**Assignment 4**

1. **Which components have you used in Load Runner?**

**LoadRunner consists of several key components including VuGen (Virtual User Generator), Controller, Load Generators, Analysis, and Agent process, which together facilitate script creation, scenario execution, load generation, and performance analysis.**

### Virtual User Generator (VuGen)

VuGen is an Integrated Development Environment (IDE) used to create Vuser scripts by recording and scripting user interactions with the application under test.

It simulates real user behavior and generates Vuser scripts for various protocols and applications.

It supports script editing, enhancement, and debugging.

1. **Controller**

The Controller manages and drives the load testing scenarios.It defines how many virtual users (VUsers) to execute, their behavior, load distribution, ramp-up and ramp-down patterns, and execution schedule. The Controller orchestrates test execution by coordinating multiple load generators.

It also handles performance data collection during the test.

1. **Load Generators (or Injectors)**

Load Generators run the Vuser scripts generated by VuGen and simulate the load on the system under test by spawning multiple virtual users.

They distribute the load across multiple machines if needed to simulate high user volumes efficiently.

This component uses hardware resources such as CPU and RAM to create the required load.

1. **Analysis**

The Analysis component processes raw test data collected during execution.

It creates detailed reports, graphs, and charts to help identify performance bottlenecks, system behavior under load, and to analyze transaction response times and throughput.

Analysis helps testers and developers make informed decisions to optimize and tune the system.

1. Agent Process

The Agent acts as an interface between the Controller and Load Generators.

It communicates and manages commands issued by the Controller to execute load on specified machines.

1. **How can you set the number of Vusers in Load Runner?**

**Select the checkbox by the script whose run you want to modify and enter the number of Vusers to add**. In this example, webhttphtml3 is selected, with 10 in the # (number) column. To initialize the Vusers, click Init. Ten Vusers are immediately initialized and move to the Ready state.

1. **What is Correlation?**

**Correlation** is a statistical measure that describes the extent to which two variables are related. It quantifies the degree to which changes in one variable are associated with changes in another variable.

Correlation is commonly used in various fields such as economics, finance, and social sciences to identify and measure relationships between variables.

**Correlation Coefficient**

The correlation coefficient, denoted as **r**, is a numerical value that ranges from -1 to +1. It indicates the strength and direction of the relationship between two variables:

**+1**: Perfect positive correlation (both variables move in the same direction).

**-1**: Perfect negative correlation (one variable increases while the other decreases).

**0**: No correlation (no linear relationship between the variables)

**Types of Correlation**

**Positive Correlation**: Both variables move in the same direction. For example, height and weight typically have a positive correlation

**Negative Correlation**: Variables move in opposite directions. For example, the price of a product and its demand often have a negative correlation

**No Correlation**: No linear relationship between the variables

1. **How Load Runner interacts with the application?**

LoadRunner, now known as Micro Focus LoadRunner, is a software testing tool used to assess application performance under load.

It**simulates millions of concurrent users, records their interactions, and analyzes key components’ performance during load testing.**

1. How many VUsers are required for load testing?

Key Factors Influencing VUser Calculation

Target Transactions/Throughput:

If the goal is to achieve 10,000 transactions/hour (as in ), the required VUsers depend on:

Transaction time per user: If 7 transactions take 16 seconds, each user completes ~0.44 transactions/second (7/16).

Total transactions needed: 10,000/hour = ~2.78 transactions/second (10,000/3,600).

VUsers required: 2.78 TPS ÷ 0.44 TPS/user ≈ 6.3 VUsers (round up to 7–10 for buffer**).**

Little’s Law ( ):

Formula: N = Z × (R + T), where:

N: VUsers

Z: Target TPS (e.g., 2.78)

R: Response time (e.g., 16 seconds for 7 transactions → ~2.3s/transaction)

T: Think time (e.g., 9 seconds added to slow TPS to 0.28/user, as in ).

Example: For 2.78 TPS, R = 2.3s, T = 9s → N = 2.78 × (2.3 + 9) ≈ 31 VUsers.

Real-World Traffic Simulation ( ):

For scenarios like e-commerce:

Peak users: If 1,000 carts/hour with 10-minute sessions, each user completes 6 transactions/hour → 167 VUsers (1,000/6).

Scaling: For 4× load, multiply VUsers proportionally (e.g., 167 × 4 = 668).

Resource Constraints ( ):

Load generator limits: Each VUser consumes memory (e.g., 10–12MB). For a server with 16GB RAM (after OS):

Max VUsers = (16,000MB - OS usage) ÷ 10MB ≈ 1,600 VUsers per server.

Step-by-Step Calculation Example

Scenario: Achieve 10,000 transactions/hour with 7 transactions/16 seconds per user.

Transactions per user/second: 7/16 = 0.44 TPS.

Total TPS needed: 10,000/3,600 ≈ 2.78 TPS.

VUsers (no think time): 2.78/0.44 ≈ 7 VUsers.

With think time: Adjust to 25 seconds/iteration (add 9s delay) → 7 transactions/25s = 0.28 TPS/user.

VUsers = 2.78/0.28 ≈ 10 VUsers.

Final Recommendation

Baseline: Start with 10–30 VUsers for 10,000 transactions/hour, adjusting think time to meet targets.

Validation: Monitor system performance (response time, error rates) and scale VUsers if bottlenecks occur.

Tools: Use calculators ( , ) or formulas (Little’s Law) to refine estimates based on actual test results.

1. **What is the process for developing a Vuser Script?**

The very beginning step is to create a blank script in VuGen. Black script can be created in multiple ways: via File menu, by clicking on **Add New Script** icon or by pressing shortcut key combination **Ctrl + N**. Before you create a blank script, you must decide in which protocol you need to script.

1. **What is the relationship between Response Time and Throughput?**

**Response time** and **throughput** are two key metrics used to evaluate the performance of a system, particularly in the context of databases, web servers, and other transaction-based systems.

**Response Time**:

* **Definition**: Response time is the amount of time it takes for a system to respond to a request. It is measured from the moment a request is made until the moment the response is received.
* **Importance**: It is crucial for user experience, as shorter response times generally lead to higher user satisfaction. For example, when a user submits a query to a database, the response time is the duration from the submission to the retrieval of the results.

**Throughput**:

* **Definition**: Throughput is the number of transactions or requests that a system can handle in a given period of time. It is typically measured in transactions per second (TPS) or requests per minute.
* **Importance**: Throughput is essential for understanding the capacity of a system. Higher throughput indicates that the system can handle more transactions in a given time frame, which is vital for scalability.

**Relationship Between Response Time and Throughput**:

**Inverse Relationship**: Generally, response time and throughput are inversely related. As throughput increases, response time tends to increase due to the higher load on the system[**2**](https://www.bing.com/ck/a?!&&p=3f8a91bbe087171b1988f46be9f33c698d1dc9149aa4bf1773cfe89a8daf3a86JmltdHM9MTc1MzIyODgwMA&ptn=3&ver=2&hsh=4&fclid=3bdfe25d-64b6-6da6-240c-f79d65d26c15&u=a1aHR0cHM6Ly9zdGFja292ZXJmbG93LmNvbS9xdWVzdGlvbnMvNDk1NTI3NDUvaG93LXRocm91Z2hwdXQtYW5kLXJlc3BvbnNlLXRpbWUtYXJlLXJlbGF0ZWQ&ntb=1). Conversely, if response time decreases, it often means that the system can handle fewer transactions simultaneously, thus reducing throughput[**1**](https://www.bing.com/ck/a?!&&p=0ff7ef6d6ac6a256fa2920e4e1851cad346278fa5edf1f5ca8c1e1f8881e5e3bJmltdHM9MTc1MzIyODgwMA&ptn=3&ver=2&hsh=4&fclid=3bdfe25d-64b6-6da6-240c-f79d65d26c15&u=a1aHR0cHM6Ly93d3cuaWJtLmNvbS9kb2NzL2VuL2luZm9ybWl4LXNlcnZlcnMvMTQuMTA_dG9waWM9dGltZS1yZXNwb25zZS10aHJvdWdocHV0&ntb=1).

**Resource Allocation**: The trade-off between response time and throughput becomes evident when balancing the need for high transaction throughput with the need to perform large queries. Allocating more resources to a specific query can decrease its response time but may negatively impact overall throughput.