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Agenda

- ✦ Introduction
- ✦ What is Performance Testing?
- ✦ What do we focus on?
- ✦ Prime directive of performance testing
- ✦ Benefits performance testing
- ✦ Type of performance tests?
- ✦ Common performance problems
- ✦ What to measure?
- ✦ Baseline and Benchmarking
- ✦ Setting the requirements
- ✦ Common Mistakes
- ✦ Summary
- ✦ [optional] Load and performance Simulation Models
- ✦ [optional] How early should we performance test?
- ✦ [optional] Load Test Resource Topologies

Introduction

- ✦ The importance of performance testing
- ✦ What is performance testing
- ✦ What do we focus on?
- ✦ Prime directive of performance testing
- ✦ Benefits of performance testing



The importance of performance testing

- ✦ Systems are getting more and more **complex**
- ✦ **New technologies** are arriving at our door step – AI, IoT, IoE, mobile, cloud, big-data, Non SQL DB, more...
- ✦ **Networks and topologies** are getting more diversified and complex, and provided as commodity (cloud PaaS, etc.)

The importance of performance testing

- ✦ **Mass users** are using the systems more and more
- ✦ Systems are more **global** and working **24*7**
- ✦ Business is required to put up a **fast support systems**, and around the clock services
- ✦ **Systems are growing faster** than in the past, requiring faster performance improvement over time

What Is Performance Testing?

- ✦ **Performance testing** is in general, a **testing** type performed to determine *how a **system** performs in terms of responsiveness and stability under a particular workload*
- ✦ Performance Testing is being **measured** (many times) in terms of response time, throughput and resource utilization under running workload
- ✦ We regularly test 3 major issues: Speed, scalability and Stability under load

What do we focus on?

- ✦ **Response time** – the measured time that the end-user-request is waiting for a response from the application



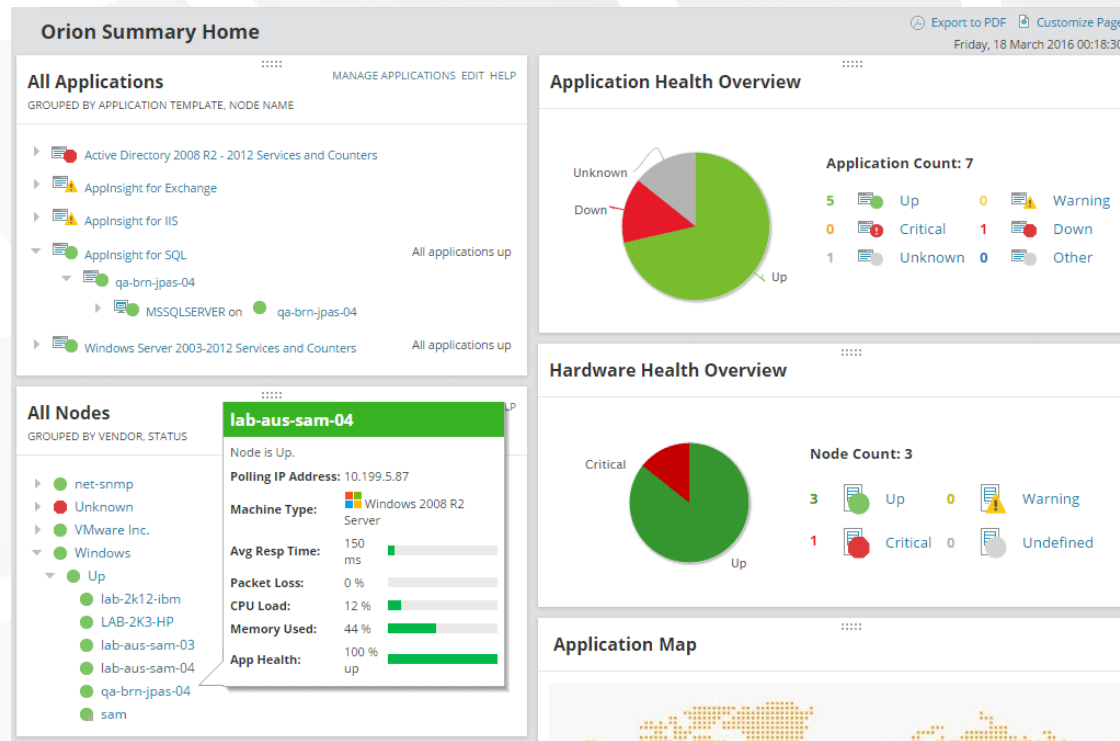
What do we focus on?

- ⚡ **Throughput** - the amount of transactions produced over time during a test or the amount of capacity the application can handle



What do we focus on?

- 🚩 **Resource utilization** - the total amount of resources actually consumed, compared against the amount of resources planned for a specific process



Prime directive of Performance Testing

- ✦ The objective of performance test is to validate the back-end architecture, hardware and applications scalability:
 - ✦ Determine the **performance, stability and scalability** of an application under various load conditions
 - ✦ Determine which **configuration sizing** provides the **best performance level**
 - ✦ Determine if the **current architecture** can **support the application at peak user levels**

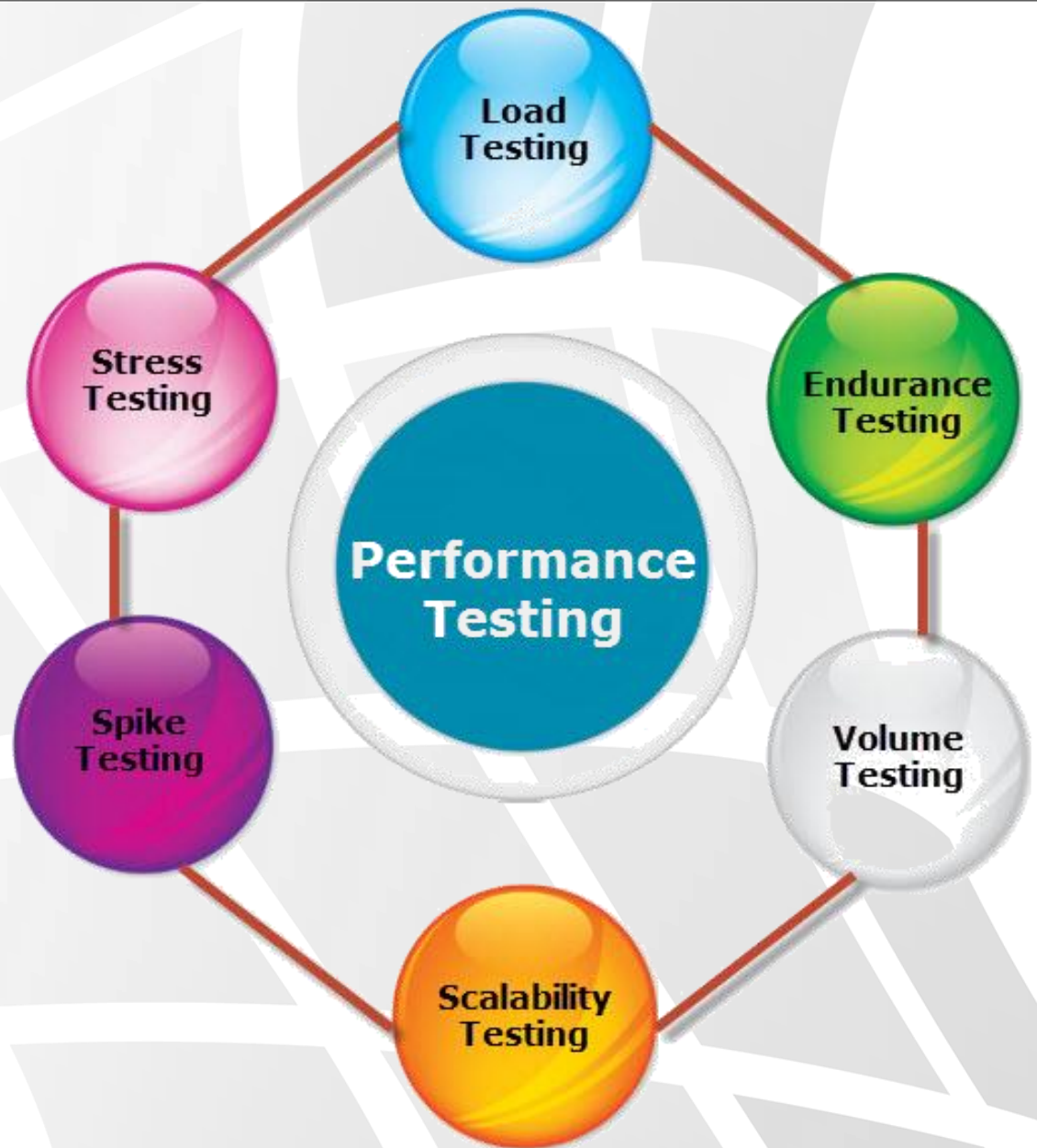
Prime directive of Performance Testing

- ✦ Prove application is **stable enough** to go into production (Acceptance)
- ✦ Determine if the new version of the software had a **negative impact on response time**
- ✦ Determine at what point does **degradation of performance** occur (Capacity Planning)
- ✦ Identify application and infrastructure **bottlenecks**
- ✦ Evaluate product and/or hardware to determine if it can **handle projected load volumes**

Benefits of Performance Testing

- ✦ Higher Production Readiness
- ✦ Meeting User Requirements for doing business
- ✦ Improved efficiency of performance
- ✦ Reduced cost – maintenance, operational
- ✦ Meeting Performance Standards/regulatory needs
- ✦ Contingent Disaster recovery situations

Types of performance testing



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Types of performance tests (KPIs)

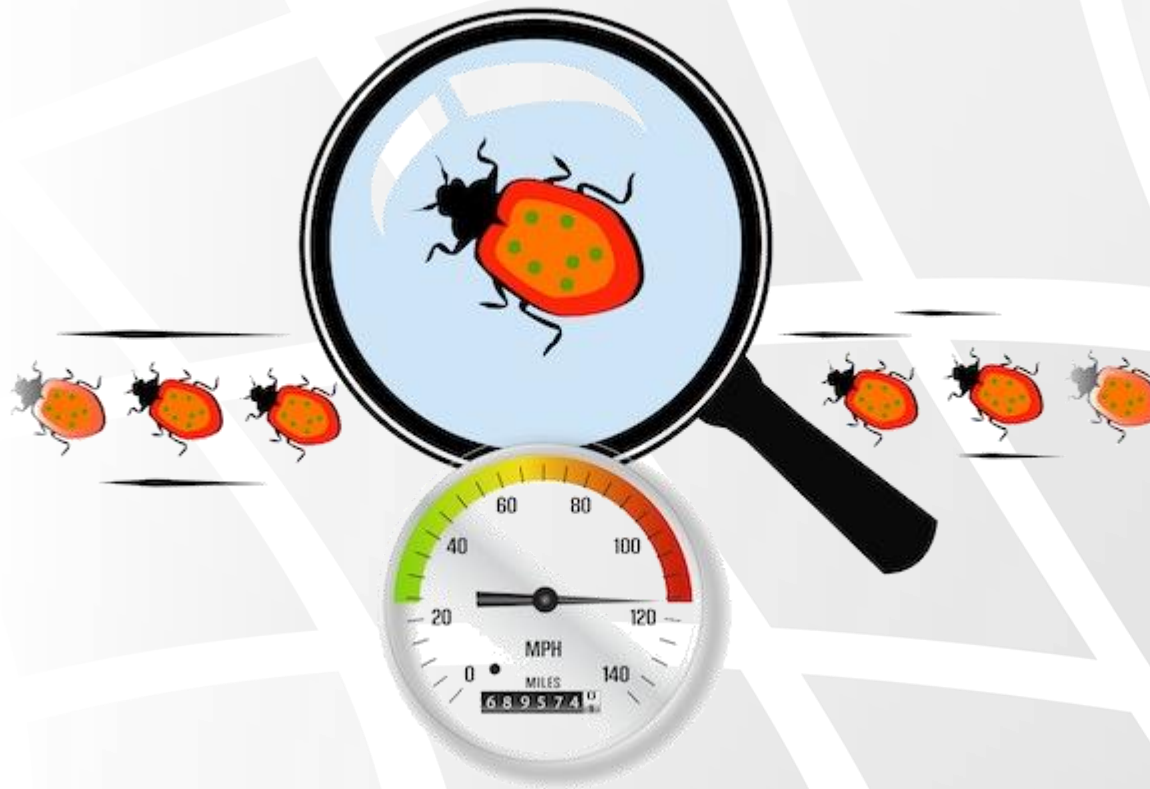
- ✦ **Load testing (concurrency)** - checks the application's ability to perform under *anticipated user loads*.
 - ✦ The objective is to identify performance bottlenecks before the software/system application goes live.
- ✦ **Stress testing** - involves testing an application under extreme workloads to see how it handles high traffic or data processing .
 - ✦ The objective is to identify breaking point of an application.
- ✦ **Endurance testing** - is done to make sure the software/system can handle the expected load over a long period of time.
 - ✦ The objective is to evaluate how the system works for long period of time, under expected load (regular, average, max, above max).

Types of performance tests (KPIs)

- ✦ **Spike testing** - tests the software's reaction to sudden large spikes in the load generated by users.
- ✦ **Volume testing** - Under Volume Testing large no. of Data is populated in database and the overall software system's behavior is monitored.
 - ✦ The objective is to check software application's performance under varying database volumes.
- ✦ **Scalability testing** - The objective is to determine the software application's effectiveness in "scaling up" to support an increase in user load. It helps plan capacity addition to your software system.

<http://www.guru99.com/performance-testing.html>

Common performance problems



Common performance problems

⚡ Long Load time -

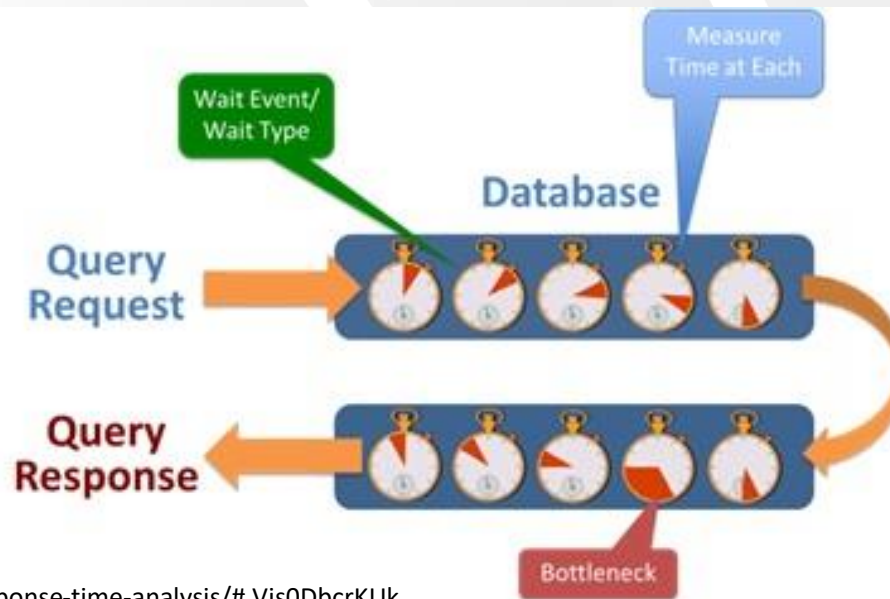
Load time is normally the initial time it takes an application to start.

This should generally be kept to a minimum.



Common performance problems

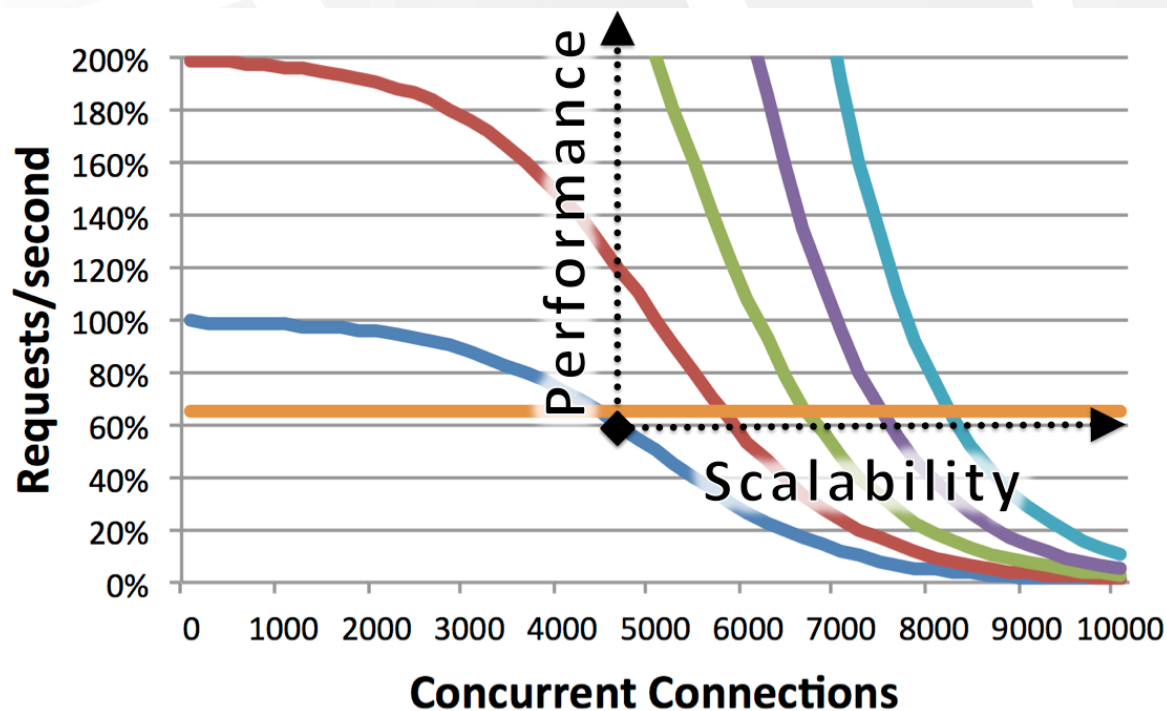
- ✦ **Poor response time** - Response time is the time it takes from when a user inputs data into the application until the application outputs a response to that input. Generally this should be very quick (depending on the actual task done).
- ✦ **Response Time = Processing Time + Waiting Time**



<http://logicalread.solarwinds.com/response-time-analysis/#.Vjs0DbcrKUK>

Common performance problems

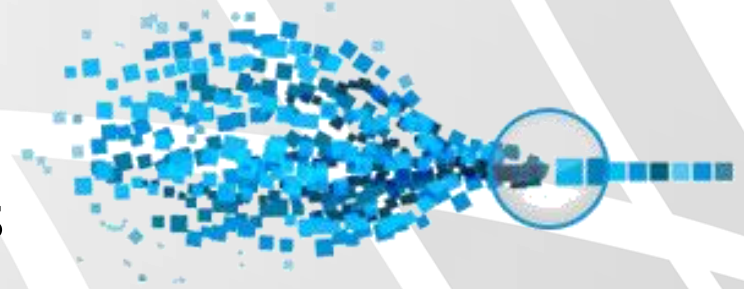
- ✦ **Poor scalability** - product cannot handle the expected number of users or when it does not accommodate a wide enough range of users.



<http://blog.erratasec.com/2013/02/scalability-its-question-that-drives-us.html#.Vjs0krckUK>

Common performance problems

- ✦ **Bottlenecking** - Bottlenecks are obstructions in system which degrade overall system performance.
- ✦ **Bottlenecking is when either coding errors or hardware issues cause a decrease of throughput under certain loads.**
- ✦ Bottle-necking is generally fixed by either fixing poor running processes or adding additional Hardware
- ✦ Some **common performance bottlenecks** are
 - ✦ CPU utilization
 - ✦ Memory utilization
 - ✦ Network utilization
 - ✦ Operating System limitations
 - ✦ Disk usage



<http://www.guru99.com/performance-testing.html>

Measuring performance (KPIs)



What is a Key Performance Indicator?

- ✦ A Key Performance Indicator (or KPI) is usually defined and used to **evaluate the system's ability to meet a certain attribute of characteristic (the "How")**.
- ✦ The outcome of the measurement is used to trigger any tuning and process improvements.



What should we measure?

- ✦ If any of the below resources appears to be going through an excessive intake – this might point out on bottlenecks
- ✦ **Resource Utilization**
 - ✦ CPU, useful when broken out by process (Wait time, User/System time, idle time)
 - ✦ Memory, useful when broken out by process (Usage, broken out by process)
 - ✦ Disk activity (Requests, bytes read/write/sec)
 - ✦ Network bytes (Bytes read, Throughput, established connections)

What should we measure?

⚡ Performance Counters

- ⚡ There are 2 key common counters we can measure and monitor:
 - ⚡ **Time To First Byte (TTFB)**
 - ⚡ **Time To Last Byte (TTLB)**

What should we measure?

- ✦ User Load can be static value or ramp-up and down during performing the load test
- ✦ **Load Counters**
 - ✦ **User Load** - The number of concurrency users that are accessing the system in a given time
 - ✦ **Requests/sec** - Displays the number of requests being issued each second
 - ✦ **Errors/sec** - Displays the number of errors that occurred during the load test run each second (I.E. Unauthorized-401, Access Denied-403, File or Directory not found-404 etc')

30

High Performance Discussion...

Exercise

20 min



70



High Performance Discussion...

- ✦ We will discuss a few performance topics :
 1. **Business driven performance testing** - describe the business goals and business benefits that underline doing performance testing
 2. **Performance Planning aspects** – what aspects should we think about for planning a performance test?
 3. **Workload models** - describe requirements for a performance model. if you know models like that, describe with an example
 4. **Aspects of running performance testing early in the lifecycle** - describe in which areas dev, test and other technical experts can test performance early, and which kind of performance testing is that.

Baseline & Benchmarking



Baseline and Benchmarking

- ✦ At the very beginning of a performance test, we need to establish a **stable baseline**
- ✦ A **performance baseline** is performance information gathered at the beginning of the initiative from which variations are measured throughout the performance lifecycle

After every benchmark (new test run) we will want to compare it to the baseline...

Baseline and Benchmarking

- ✦ The **baseline** is used for **comparison** between **test runs, monitoring** the **project performance** over the period of time that has passed in project execution
- ✦ **Benchmarking** is the process of **comparing** the **system performance** against the **baseline**

Baseline is reflecting the performance requirements

Why Baseline performance?

- ✦ To establish goals and standards
- ✦ To set SLA metrics and performance thresholds
- ✦ To make important decisions

Performance requirements



Define performance requirements

- ✦ A specific business process or a mix of business processes
- ✦ A specific response time threshold
- ✦ A specific load
- ✦ A specific set of application characteristics
- ✦ Computing power needed and a specific constrains if any



Define performance requirements

✦ **Typical conversation of a performance tester with the project manager -**



Define performance requirements



Tester: What is the load you want to replicate on the tested system?

Manager: well, I guess 2000 concurrent users!



Define performance requirements



Tester: What are the most frequent business processes you want to test?

Manager: I believe the most common ones are - *(1) Login, add item, checkout.*
(2) Login, search ,logout.
(3) Login, fill a form, send a form , logout.



Define performance requirements



Tester: and what should be the transaction rate?

Manager: All at the same time....?#\$\$@?



Define performance requirements



Tester: Well - can you tell me the rate of all the business processes you want to test, over an hour, at peak and normal times?

Manager: I don't know the transaction rate, I'll have to talk with our CTO....



Define performance requirements

After a few days...



Tester: ?? ##@@!!??

Manager: The CTO said we should simulate BP (Business Process) 1 with the rate of X, BP 2 with the rate of Y...



Define performance requirements

Now we can start...



Scenarios and actions

Scenario	Action	Input Data	Output Data
Browsing Product Catalog by an existing user	Login	<ul style="list-style-type: none">•Unique username•Password of the username	
	Browse	<ul style="list-style-type: none">•Catalog Tree•User Type	<ul style="list-style-type: none">•Product description•Title•Category
Browsing Product Catalog by a new user	Login	<ul style="list-style-type: none">•Unique username•Password of the username	
	Browse	<ul style="list-style-type: none">•Catalog Tree•User Type	<ul style="list-style-type: none">•Product description•Title•Category

Think-time

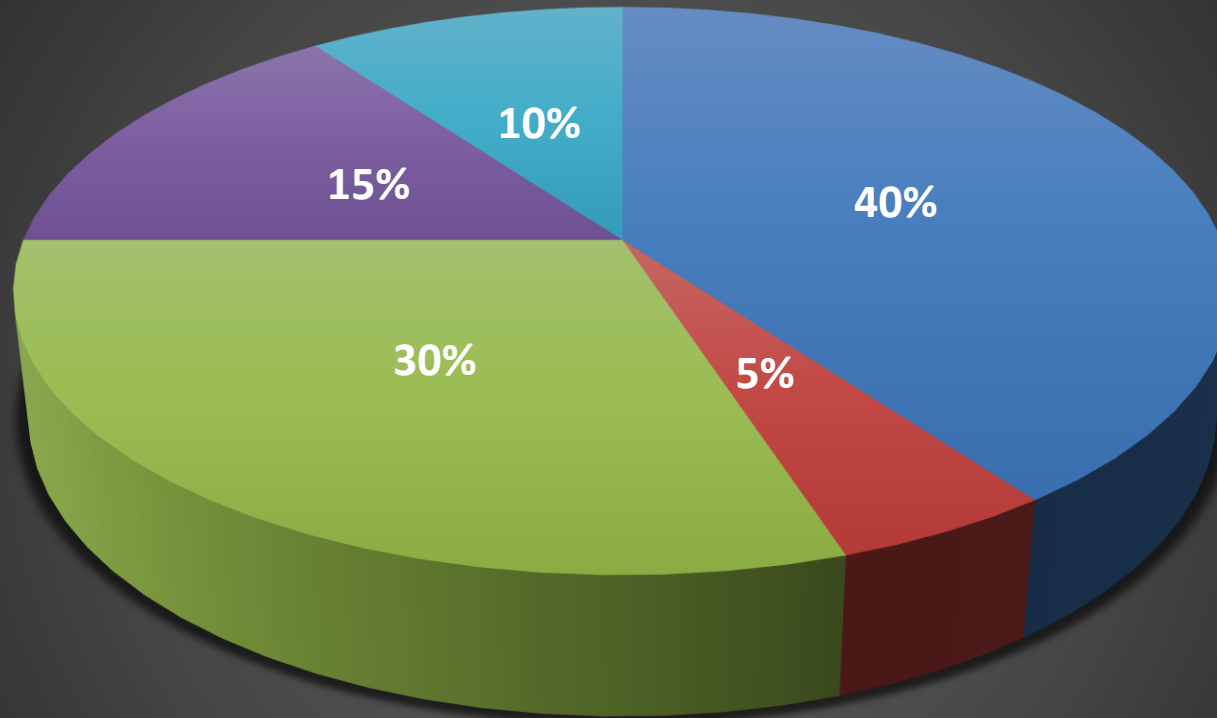
Scenario	Action	Input Data	Output Data	Think Time
Browsing Product Catalog by an existing user	Login	<ul style="list-style-type: none">•Unique username•Password of the username		5-8 seconds
	Browse	<ul style="list-style-type: none">•Catalog Tree•User Type	<ul style="list-style-type: none">•Product description•Title•Category	4-30 seconds
Browsing Product Catalog by a new user	Login	<ul style="list-style-type: none">•Unique username•Password of the username		5-15 seconds
	Browse	<ul style="list-style-type: none">•Catalog Tree•User Type	<ul style="list-style-type: none">•Product description•Title•Category	10-60 seconds

Usage Patterns

User Scenario	Percent Load Distribution
Browsing product catalog	40%
Creating a user account	5%
Searching for a product	30%
Login to application	15%
Order Placement	10%
Total	100%

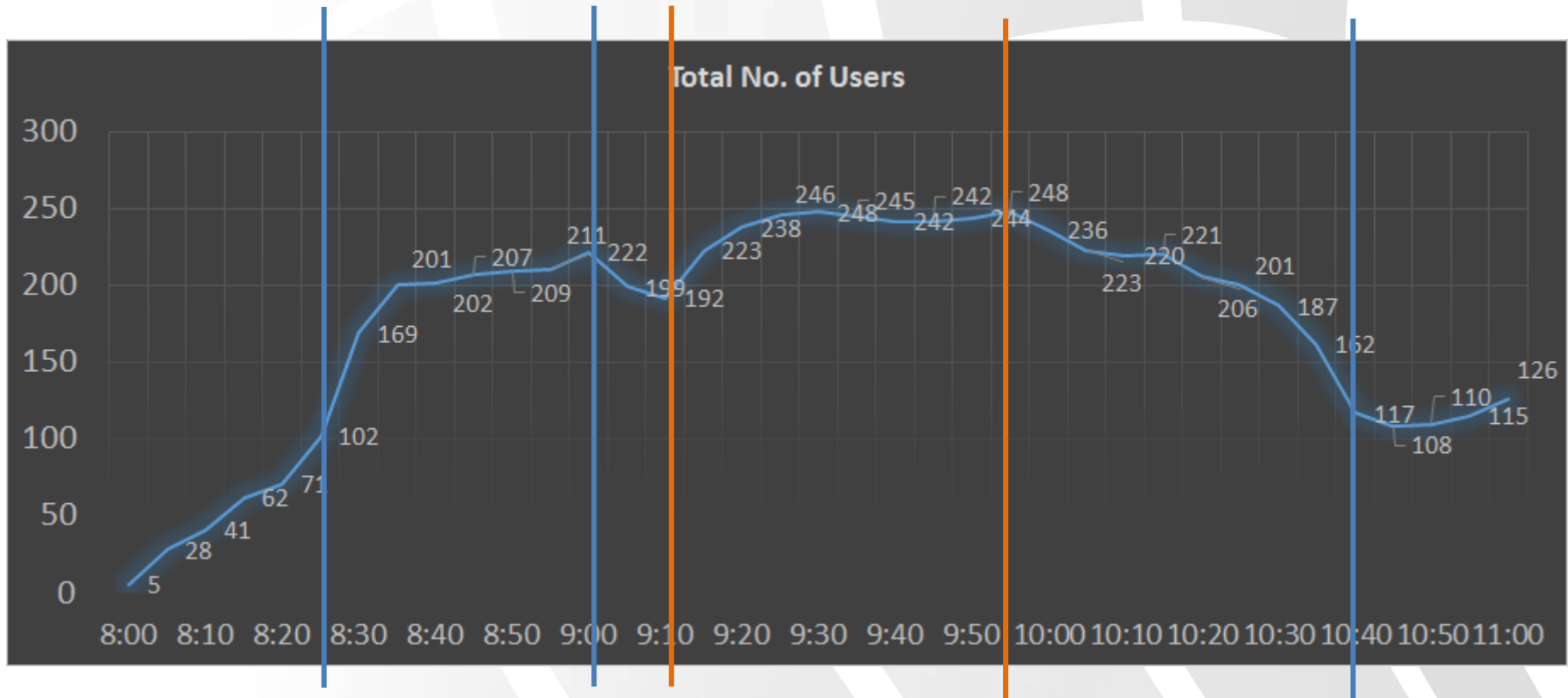
Usage Patterns

Percent Load Distribution



- Browsing product catalog
- Searching for a product
- Login to application
- Creating a user account
- Order Placement

Distribution of Users logging in...



✦ What profile are those users using?

- ✦ Employees – lots of data entry (inserts), lots of queries, lots of updates
- ✦ Managers – lots of queries, reports, small amount of updates, some deletes

Common traps in performance testing



Don't fall into common traps...

✦ **Premature Optimization**

- ✦ Don't try to optimize the application **before** you have "tested the water" and ran a few performance cycles

✦ **Random Optimization**

- ✦ In order to make any optimization you have to change **only one** set of a variable (isolate), retest the system and then compare the result to the baseline

✦ **Insufficient Requirements**

- ✦ You have to make sure that all your performance requirements capture all the needed variables, in case they are not - it will be hard to produce valid conclusions
 - ✦ Same as last version...

Performance testing modeling



Load & Performance Workload Modeling

- ✦ Modeling enables us to **simulate load**
- ✦ Load simulation enables us to **extrapolate and evaluate production load in similar or expected conditions**
- ✦ Workload model is built collecting the following data items / preparations - ...

Load & Performance Workload Modeling

- ✦ KPIs required
- ✦ Data base & network traffic volumes – with expected growth
- ✦ Application modularity and scalability
- ✦ Parallelism capabilities (foreign populations)
- ✦ User profiles (User Community Models) – identification and creation
- ✦ Profile scenario representation (percentage)
- ✦ Test Environment & configuration – production like, able to be extrapolated
- ✦ Workload (production) patterns identification
- ✦ Test environment mechanisms (cache management, network boxes buffers management, etc')
- ✦ And more...

How early should we test performance?



How early should we test performance?

- ✦ Common belief : "...performance testing can't effectively start until the application is stable ..."
- ✦ An experienced performance tester (and for some tasks a developer) can do a lot of things:
 - ✦ NW and/or Web server throughput limits
 - ✦ Individual server resource utilization under various loads
 - ✦ Search speeds, query optimization, table/row locking, and speed versus capacity measurements for DBs
 - ✦ Speed cost and resource cost of security measures
 - ✦ Measure and evaluate Swap rate, I/O rate for certain processes and APIs
 - ✦ And more...

Which resources/skills are involved in performance testing?



Resources involved in the performance Testing...

- ✦ Types of experts that might be needed:
 - ✦ Network, DBs , OSs, Technologies experts (Web, cloud, mobile, big-data), Hardware, Sizing, Application...
- ✦ **Scheduling** them in order to get their input is **critical** – their **cost is very high** to the project; they are **not needed 100%** of their time

Summary

- ✦ Introduction
- ✦ Benefits
- ✦ Risks and common mistakes
- ✦ PT Requirements
- ✦ PT Measurements (KPIs)
- ✦ How early?
- ✦ Resources & scheduling



THANK YOU!

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The need for Speed...

Performance & Load Testing Workshop