Steps in Performance Evaluation

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Outline

1 Systematic approach to performance evaluation (PE)

2 Common mistakes

3 Home exercise

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The unique characteristics

- **Metrics**: the criteria used to evaluate the performance of the system. components.
- **Workloads**: the requests made by the users of the system.

- Power consumption
- Number of queries sent to a database
- Compression ration of a data storage
- Throughput (rate of production)
- The interval between HTTP requests to a web server
- CPU utilization
- Volume of clean water used per household
- SPECfp
- LinPack

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- SPECfp (workload)
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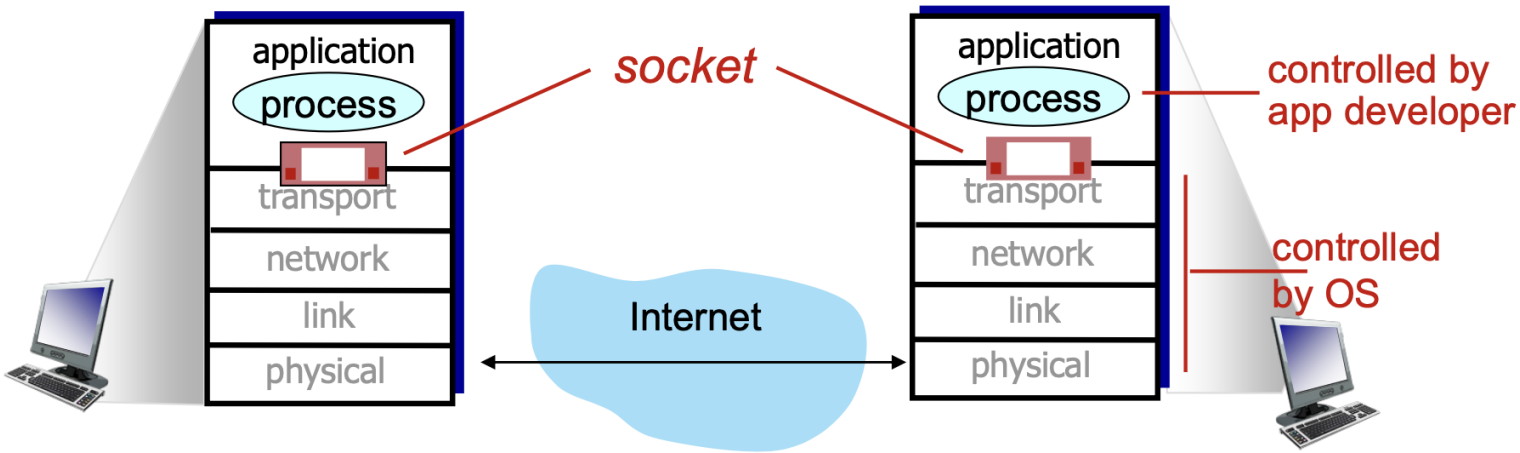
- Which metrics to be evaluated?
- Which workloads to be applied to the PE system ?

Performance evaluation of a website



- Which techniques should be used? (`ping`, `curl`)
- Which metrics to be evaluated? (round-trip communication, bandwidth, error,...)
- Which workloads to be applied to the PE system ? (bursty, interactive, latency sensitive, non-realtime)

Steps in PE project

1. State goals and Define the System
2. List Services and Outcomes
3. Select Metrics
4. List Parameters
5. List Factors to Study
6. Select Evaluation Technique
7. Select Workload
8. Design Experiments
9. Analyze and Interpret Data
10. Present Results

Step 1: State Goals and Define the System

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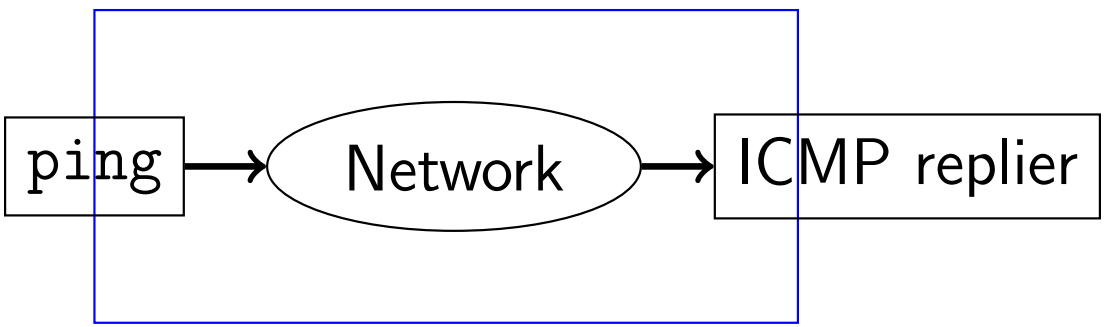
- Goal 1 = "to estimate their impact on the response time of interactive users".
  $\Rightarrow$ System = "time sharing + CPUs + other computer components"
- Goal 2 = "to decide which ALU"
  $\Rightarrow$ System = "Components of CPUs"



Step 1: System boundary example

System boundary

The system boundary is a conceptual line that divides the system that you want to study from 'everything else'.

Which of the following is correct system boundary of ATM ?

- The physical machine itself
- The customer and the machine
- The machine and the bank's local database of customer accounts
- The machine and the bank's national network and central database of transactions and account balances
- The machine and the staff that loan and run regular software checks of the machine

Different analyses may have different boundaries.

Step 2: List Services and Outcomes

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List of services and possible outcomes are useful in selecting right metrics and workloads.

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How to choose correct metrics?

- In this lecture, just list all possible metrics (as you recognize).
- Choosing correct metrics: Lecture #3, maybe :-)

Step 4: List Parameters

- List all possible parameters that affect performance.
- Parameter types:
  - **System parameter**: not vary much among various system installations.
  - **Workload parameter**: vary from one installation to the next.
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System parameters

- Speed of local and remote CPUs
- Network speed
- Operating systems involved in the system

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- Time between successive `ping` send
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- Helpful to determine what data needs to be collected before or during the analysis.

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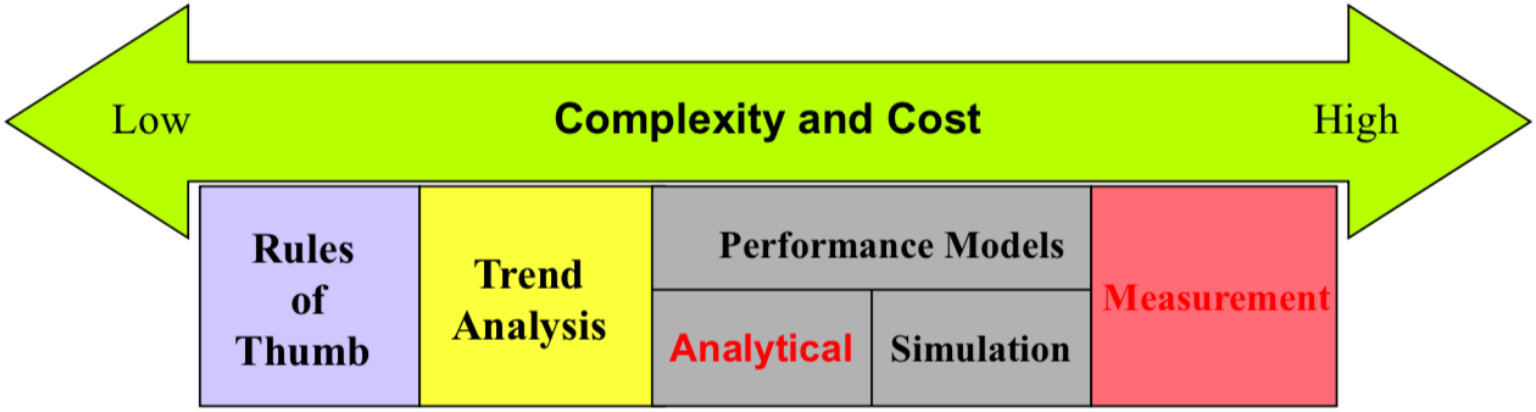
- Selected factors must be feasible (*khả thi*) to decision makers' control.
- Non-factor parameters must be fixed (and also feasible and low impact).

Step 6: Select Evaluation Technique



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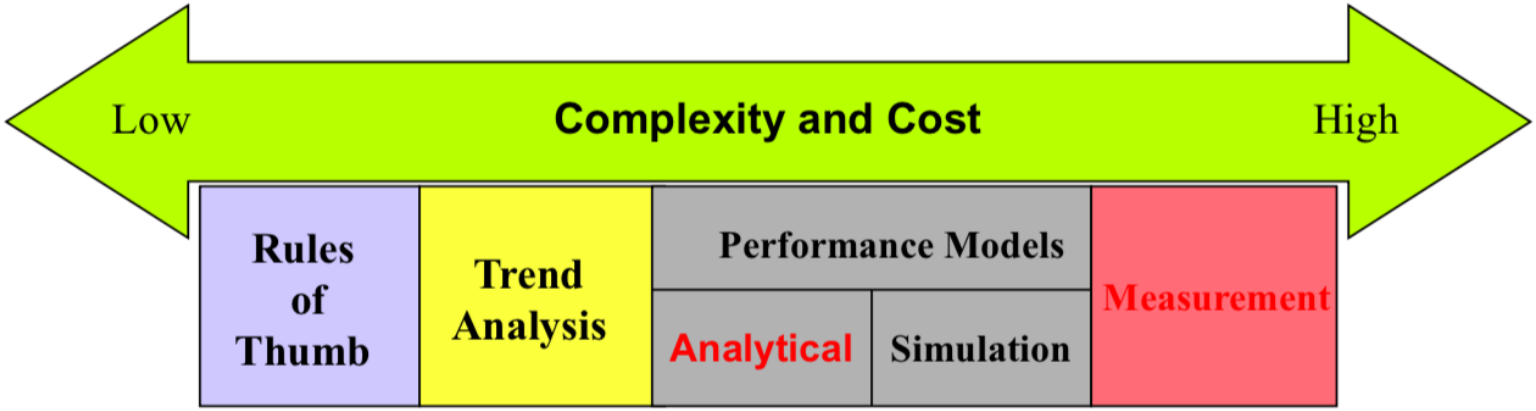

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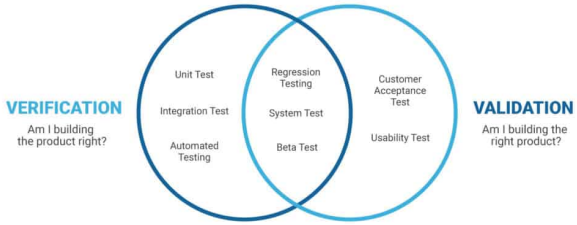
- Prototypes implemented ⇒ measurement.
- Use analytical modeling for validation.



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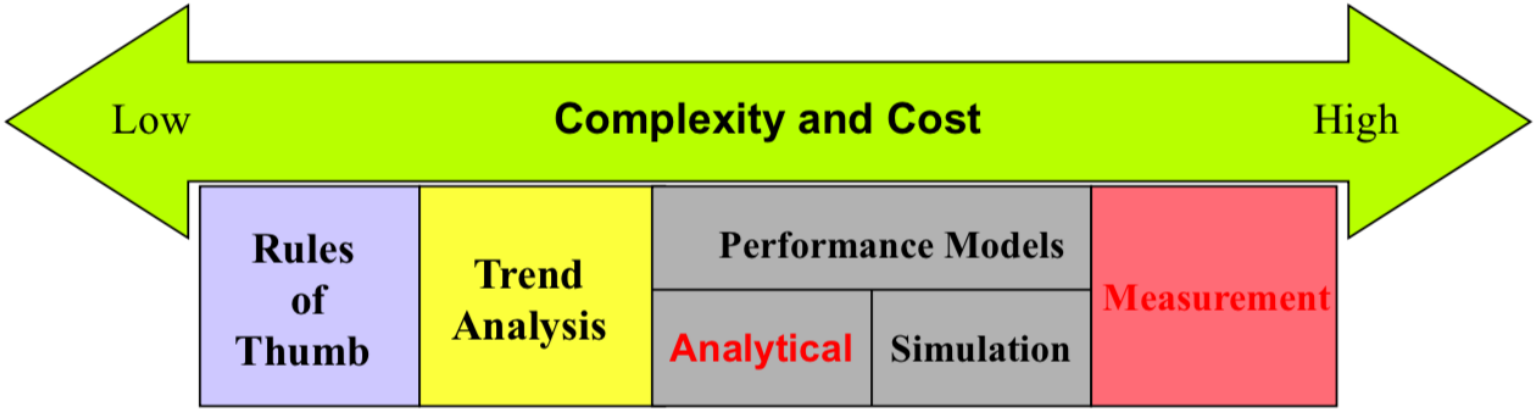

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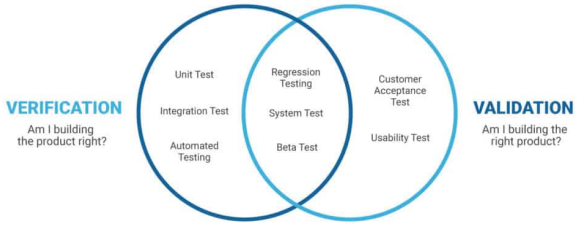

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- Choosing suitable workloads: Lecture #4, maybe :-)

Step 8: Design Experiments

- Based on list of factors and their levels, deciding a sequence of experiments that offer
  - maximum information: co-relationship between factors and metrics,
  - minimal effort: number of experiments.
- 2-phase approach
  1. Phase 1: large number of factors, small number of levels.
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Factors below are considered to compare remote pipe and remote procedure call (RPC).

- Type of channels: Remote pipes and remote procedure calls (2 levels).
- Size of the Network: Short distance and long distance (2 levels).
- Sizes of the call parameters: small and large (2 levels).
- Number n of consecutive calls=Block size: 1, 2,. . . , 1024 (11 levels).

$\Rightarrow$ # experiments (full factorial) $= 2^3 \times 11 = 88$.

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Using the same example in Step 8.

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

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- Reading Chapter 10 in textbook, maybe or low score :-)

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Basic subset of common mistakes

Students are advised to experience themselves.

1. No goals: goals $\Rightarrow$ metrics, workloads, techniques
2. Biased goals: "to show that OUR system is better than THEIRS"
3. Unsystematic approach
4. Analysis Without Understanding the Problem
5. Incorrect Performance Metrics
6. Unrepresentative Workload
7. Wrong Evaluation Technique
10. Inappropriate Experimental Design
12. No Analysis
18. Ignoring Variability
20. Improper Presentation of Results

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A report on PE project

To compare (w.r.t. performance) different methods to find shortest paths in Python

- 3 methods: Dijkstra, Bellman-Ford, Johnson.
- Briefly describe (along with justification (*lý giải*)) the system and list:
  - Services
  - Performance metrics
  - System parameters
  - Workload parameters
  - Factors and their ranges
  - Evaluation technique
  - Workload

If a student submits a report (4 page long) within 2 weeks, his/her lab score will be bonused 5 points (/10).