

# Computer System Lifecycle

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# The Importance of Performance in Computer Systems

- Mission-critical applications
- Life support applications
- Homeland security
- Battlefield situations
- Personal communication systems

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# QoS Metrics

- Response time
- Throughput
- Availability
- Reliability
- Security
- Scalability
- Extensibility

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# Response Time Breakdown

Browser Time		Network Time			E-commerce Server Time		
Processing	I/O	Browser to ISP Time	Internet Time	ISP to Server Time	Processing	I/O	Networking

..... CONGESTION .....

- Service time (does not depend on the load)
- Congestion (load-dependent)

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# Throughput

- Measured in units of work completed over time. It's a rate.
  - I/O's/sec
  - Page downloads/sec
  - HTTP requests/sec
  - Jobs/sec
  - Transactions per second (tps)

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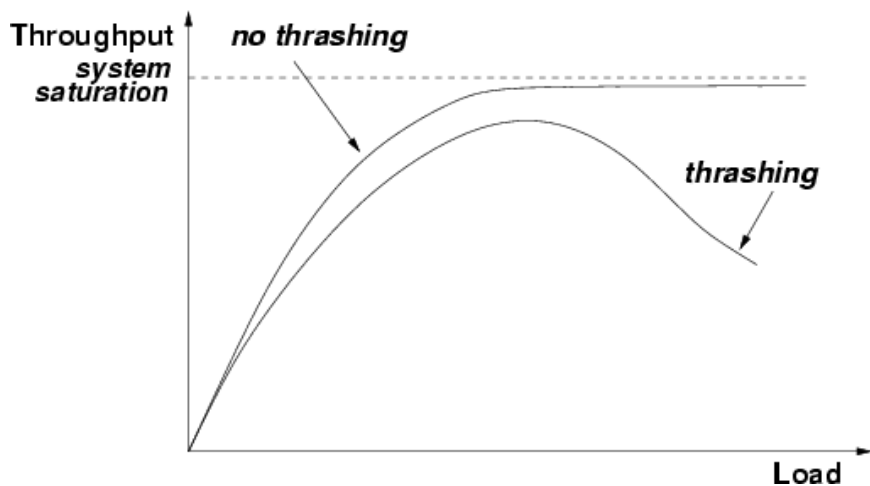
# Throughput Example

- An I/O operation at a disk of an OLTP system takes 10 msec on average.
  - What is the maximum throughput of the disk?
  - What is the throughput of the disk if it receives I/O requests at a rate of 80 requests/sec?

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# Throughput vs. Load



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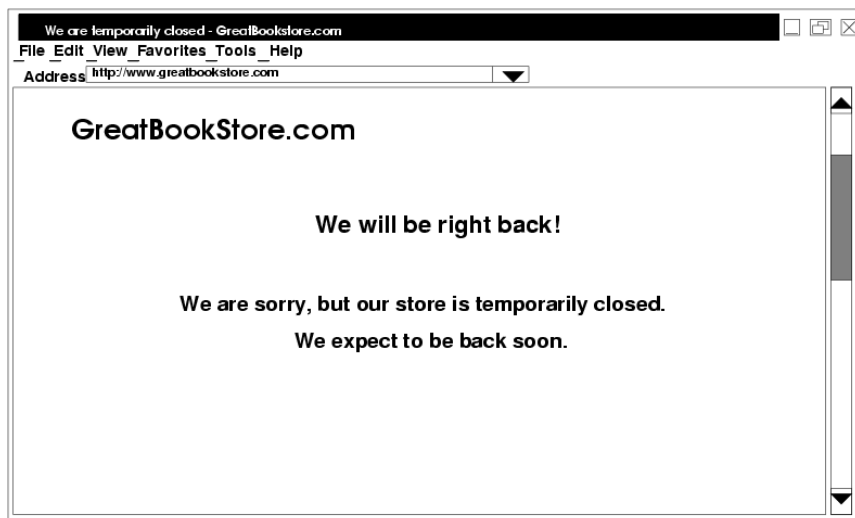
# Availability

- Fraction of time a system is available (i.e., operational).
- Service interruptions can damage the reputation of a company, may endanger lives, and may cause financial disasters.
- A system with 99.99% availability over 30 days is unavailable  
 $(1-0.9999) \times 30 \times 24 \times 60 = 4.32$  minutes.

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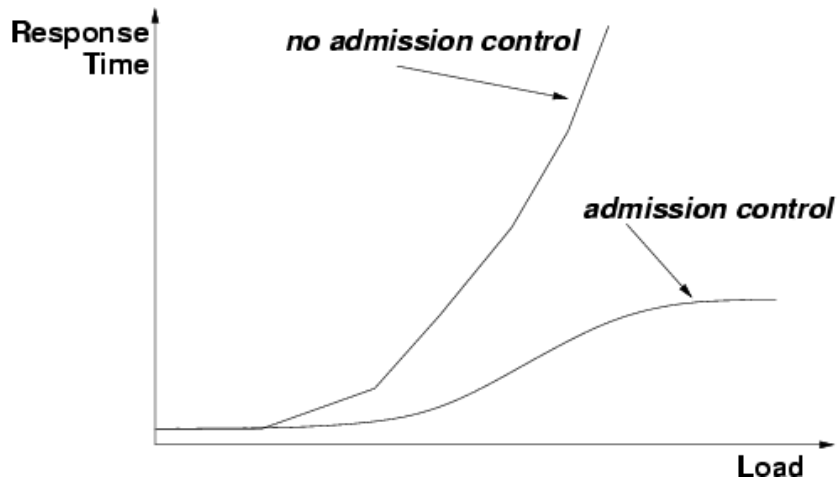
# Availability Problems



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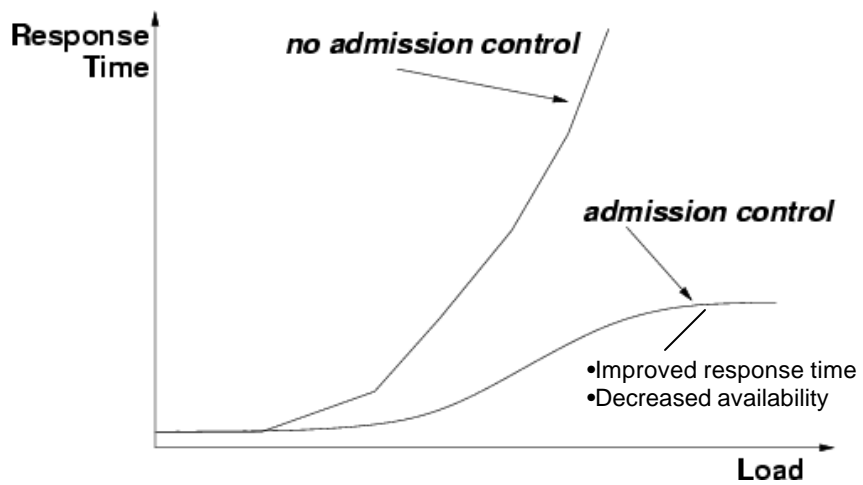
# Admission Control



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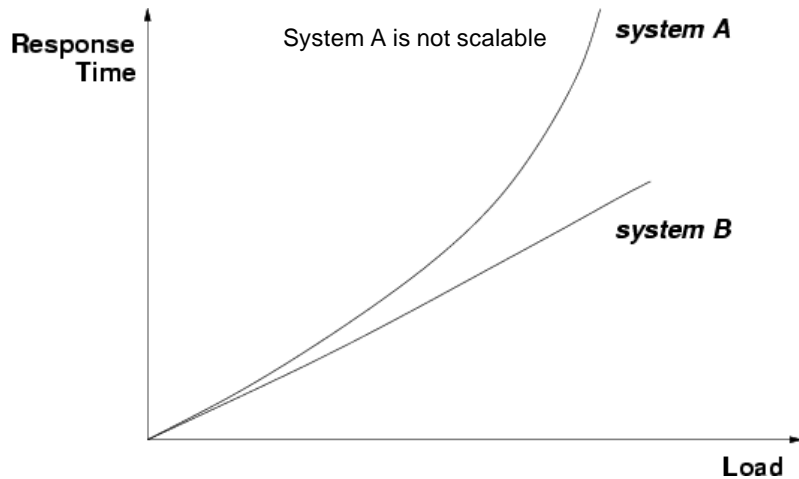
# Admission Control



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# Scalability



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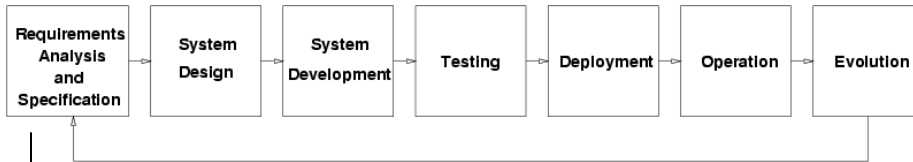
# Extensibility

- Property of a system to constantly evolve to meet functional and performance requirements.
- Autonomic computing, self-managing systems, self-healing systems.

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# Computer System Lifecycle



Functional requirements: what the system has to do and on what type of platforms.

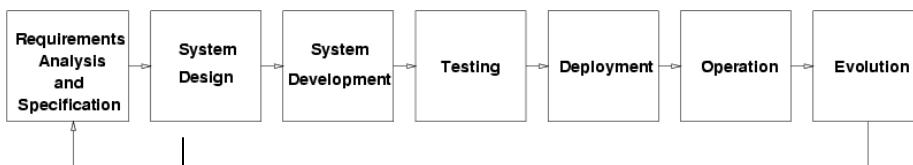
Non-functional requirements: how well the system has to accomplish its functions. Service Level Agreements (SLA) are established.

In many cases, non-functional requirements have been neglected or considered only at system test time!

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# Computer System Lifecycle



How will the requirements be met?

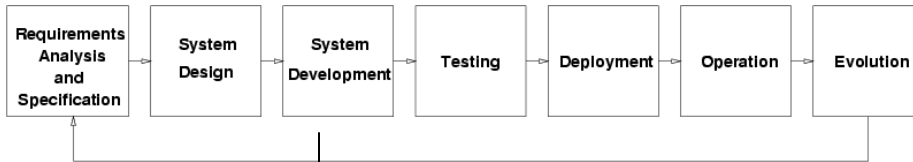
- System architecture
- System broken down into components
- Major data structures, files, and databases are designed.
- Interfaces between components are specified

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# Computer System Lifecycle



Components are implemented.

- some are new
- some are re-used
- some are adapted

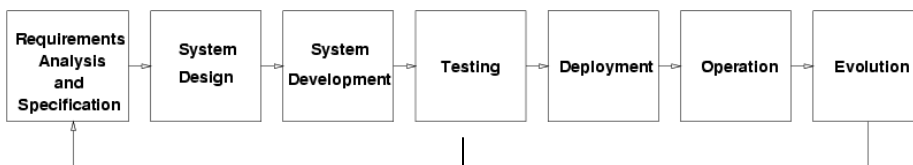
Components are interconnected to form a system

Components should be instrumented as they are built

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Concurrent with system development, as components become available (unit testing)

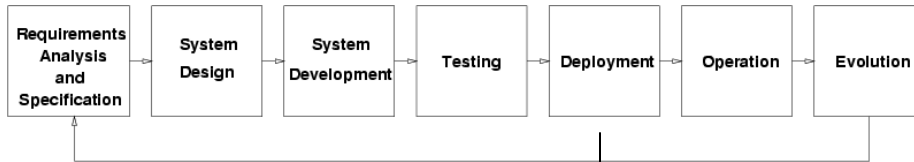
Integrated tests are carried out when the entire system is ready.

Often, more time is spent in testing functional requirements than in testing non-functional requirements.

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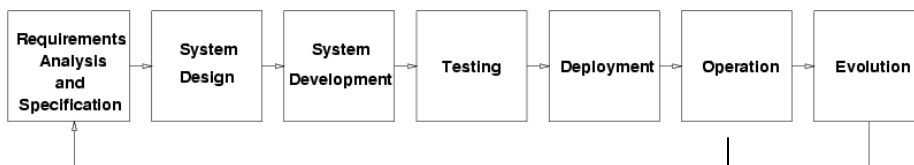


Configuration parameters have to be set in order to meet the SLAs.  
e.g., TCP parameters, database poolsize, maximum number of threads, etc.

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Constant monitoring to check if the system is meeting demands:

- workload (peak periods, unusual patterns)
- external metrics (user-perceived)
- internal metrics (help to detect bottlenecks and to fine tune the system)
- availability (external and internal)

It may be needed to dynamically adjust configuration parameters

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Systems may need to evolve to cope with new laws and Regulations (e.g., HIPPA)

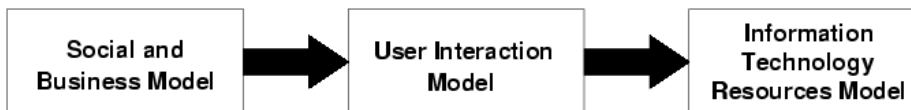
Systems may need to evolve to provide new functions (e.g., sale of downloadable MP3 music in addition to CDs)

How are the IT resources going to cope with evolution in terms of SLAs ?

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# Reference Model for IT



Business Model:

- number of branches
- number and location of ATMs
- number of accounts of each type
- business evolution plans (e.g., mergers)

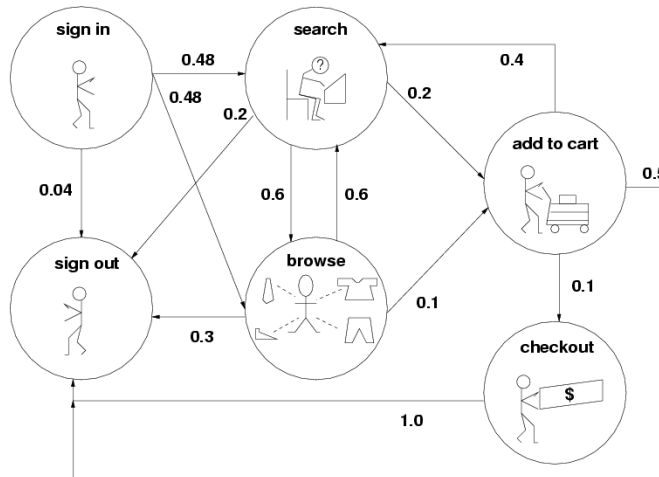
Social Model

- privacy policy
- accessibility policy

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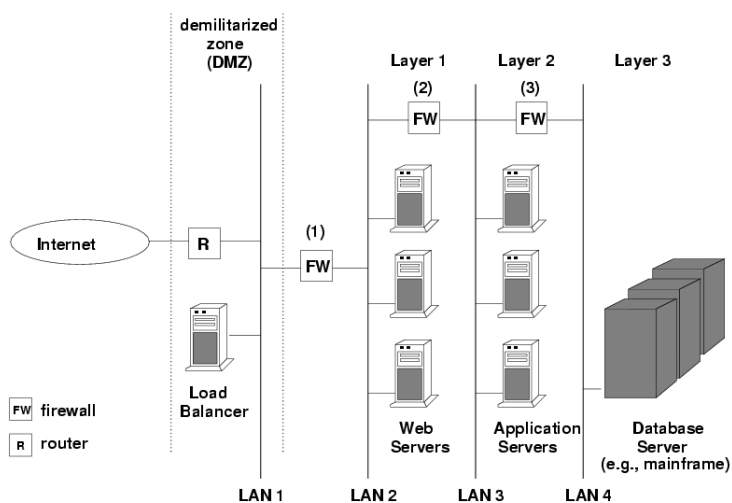
# A Use Model: Customer Behavior Model Graph



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# IT Infrastructure: Example



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