21. **Ignoring Social Aspects**

22. **Omitting Assumptions and Limitations**