Web Application Development
Fall 2012 Final Exam Study Guide

This guide is designed to be a list of topics that might appear on the final exam. Most (if not all) of the answers to these questions are in the lecture slides, and the questions appear in (near-) chronological order based on the lectures. These questions are also characteristic of the types of questions that might appear on the exam.

1) What is HTTP? What problem(s) does it solve as compared to pre-HTTP protocols? Describe the contents/parts of an HTTP request and response. Know the differences between the various HTTP methods and when each method should be used. Know the parts of a URL.

2) Understand the basic principles of internet networking. What is a MAC address? An IP address? A DNS hostname? Describe the process, in detail, of sending a request from a client computer to a web server and retrieving a response.

3) Understand the basic functions of a web server for both static and dynamic (i.e., generated from web applications) content. For dynamic content, understand the typical division of functionality between the web server, the application server, and the database system.

4) What is HTML? What advantages does it have over a plain-text representation of data? What advantages does it have over binary data representations (PDF, PS, etc).

5) What is CSS? What advantages does CSS offer over including style information directly into the HTML document? Why is it called "cascading" and why is this feature important?

6) What purposes do the HTML tags <div> and <span> serve?

7) What is JavaScript? What advantages are there to using JavaScript to manipulate a web page rather than sending all requests to the web server? What problems are there when using JavaScript to manipulate a page?

8) What factors in modern browsers make writing JavaScript difficult?

9) What is the DOM? How is it useful?

10) What are the advantages of writing an application as a web application? As a client-side application installed on a user's computer? As a server-side application accessed via a non-web-based client-side application?

11) What advantages does a server-side Java application have over a client-side Java applet? What disadvantages?

12) Know the basic details of the javax.servlet.http package, including the HttpServlet, the HttpServletRequest, the HttpServletResponse, and a Session. What are the scope and use of various attributes (application-level, session-level, request-level, page-level) and request parameters.

13) What are HTML hidden fields? Cookies? Sessions? What advantages does each method have over the others? For each method give an example of when that method is clearly better than the others. Know how sessions are typically implemented.

14) What is the difference between a process and a thread? What are some advantages of using a thread instead of a separate process? A separate process instead of a separate thread?

15) What is a race condition? What does it mean for code to be "thread-safe"?

16) Understand the Java `synchronized` keyword, used both in a method's declaration and when used internally within a method.

17) Understand the difference between Java local variables, instance variables, class (`static`) variables, instance methods, and class (`static`) methods.

18) Understand the association between Java Servlets within Tomcat, HTTP requests, and threads.

19) What is a DAO? What advantages does a DAO offer over embedding the data management directly into the Servlets logic?

20) What advantages does a database offer over storing data directly in the filesystem? The filesystem over using a database?

21) What problems can be caused by a user embedding HTML tags in input fields? Describe at least two methods to correctly print user-input data as HTML output.

22) What problems can be caused by a user embedding SQL syntax characters in input fields? If writing SQL directly by hand, give at least two ways to fix this problem.

23) What is a B-tree? What advantages and disadvantages does a B-tree have over other storage methods?

24) Understand the basic structure of a relational database. Why is it called "relational"?

25) What is SQL? Know basic details about the common types of SQL statements (`SELECT`, `INSERT`, `UPDATE`, etc).

26) What is a SQL join?

27) Within a database, what is a primary key? What is a secondary index? What are the advantages and disadvantages of keeping a large number of secondary indexes on a dataset?

28) What advantages are there of assigning a database record a unique numeric primary key rather than a unique non-numeric key? What are the disadvantages?

29) What is the difference between a java.sql.Statement and a java.sql.PreparedStatement?

30) What is a transaction? Understand basic terminology related to transactions (begin, commit, rollback, etc).

31) What are the ACID properties?   Understand how these properties are guaranteed in a modern database system.

32) Understand why Java synchronization can still be necessary even with database concurrency control.

33) What is a connection pool? Why is connection pooling important when using a database?

34) Understand the basics of object-relational mapping tools. What advantages and disadvantages are offered by an object-relational mapping tool over directly writing the SQL?

35) What makes a Java object a Java bean? What advantages does a Java bean offer over a plain-old Java object? Name at least two ways in which Java beans have simplified data management that are relevant to this course.

36) What is a component model? What is a design pattern? Why are these ideas useful?

37) What is the property design pattern?

38) What is Java reflection? Know at least two ways in which Java reflection has simplified data management that are relevant to this course.

39) Understand the Java `interface` keyword.

40) What is a Java Server Page? What are the advantages of generating HTML within a Java Servlet? Using a JSP? Understand the basic functions provided by JSPs and how to use them.

41) Understand the difference between using a Model 1 JSP architecture and using a Model 2 JSP architecture. What are the advantages and disadvantages of each?

42) Understand the JSP expression language and how to use it, what functions it provides, and how it resolves expressions to output data.

43) What is Model View Controller? Understand the responsibilities of each component of the MVC architecture. What advantages does MVC have over unstructured servlets? Why is MVC particularly well-suited to web applications as opposed to other types of applications? What are the problems with the MVC design we used in class?

44) What is a JSP tag library? Know the basic functionality provided by the JSTL core and fmt tag libraries.

45) What is a hash function? Describe how hash functions can be used to provide security for data. What makes a hash function cryptographic?

46) What is a salt?

47) What is network sniffing? Spoofing?

48) What is authentication? Authorization? Privacy?

49) Understand the details of public key cryptography, including public and private keys, encryption, and signatures.

50) Understand the details of private key cryptography. What are the advantages and disadvantages of public key vs. private key cryptography. How does a hybrid cryptosystem address the shortcomings of public and private key cryptography?

51) What is SSL? HTTPS? What properties does SSL provide? Understand, in detail, how SSL works and each step of the SSL protocol.

52) What is an X.509 certificate? What is the most relevant information it contains, and how is this information used to guarantee the authenticity of a certificate?

53) Understand the strengths and weaknesses of SSL for web security. How can its security be violated?

54) What is an SSL client certificate? What are the advantages and disadvantages of authentication using SSL client certificates over other methods?

55) What is a Certificate Authority, and what function do they provide? How do we guarantee the authenticity of a Certificate Authority?

56) What is two-factor authentication? Give some examples of two-factor authentication. What advantages does this offer over one-factor authentication?

57) Understand how good programming style can make a program easier to understand.

58) What is Struts? What advantages does Struts have over the MVC architecture used by most of the course examples?

59) What are the challenges of internationalization? Understand the common aspects of programmatic internationalization: language translation, number and date formats, sort orders. What are the advantages and disadvantages of using a message catalog for internationalization as compared to separate pages or views?

60) What is unit testing?

61) What is Ajax? Describe, in detail, the technologies and operations used to make an Ajax application. What are the advantages and disadvantages of using Ajax as compared to synchronous requests? What are the advantages and disadvantages of using Ajax as compared to Adobe Flash, Java Applets, or other interactive client-side runtime environments?

62) You should understand some basic principles of relational database design, to be able to compare and contrast two different data layouts proposed for a data design problem.

63) For each of the ACID properties, name a technology or technique commonly used to guaranteed that property within a database system.

64) What is write-ahead logging? Understand the sequence of operations for transactional reads and writes with write-ahead logging, as well as how the log is used to recover the correct database state during system crashes or transaction rollbacks. Explain how write-ahead logging can increase the performance of a transactional system even though it increases the number of writes and amount of data written.

65) What is two-phase locking? Explain the sequence of operations for transactional reads and writes with two-phase locking. How is two-phase locking typically enforced?

66) What is deadlock? Describe two methods to avoid deadlock when two-phase locking is used.

67) Describe three methods to distribute user requests evenly among a collection of static web servers. For each method, what are the advantage and disadvantage of that method as compared to the other methods?

68) What are the advantages and disadvantages of static web caching as compared to distributing HTTP requests among a collection of static web servers at the content provider?

69) What is a Content Distribution Network (CDN)? What are the advantages and disadvantages of using a CDN as opposed to a traditional collection of web servers and ad-hoc static web caches?

70) Why is scaling web applications harder than scaling static web content? Describe one common method to distribute requests evenly among a collection of web and application servers. What is the problem with this common method?

71) Understand database partitioning, and how it can increase the performance of a database server. What problems are caused by partitioning a database?

72) What is database replication, and how does it increase database scalability? What problem does replication have?

73) How can increasing the concurrency of requests increase database performance? What problems can increased concurrency cause?

74) Why should one tune the performance of their web application? Why shouldn't one tune the performance of their web application?

75) How do you determine which parts of your web application that you should tune? Why is it important to test and tune your web application at high system loads? What are the common resource bottlenecks? Of these, which resource is usually the bottleneck for web applications? What is the 80/20 (or 90/10) rule?

76) How might you try to increase the performance of a CPU-bound web application? A memory-bound web application? An I/O-bound web application?

77) What is primitive analysis?

78) What factors influence how long it takes to read or write a program's instance variable? What factors influence how long it takes to read or write a data element in a database?

79) When measuring the performance of a web application, why is it important to log requests and timing information to memory rather than to disk?

80) How can increasing the concurrency of a web application eliminate I/O as a performance bottleneck? What are the advantages and disadvantages of batching I/O operations together for scalability and performance?

81) Describe several approaches to reduce browser-to-server network I/O.

82) Aside from increasing the number of executing threads, how can one increase the effective concurrency of a web application?

83) What are the advantages and disadvantages of web services using SOAP compared to traditional Remote Procedure Call mechanisms?

84) What is WSDL? How do you use a WSDL file to deploy or use a web service?

85) What is Hibernate? What are the advantages and disadvantages of Hibernate compared to the BeanFactory?

86) Data is often located far from the source of a request or far from a fast computer processor. Where should one perform a computation? Specifically, what are the advantages of moving a computation to where the data is located? What are the advantages of moving the data instead?

87) What is a persistence framework? What are the challenges in creating one?

88) What is the key conceptual difference between the Hibernate Query Language and SQL?

89) What are the advantages and disadvantages of Python Django compared to Java Servlets?