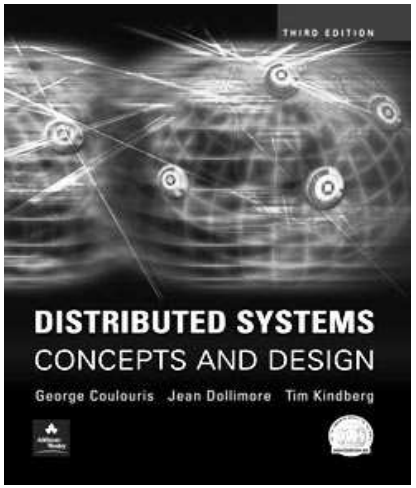
Exercises for Chapter 1:

Characterization of Distributed Systems



From **Coulouris, Dollimore and Kindberg**

Distributed Systems:

Concepts and Design

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Exercise 1.1

- Give five types of hardware resource and five types of data or software resource that can usefully be shared. Give examples of their sharing as it occurs in practice in distributed systems.

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Exercise 1.2

- How might the clocks in two computers that are linked by a local network be synchronized without reference to an external time source? What factors limit the accuracy of the procedure you have described? How could the clocks in a large number of computers connected by the Internet be synchronized? Discuss the accuracy of that procedure.

Exercise 1.3

- A user arrives at a railway station that she has never visited before, carrying a PDA that is capable of wireless networking. Suggest how the user could be provided with information about the local services and amenities at that station, without entering the station's name or attributes. What technical challenges must be overcome?

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Exercise 1.4

- What are the advantages and disadvantages of HTML, URLs and HTTP as core technologies for information browsing? Are any of these technologies suitable as a basis for client-server computing in general?

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Exercise 1.5

- Use the World Wide Web as an example to illustrate the concept of resource sharing, client and server.

  Resources in the World Wide Web and other services are named by URLs. What do the initials URL denote? Give examples of three different sorts of web resources that can be named by URLs.

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Exercise 1.6

- Give an example of a URL.

  List the three main components of a URL, stating how their boundaries are denoted and illustrating each one from your example.

  To what extent is a URL location transparent?

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Exercise 1.7

- A server program written in one language (for example C++) provides the implementation of a BLOB object that is intended to be accessed by clients that may be written in a different language (for example Java). The client and server computers may have different hardware, but all of them are attached to an internet. Describe the problems due to each of the five aspects of heterogeneity that need to be solved to make it possible for a client object to invoke a method on the server object.

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Exercise 1.8

⌘ An open distributed system allows new resource sharing services such as the BLOB object in Exercise 1.7 to be added and accessed by a variety of client programs. Discuss in the context of this example, to what extent the needs of openness differ from those of heterogeneity.

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Exercise 1.9

- Suppose that the operations of the BLOB object are separated into two categories – public operations that are available to all users and protected operations that are available only to certain named users. State all of the problems involved in ensuring that only the named users can use a protected operation. Supposing that access to a protected operation provides information that should not be revealed to all users, what further problems arise?

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Exercise 1.10

- The INFO service manages a potentially very large set of resources, each of which can be accessed by users throughout the Internet by means of a key (a string name). Discuss an approach to the design of the names of the resources that achieves the minimum loss of performance as the number of resources in the service increases. Suggest how the INFO service can be implemented so as to avoid performance bottlenecks when the number of users becomes very large.

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Exercise 1.11

- List the three main software components that may fail when a client process invokes a method in a server object, giving an example of a failure in each case. Suggest how the components can be made to tolerate one another's failures.

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Exercise 1.12

- A server process maintains a shared information object such as the BLOB object of Exercise 1.7. Give arguments for and against allowing the client requests to be executed concurrently by the server. In the case that they are executed concurrently, give an example of possible 'interference' that can occur between the operations of different clients. Suggest how such interference may be prevented.

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Exercise 1.13

- A service is implemented by several servers. Explain why resources might be transferred between them. Would it be satisfactory for clients to multicast all requests to the group of servers as a way of achieving mobility transparency for clients?

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