Performance Modeling of Computer Systems and Networks

Prof. Vittoria de Nitto Personè

Bounding Analysis

Università degli studi di Roma Tor Vergata
Department of Civil Engineering and Computer Science Engineering

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Bounds on Performance

The simplest useful approach to computer system analysis using QN models

- Asymptotic bounds
  - wider class of systems
  - simpler
- Balanced system bounds
  - tighter, more precise information

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Bounds on Performance

Useful characteristics:

- ✧ provide valuable insight into the primary factors affecting the performance of computing systems
- ✧ can be computed quickly, even by hand; suitable as a "first cut" modeling technique useful to eliminate inadequate alternatives at an early stage of a study
- ✧ In many cases, a number of alternatives can be treated together, with a single bounding analysis useful information about them all

System sizing studies, based on preliminary estimates of system characteristic

Alternative upgrades to existing systems, to estimate the potential performance gain

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Asymptotic Bounds

Only one assumption:

the service demand at a center does not depend on how many other customers currently are in the system, or at which service centers

Open systems (transaction workloads):

the throughput indicates the maximum possible arrival rate that the system can process succesfully

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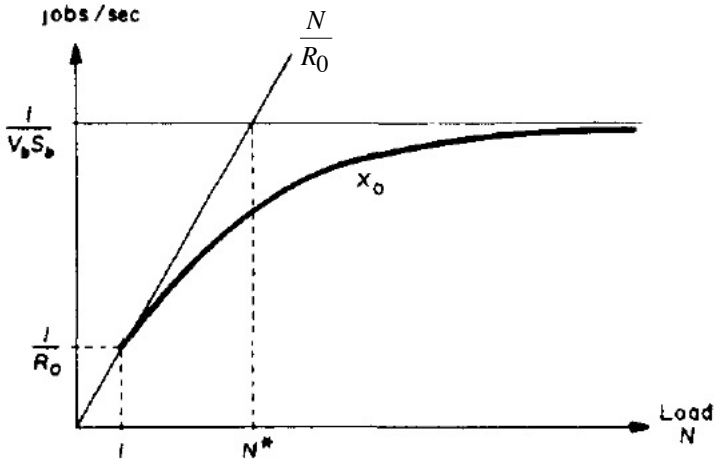
Bounding analysis

Asymptotic Bounds

Closed systems (batch and terminal workloads)



System throughput X_0

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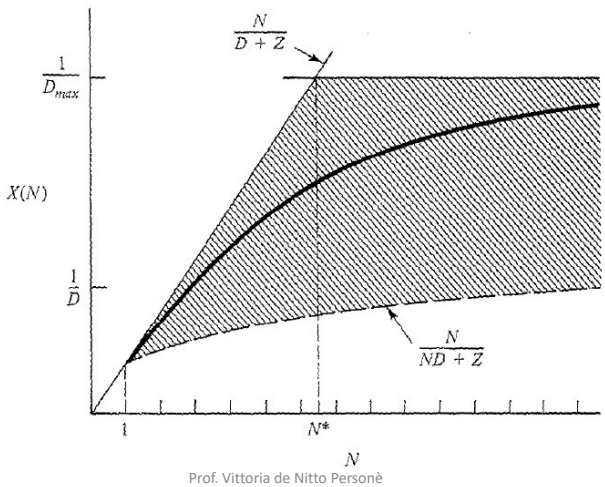
Bounding analysis

Throughput Asymptotic Bounds

Closed systems (terminal workloads)

Terminal Throughput:



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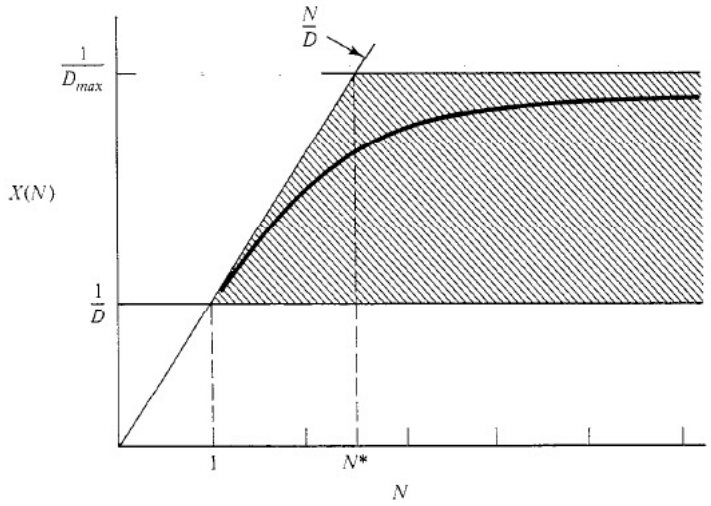
Throughput Asymptotic Bounds

Closed systems (batch workloads)



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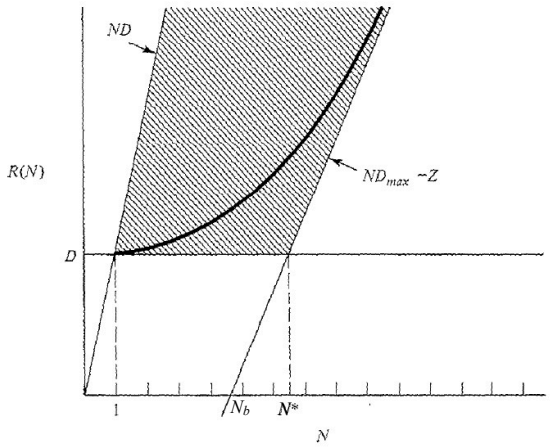
Response Time Asymptotic Bounds

Closed systems (terminal workloads)

Terminal Response Time:



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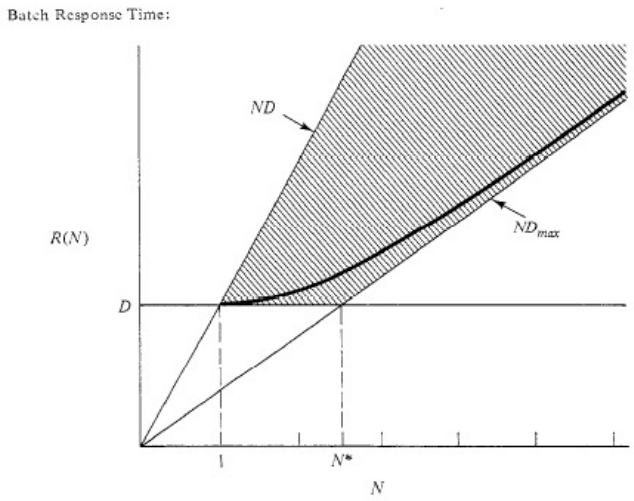
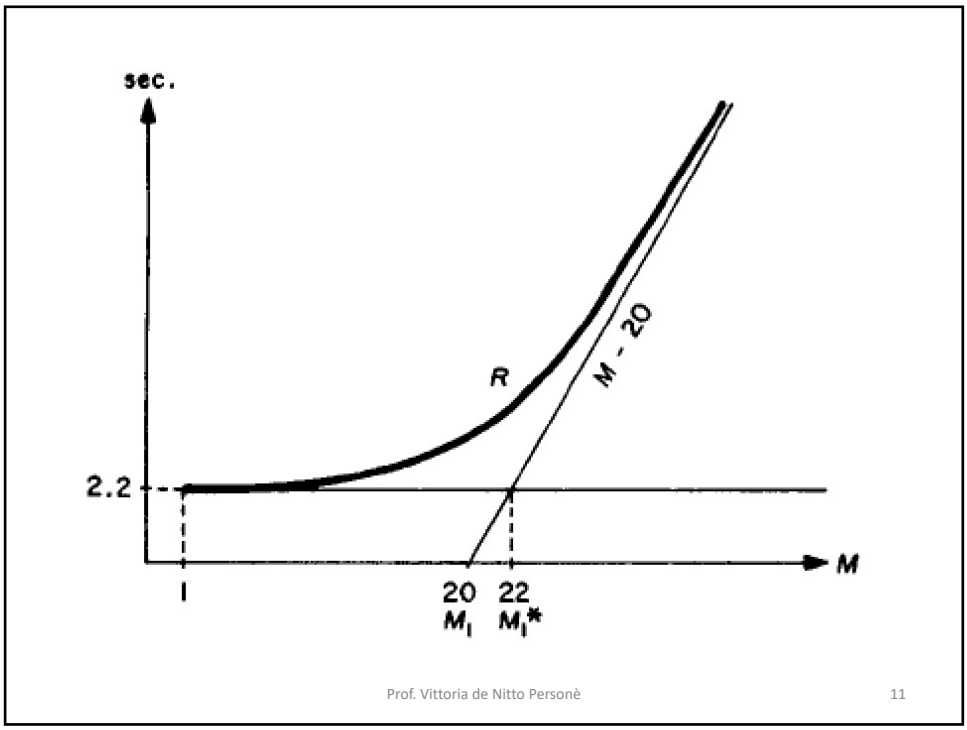
Response Time Asymptotic Bounds

Closed systems (batch workloads)

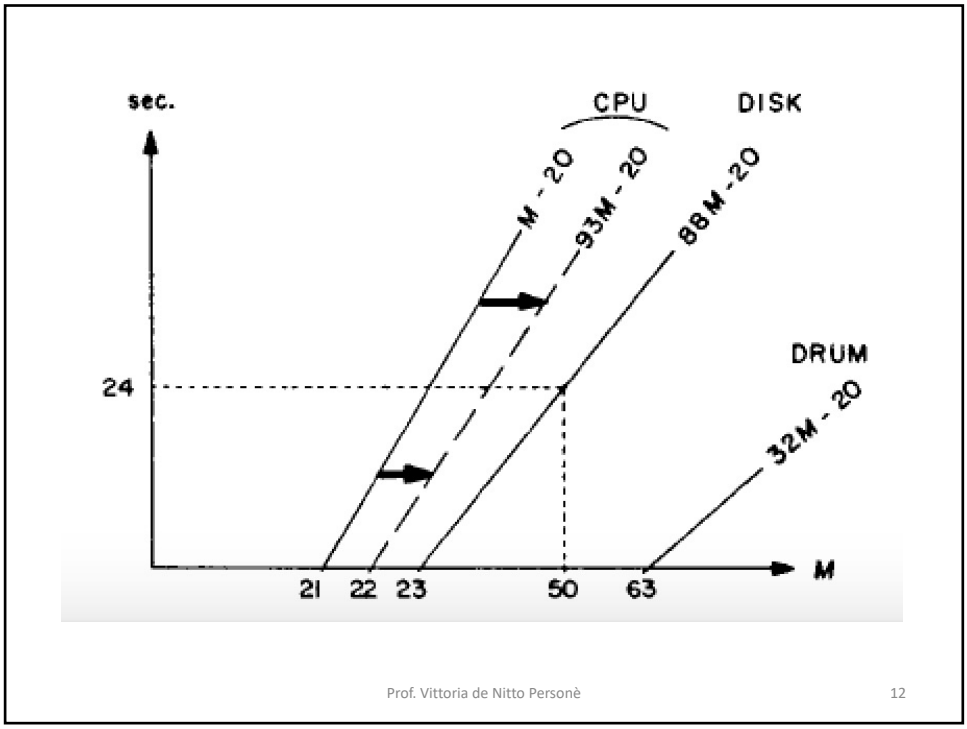


Asymptotic Bounds: conclusion

- Gross guidance on effects of proposed changes
- reducing V_i or S_i for a device which is not the bottleneck will not affect significantly the throughput → just a minor change in D
- Reducing V_iS_i for all the bottleneck devices remove the bottleneck and the improvement will be noticed until the bottleneck will move elsewhere


sec.
R
M - 20
2.2
M
1
20
M_1
22
M_1*

11


sec.
CPU
DISK
M - 20
93M - 20
88M - 20
DRUM
24
32M - 20
M
21
22
23
50
63

12