# CSCI 604 Distributed Computer Systems Architecture

# Unit 4

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| Teacher: | George Rudolph |  |
| Subject: | OS Support and Web Services |  |
| Objective 1: | Discuss what support the OS provides for distribution |  |
| Objective 2: | Describe OS architecture for processes, threads and communication |  |
| Objective 3: | Discuss OS-level virtualization |  |
| Objective 4: | Describe Web Services using IDL and XML |  |
| Objective 5: | Discuss Coordination of Services |  |

## C Level Maximum 50 points

Your written answers may include pictures, drawings, short phrases instead of sentences, as long as the answer is clear and says what you mean.

1. Outline the tasks of encapsulation, concurrent processing, protection, name resolution, communication of parameters and results, and scheduling in the context of the UNIX file service (or that of another kernel that is familiar to you). (10 pts)
2. Why are some system interfaces implemented by dedicated system calls (to the kernel), and others on top of message-based system calls? (5pts)
3. Should signal (software interrupt) handlers belong to a process or to a thread? (5pts)
4. Explain the advantage of copy-on-write region copying for UNIX, where a call to fork is typically followed by a call to exec. What should happen if a region that has been copied using copy-on-write is itself copied? (10 pts)
5. Explain what the kernel must provide for a user-level implementation of threads, such as Java on UNIX. (10 pts)
6. From your understanding of the Xen approach to virtualization, list specific features of Xen that can support the XenoServer architecture. For each feature, give a sentence or two that indicates how it contributes to the synergy between virtualization and cloud computing. (10 pts)
7. Outline a comparison of the request-reply protocol as described in Section 5.2 with the implementation of client-server communication in SOAP. State two reasons why the use of asynchronous messages by SOAP is more appropriate over the Internet. To what extent does the use of HTTP by SOAP reduce the difference between the two approaches? (10 pts)
8. Illustrate the contents of a SOAP Request message and corresponding Reply message in the Election service example of Exercise 5.11, using the pictorial version of XML as shown in Figure 9.4 and Figure 9.5.
9. Outline the five main elements of a WSDL service description. In the case of the Election service defined in Exercise 5.11, state the type of information to be used by the Request and Reply messages – does any of this need to be included in the target namespace? (10 pts)
10. Explain what a security policy is and what the corresponding mechanisms are in the case of a multiuser operating system such as UNIX. (5pts)
11. Explain the role of a servlet container in the deploying of a web service and the
12. execution of a client request. (5pts)
13. Outline the replication scheme used in UDDI. Supposing that vector timestamps are used to support this scheme, define a pair of operations for use by registries needing to exchange data. (10 pts)
14. Briefly explain why UDDI can be described as being both a name service and a directory service, mentioning the types of enquiries that can be made. The second ‘D’ in the name UDDI refers to ‘discovery’ – is UDDI really a discovery service?

## B Level 30 points—Choose Two

1. Suggest a scheme for balancing the load on a set of computers. You should discuss:
   1. what user or system requirements are met by such a scheme;
   2. to what categories of applications it is suited;
   3. how to measure load and with what accuracy;
   4. how to monitor load and choose the location for a new process.

Assume that processes may not be migrated.

1. A file server uses caching and achieves a hit rate of 80%. File operations in the server cost 5 ms of CPU time when the server finds the requested block in the cache, and an additional 15 ms of disk I/O time otherwise. Explaining any assumptions you make, estimate the server’s throughput capacity (average requests/sec) if it is:
   1. single-threaded;
   2. two-threaded, running on a single processor;
   3. two-threaded, running on a two-processor computer.
2. A client makes RMIs to a server. The client takes 5 ms to compute the arguments for each request, and the server takes 10 ms to process each request. The local OS processing time for each send or receive operation is 0.5 ms, and the network time to transmit each request or reply message is 3 ms. Marshalling or unmarshalling takes 0.5 ms per message. Estimate the time taken by the client to generate and return from two requests:
   1. if it is single-threaded, and
   2. if it has two threads that can make requests concurrently on a single processor.

Is there a need for asynchronous RMI if processes are multi-threaded?

1. Define a Java interface for the Election service suitable for use as a web service. State why you think the interface you defined is suitable. Explain how a WSDL document for the service is generated and how it is made available to clients.
2. As an alternative to #4, define and implement the Election Service, and show an example of it running. You may use Mule or any other tools you find suitable.
3. A coordination protocol could be carried out in order to coordinate the actions of web services. Outline an architecture for a protocol that is
   1. centralized, and
   2. distributed.

In each case, describe the interactions needed to establish coordination between a pair of web services.

## A Level 20 points—Choose One

1. Compare the worker pool multi-threading architecture with the thread-per-request architecture. Extend both architectures to parallel cluster computing with processes (worker pool multi-process and process-per-request) instead of threads. Which architecture is better when considering threading? When considering cluster processes?
2. Explain the main differences between TLS and XML security. Highlight why XML is particularly suitable for the role it plays, in terms of these differences.
3. Documents protected by XML security may be signed or encrypted long before anyone can predict who will be the ultimate recipients. What measures are taken to ensure that the latter have access to the algorithms used by the former? Are these measures secure and effective?

F: < 60 D: < 70 C: < 80 B: < 90 A: >= 90