Cover sheet with information to the invigilator

UNIVERSITY OF SKÖVDE

School of Information Technology

Course Distributed Systems G1F

Sub-course

Course code IT413G

Credits for written examination: 4 HP

Date 2023-12-15

Examination time 14.15-19.30

Available teachers Erik Billing

Available on phone number: 070-2996417

Visiting the examination ☒ Yes, at 15.30

☐ No

Aids and other information for invigilators

Calculator ☐ Provided by the University

☐ Student's own calculator

☒ Not allowed

Writing paper ☒ Lined

☐ Squared

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Instructions to examinations responsible

All examination documents are to be handed in at Reprocentralen.

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OF SKÖVDE

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WRITTEN EXAMINATION

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Examination responsible Erik Billing
Examiner Simon Butler

Aid at the exam/appendices Swedish-English / English-Swedish dictionary

Other

Enter answers directly in the exam, where applicable.
Enter your name and number on every page of the exam.
Use clear handwriting, unreadable answers will be ignored.

Instructions

- ☒ Answer inside exam if possible, use separate sheets if you need space.
- ☒ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Examination results will be made public within 18 working days.

Good luck!

Total number of pages: 12

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Note:

The examination includes multiple selection and multiple-choice questions. You can choose only one correct option for multiple-choice questions, which use circle icons. To pass a multiple-choice question, you should have selected only one correct option. For multiple selection questions, which use square icons, you may select several options. To pass a multiple-selection question, you must select all correct options, and you should not have selected any wrong options. Enter your answers to multiple choice/selection questions directly into the exam paper. Answers given otherwise do not count. Select an option by drawing a cross in the box/circle. If you change your mind, fill-in the whole box/circle, as illustrated below.

Properly completed multiple-**selection** responses: 

Amended multiple-**selection** response: 

Properly completed multiple-**choice** responses: 

Amended multiple-**choice** response: 

Rating:

- The maximum number of points is indicated to the right of each question. Note that most questions have sub-questions (a, b, c, ...) and the indicated points refer to the total maximum score for that question, given perfect answers to all sub-questions.
    - Multiple choice questions are awarded with full points for a correct answer or zero points otherwise.
    - Unless otherwise specified, multiple selection questions are awarded with 1 point for each correct selection and -1 point for each incorrect selection. The maximum number of points may be higher than the number of correct selections and is awarded to completely correct answers. There are no multiple selection questions will zero correct options. The total score cannot be less than zero.
    - Questions where you are asked to match items in two lists are awarded with 1p for each correct match. The maximum number of points may be higher than the number of correct matches and is awarded to completely correct answers.
- The total number of points on the exam is 90. After assessment, the points will be translated to a grade as follows: 81→A, 72→B, 63→C, 54→D, 45→E.
- The above grade is awarded for the course under the assumption that you have passed the Laboratory and Project assignments of the course.

Name: _____ Personnummer: _____

QUESTION 1 – Definition of Distributed systems

15 p

a) According to the course literature by Coulouris et al., what is the definition of a distributed system? (the exact formulation is not important, but make sure to include only the right aspects).

b) Name the eight challenges of distributes systems have been discussed in the course.

c) Select four challenges from your answer to (b) and describe them in detail.

Name: _____ Personnummer: _____

QUESTION 2 – Replication

10 p

a) Four different reasons for using replication have been discussed in the course. Describe these four reasons so that it is clear how replication can constitute a solution.

b) Consistency is often described as a balance or tradeoff. Explain why this is and make clear the difference extremes that we must find a tradeoff between.

Name: _____ Personnummer: _____

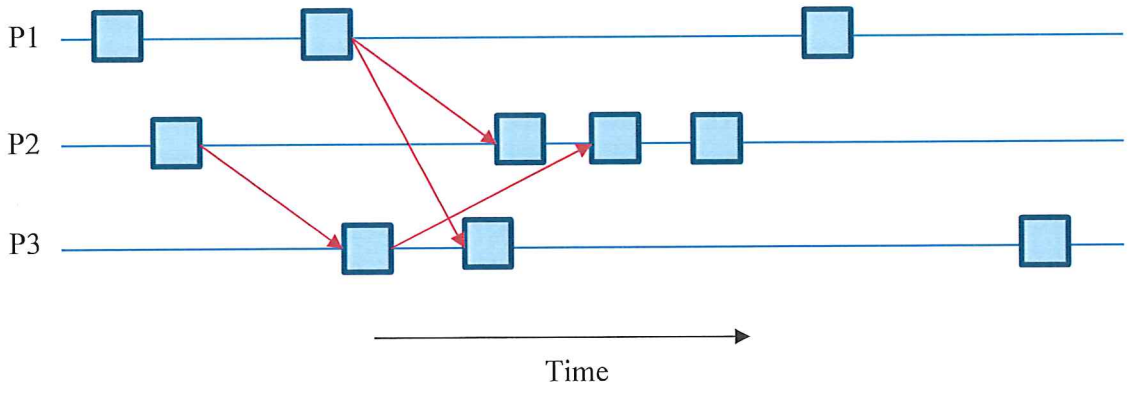
QUESTION 3 – Logical clocks

9 p

a) Assume that you are implementing a logical lock to achieve global order in a distributed system. Where in the implementation should this functionality be placed (select a single answer):

○	In the application code
○	In a for-loop
○	In the network protocol
○	In a message passing middleware
○	In the operating system

b) In the diagram of events shown below where events are depicted as small squares, and **messages** are shown as **arrows,** what is the Lamport timestamp of each event? P1, P2, and P3 represent three different processes.



Name: _____ Personnummer: _____

QUESTION 4 – System models **8 p**

a) Describe the three types of system models discussed in the course.

b) Which type of system models are most important?

Name: _____ Personnummer: _____

QUESTION 5 – Interprocess communication

11 p

a) The publish-subscribe pattern used for interprocess communication have been discussed in three different variants. Name and describe each variant, the different parts (actors) and their relations should be clearly visible. *You are encouraged to visualize your answer with a drawing.*

b) In which situations is the publish-subscribe pattern suitable:
(multiple correct answers may be selected)

- ☐ Two way communication with a single client
- ☐ Two way communication with many clients
- ☐ One way communication from a server to many clients
- ☐ One way communication from many clients to a server
- ☐ As a replacement for remote procedure calls

Name: _____ Personnummer: _____

QUESTION 6 – Representational state transfer **6 p**

Which is true for representational state transfer (REST):
(multiple correct answers may be selected)

- ☐ REST is a popular software standard for web applications
- ☐ REST is a pattern for client-server communication
- ☐ REST applications should be designed to allow caching
- ☐ In RESTful applications, each resource is identified using a unique URL
- ☐ RESTful applications often implement user sessions on the server

Name: _____ Personnummer: _____

QUESTION 7 – Failures

3 p

Communication failures can happen for three different reasons. Briefly describe these three reasons.

Name: _____ Personnummer: _____

QUESTION 8 – Security

9 p

Describe how digital signatures work, including how they are applied to a document or message, and how the signature can be verified.

Name: _____ Personnummer: _____

QUESTION 9 – Cloud services

9 p

The course discusses three common types of service delivery in cloud computing: IaaS, PaaS, and SaaS. Describe each of the three levels of service in terms of the resources the customer receives access to and the types of services the customer is able to deliver. You should illustrate your answers with examples for each case.

Name: _____ Personnummer: _____

QUESTION 10 – Networking

10 p

(a) The protocol stack discussed in the course consists of five layers. The application layer is at the top and allows applications to communicate with each other. Name each of the other four layers and give a brief description of the role or purpose of the layer.

(b) Network packets are conventionally considered to have three component parts: a header, a payload and a trailer. Explain what information is contained in the header, the payload, and the trailer.