

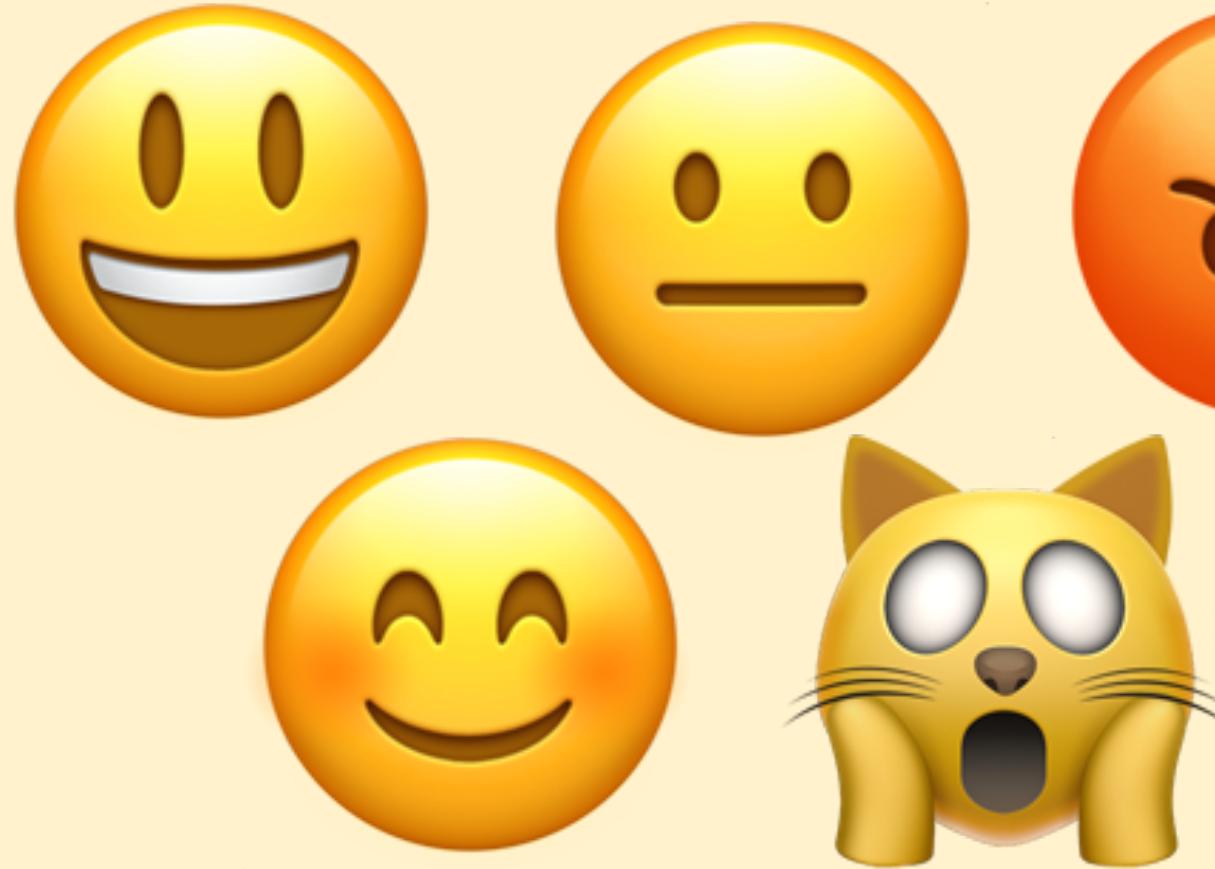
Software Testing Technology

Performance Testing

Introduction

- We have already mentioned the use of performance, stress, load, volume testing in system testing.
- Where does performance testing fit?
- Key performance targets
- Deciding on tests
- Test environment
- Analysis

What is good performance?



Performance Test

A range of numbers will be displayed below, over several seconds. If this was the time taken for a web page to show, which number represents when you would go to a different website?

Start



Which number represents the one where you would have gone to do something else?



- A. 1
- B. 2
- C. 3
- D. 4
- E. 5
- F. 6

UK 1901 Census Data

- A large data set for the UK 1901 census was made available in 2002
- Site built to cope with about 1M accesses a day
- Reported to have received 30M on some days
- Site closed for several months whilst it was improved...

The screenshot shows a BBC News page from Friday, 19 July 2002, at 12:36 GMT. The main headline reads "Census website still offline". Below the headline, a message from the Public Records Office states: "Sorry, the 1901 Census website is currently being tested. For a pre-view of the site you can visit our [test site](#). For the latest information on the Census Online Service click [here](#)". To the right, there's a sidebar with a photo of people and the text "'My census success'". Below the main article, there's a quote: "This has caused much frustration to our customers, frustration we share". At the bottom, a note from QuinetiQ says: "A QuinetiQ spokesman told BBC News Online that simulated tests show the system is robust enough to cope with one million users in an hour - about the level that caused the original".

Where does performance testing fit? (1)

- It is a form of non-functional testing
- How is that different from functional testing?
 - **Functional:** I have a list structure. Can I add an item? Can I add multiple items? Can I remove items?
 - **Non-functional:** For a typical use-case, with an estimated number of users, how much data do we expect to be in the list structure at the same time?
 - 20,000 records?
 - 400,000 records?
 - More?
 - Is performance affected by having larger amounts of data?

Where does performance testing fit? (2)

- The requirements specification should guide the performance tests
 - Are there any performance targets specified?
- Need **SMART** tests
 - Specific, Measurable, Achievable, Relevant, Time-based
 - “It needs to run fast” ... What does that mean?
 - “The credit calculation needs to return a result within a maximum of 2 seconds,...”
 - “The system should support 1,000 concurrent users in an hour.”

Where does performance testing fit? (3)

- Typically performed later in development, e.g. when there is a system to test.
- Is this too late?
 - Survey in 2006, by Forrester Research, reported in “The Art of Application Performance Testing” found that the majority of performance issues are found when the application is in production.
 - Companies who undertook some performance testing before release, were able to reduce the number of faults found in production.
 - Few companies actively thought about performance early on. Those that did were able to reduce the number of failures identified in production.

Where does performance testing fit? (4)

- Is the timing of the performance tests important?
- Important to have some checks for when it is suitable to start?
 - Need to have a **stable code-base** for the section tested – hard to have repeatable results if the code is still changing
 - **Code should have been tested** – if it hasn't it is hard to determine if you have found a bug or a performance issue

Key Performance Targets

- Example targets:
 - **Availability or uptime** – how long is the application able to stay running?
 - **Concurrency** – if there are multiple users, can the application support a certain number?
 - **Response time** – for different tasks, what are the expected times? Is there a previous version or other system to compare response to?
 - **Computer (Server?) Use** – e.g. CPU, Memory, File I/O, Disk
 - **Network Use** - e.g. Data volume, Data Throughput

Based on : “The Art of Application Performance Testing”, Ian Molyneaux,
O'Reilly Media Inc., Second Edition, 2015

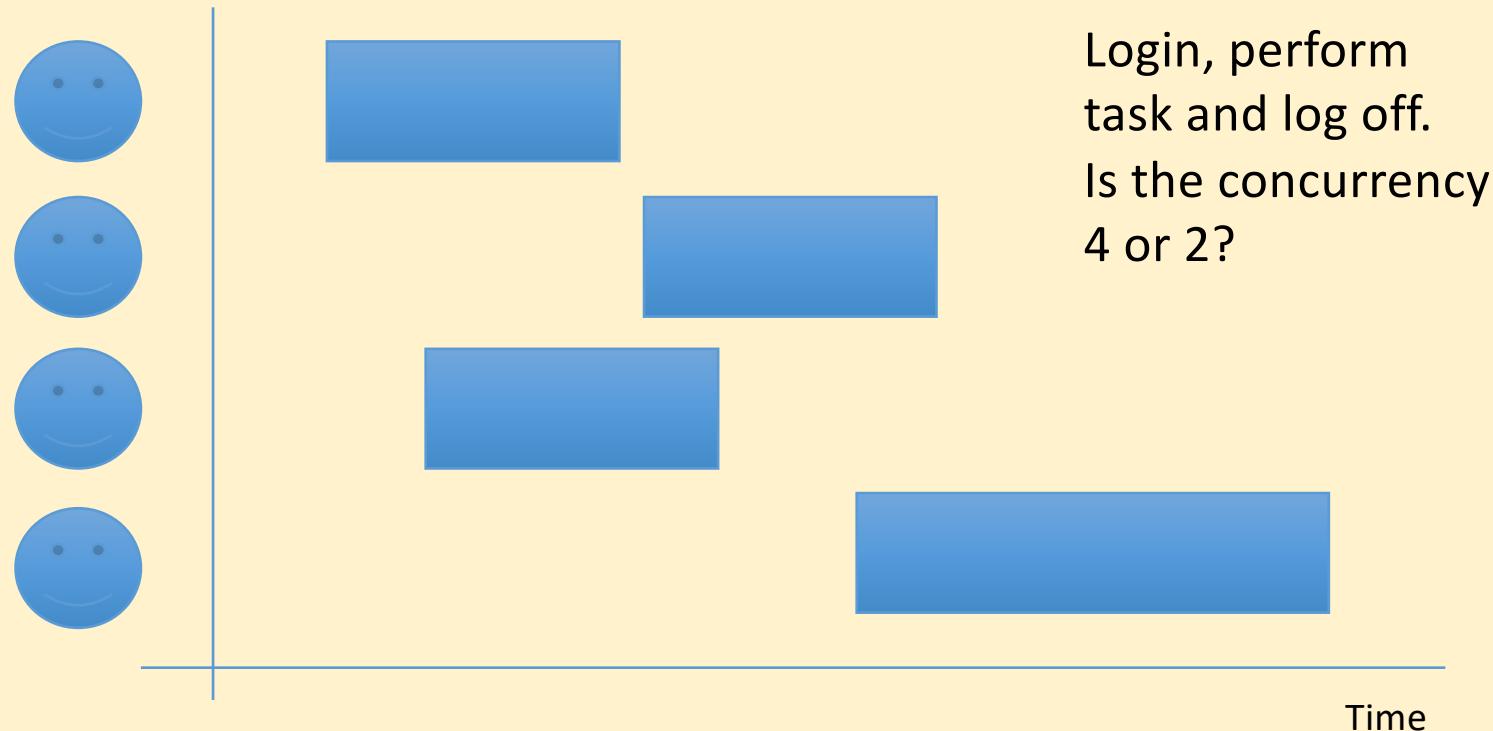


Concurrency (1)

- Is this relevant for the application?
- How might we measure Concurrency? Pick one or more that are the best description.
 - A. Number of users per day?
 - B. Number of users per hour?
 - C. Number of users per minute?
 - D. Number of users per second?

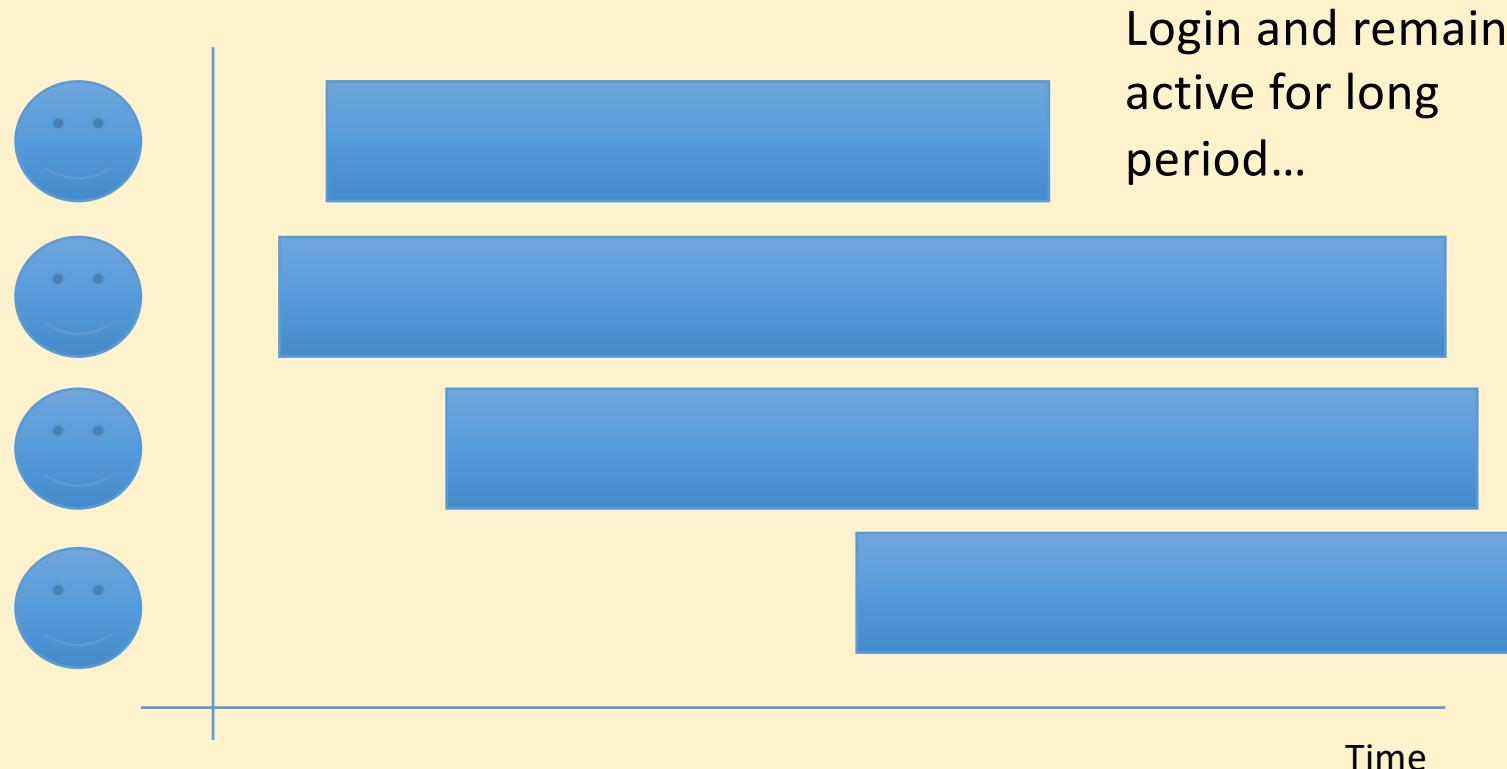
Concurrency (2)

- When is there concurrent access? How long is the access for?



Concurrency (3)

- When is there concurrent access? How long is the access for?



Network Usage (1)

- Are there any performance problems with the network connections? For example:
 - Volume of data on the network
 - Speed of transfer of data on the network
 - Network hardware problems

Deciding on tests

- Identify bottlenecks in the system
 - Memory Management
 - Database Implementation
 - Network Performance
 - File I/O
- Make tests that explore these areas
 - Can you gather data to measure the performance?
 - What is the baseline for your measurements?
 - Test early and often so that you can identify changes in performance

Creating the tests

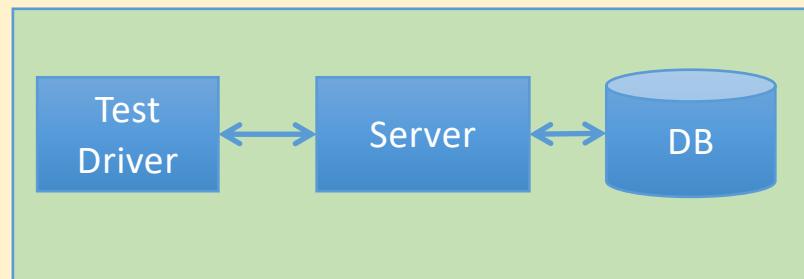
- Create scripts that describe a set of interactions that you want to test, e.g.
 - set of interactions with a website
- You might need to edit the scripts
 - Is that possible with the tools that you choose?
- Support of all of the types of interactions you need? E.g. support for login to websites?
- How will the test data be created?

Performance Test Environment

- Build the right environment for the performance testing.
- How many machines?
 - Is it a desktop application, a server application, a mobile application or a mixture?
- What types of machines?
- Build an environment that is as close to the production (live) environment as possible.

Example Functional Test Environment for a Web Application

Possible environment 1: all on the same machine



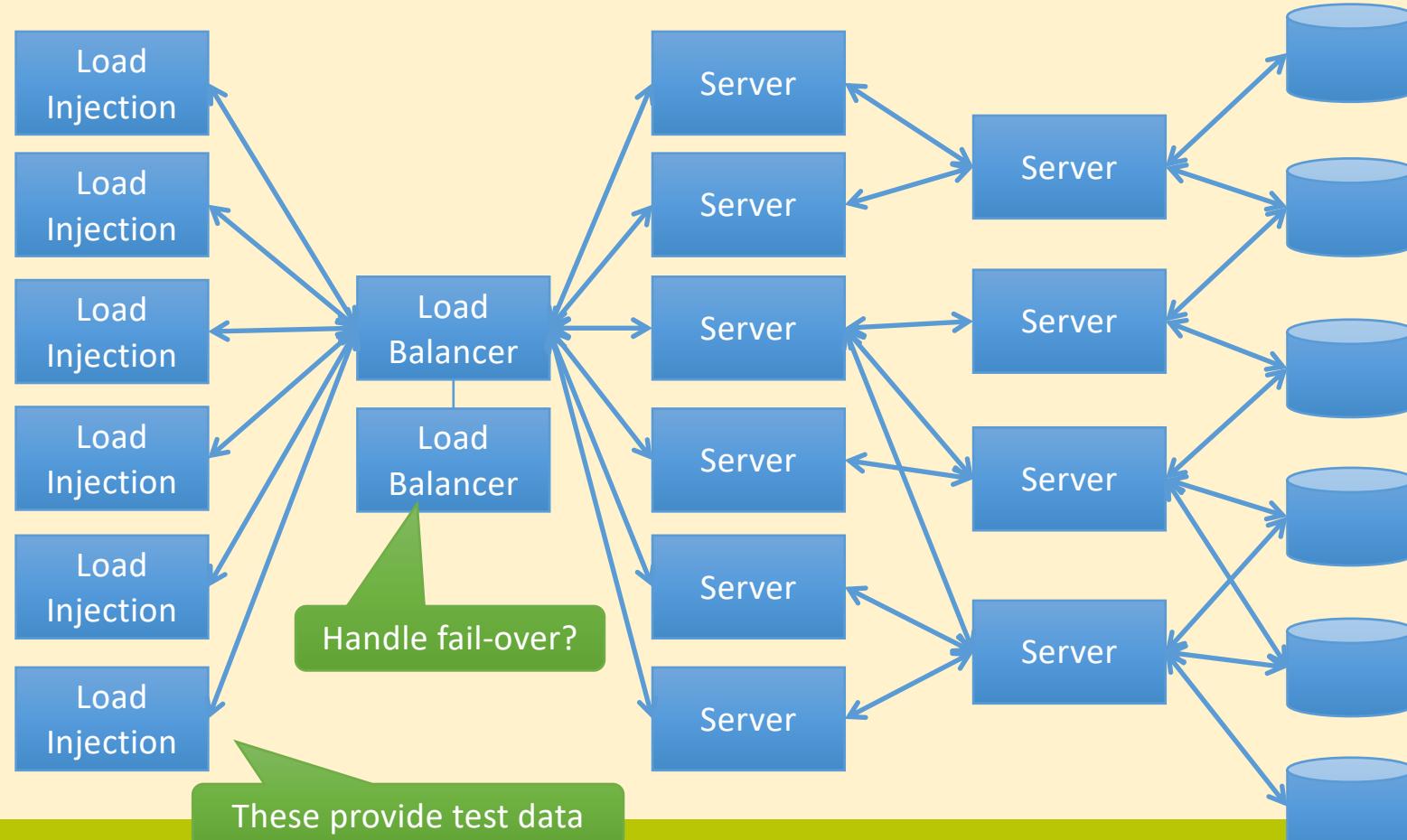
Possible environment 2: separate machines



Other environments could be used...

Example Performance Test Environment

e.g. TaoBao, eBay, YouTube, Youku, ...



How many servers might be used
for large web-based
applications?



- A. 1,000
- B. 5,000
- C. 10,000
- D. 15,000
- E. 20,000
- F. 50,000

Building the Performance Testing Environment

- eBay reported that in 2007, it had approximately 16,000 machines used for the website. More recent numbers suggest about 50,000 machines.
- Do we need to replicate all of that?
 - Maybe...? Or, we could think about realistic test environments that lets us explore how the application handles load.
- In the book, Molyneaux talks about a UK bank that has a test environment that is the same as one of its biggest offices.
- Key message: it can take a lot of time and money to setup the test environment. Plan early.

Performing tests

- Automation is key to run performance testing
- Is responsiveness more important than execution time?
 - Image Processing?
 - Stock trading application?
- Use tools to vary things like network limitations or simulated numbers of users. Look at how changes in that area will affect users.

Example types of performance tests

- **Pipe-clean tests** – validate the different performance tests
- **Volume Test**
- **Stress Test**
- **Soak / stability** – extended use tests
- **Smoke tests** – focus on areas of change. Some people also use this term to refer to tests that check if the basic system is ready for testing.
- **Isolation** - focus on specific areas

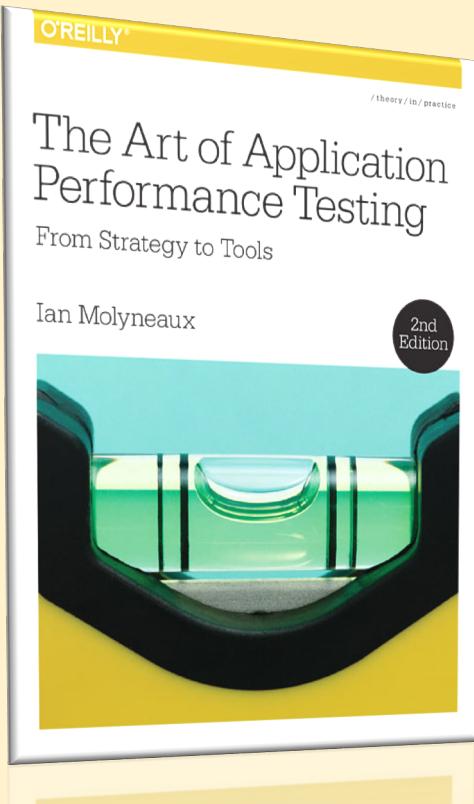
Analysis

- Run tests and gather the test results
- Determine which Key Performance Indicators (KPI) should be analysed, e.g.
 - Processor usage
 - Memory usage
 - Disk usage
 - Network data transfer rates and information about data transmission errors
- Analyse the results to determine if there problems with the performance.

Summary

- Testing performance, not functionality
- When should we start performance testing?
- Some examples of key performance indicators
- Deciding on tests
- Test environment

Performance Testing



- A lot of books on testing include a section or short chapter on Performance Testing.
- “Art of Application Performance Testing” is a book that talks about the key concepts.
- A very good read if you are interested in this type of testing.

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Any Questions?