Study Guides on Computer Networks and Distributed Systems

Introduction to Distributed Systems

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Context

Study Guides aim to help students in their preparation of the courses on CN and DS, they include context explanations, technology uses, textbook comments and emphasize significant structures and concepts. Study Guides include a Questionnaire related to the topics explained each week, these are meant to be completed by each student and submitted about two weeks later as a way to help students plan their *initial* study of each chapter.

The Powerpoint presentations that we use in lectures convey concepts that would otherwise be difficult to reproduce on the board, summarize the essential concepts and articulate them, however, they should always be *worked* alongside the relevant textbook sections and students class notes, without these, the presentations will result awkward and too contrived.

The terminology of Distributed Systems (DS) used in this chapter is very broad, one of the objectives of this chapter is to be able to understand the meaning and the significance of each concept in context, for example, *concurrency* in DS is normally understood as *parallelism* since the programs that work on shared data structures usually run on physically separated computers (Networked computers).

The nature of your work in this chapter consists, among other things, in reading it and skimming other chapters relevant sections where those concepts are explained in more depth, which will serve you to clarify your understanding, for example, in pg. 2, the no global clock characteristic of DS takes you to chapter 14 where you will find the aspects of DS related to time. Particularly, when a concept might sound somewhat artificial, it is very advisable to deepen your study a little on it by using other sections of the book until you understand it. The examples of section 1.2 and the tendencies explained in section 1.3 will help you grasp the nature of DS in a more contextualized manner.

The main objective a of a DS is *resource sharing*, that is stated in section 1.4; here we are presented a few of the most used concepts in DS: service, server, client, process. For further study, you may want to explore the textbook by Peterson and Davie (Computer Networks) that presents these important concepts in chapter 1.
Some of the DS challenges explained in 1.5 are known from our course on Computer Networks, specifically we have already studied the error detecting and correcting codes, the concept of scalability (Scalable connectivity in CN), Quality of Service, but, others will be brand new: heterogeneity, transparency and concurrency.

Questionnaire

1. Which DS transparencies apply to the TCP protocol?

2. Can you explain what the *end-to-end* argument is in networking and distributed systems? Do you think that TCP represents the essential idea in that argument? Consult the textbook by Peterson and Davie, chapter 1.

3. Can distributed systems be built upon *non-reliable* IP infrastructures?

4. Which one of the following is the main goal of Distributed Systems?
   o Concurrency
   o Lack of a global clock
   o Resource sharing
   o That failures be independent

5. The following definition of Distributed System is from Leslie Lamport's paper titled Time, Clocks and the Ordering of Events in a Distributed System: *"A distributed system consists of a collection of distinct processes which are spatially separated, and which communicate with one another by exchanging messages. A network of interconnected computers, such as the ARPA net, is a distributed system. A single computer can also be viewed as a distributed system in which the central control unit, the memory units, and the input-output channels are separate processes. A system is distributed if the message transmission delay is not negligible compared to the time between events in a single system."*

   a. According to the preceding definition, what is the most important characteristic of a Distributed System?

   b. What is the most uncertain aspect of a Distributed System included in this definition?

   c. What are the essential three key words in the definition?

6. How do the components of a DS coordinate their actions?
   o By sharing a logical clock
   o By sharing an atomic-precision clock
   o By exchanging messages

7. The components of a DS are installed in:
   o Isolated computers
   o Networked computers in a LAN with TCP/IP
   o Networked computers in any type of internetwork

8. What are the differences between mobile and ubiquitous computing?

9. You are asked to provide a TCP-based network service in your organization's network and the server location is to be found out by using UDP, devise a way to do that and explain it with detail.

10. Choose three aspects of a DS that must be transparent to the application programmer and explain why it is convenient that they remain transparent.

11. What's the difference between an open system and a open-source system? Provide one example of each.

12. Contrast the concepts of concurrency and parallelism. Discuss whether the Java language offers support for either.

13. Why is QoS important in the design of present-day Distributed Systems?

14. List the most important transparencies that apply to the Mobile IP technology

15. Solve the following exercises from DK (Coulouris, Dollimore, Kindberg, Blair)

Ex 1.4:

Ex 1.5:

Ex 1.11: