Mittuniversitetet
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The Complete Studyguide for the Course DT141G Operating Systems

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1 Aims

The overviewing aim of the course is to give the student an understanding of how computer systems work, this includes all systems from a mobile phone or router to a high-performance server. Focus is on the operating system which connects hardware with software and ultimately with its human users.

More specifically, after successfully completing this course you should have fulfilled the following aims:

- You can account for the fundamental function of the main logical components of an operating system, e.g. memory and process management, and explain their relations.
- You understand the operating system interface against hardware, software, and users.
- You are be able to explain the most common problems of resource allocation and synchronization, and be familiar with common solutions to these problems.
- You can identify and understand the importance of some key parameters for performance in an operating system.

2 Course overview

The book used for this course is *Operating System Concepts* by Silberschatz, Galvin, and Gagne [1]. This book provides a sufficient foundation for students in Computer Science. This course covers most parts of the book. Note that this book differs a little from another edition of the same book. The one above is the "International Student Version", and is a cheaper version of the book. However, in this course we will also talk about two chapters from the standard edition [2]. These two chapters are Chapter 16 "Virtual Machines" and Chapter

17 “Distributed Systems”. These areas are interesting for you, but we will not include them in the examination.

The aims of the course are examined using a written exam. There are assignments of both theoretical and laboratory nature, although most of them are theoretical, which are for your learning of the material. They do help you to prepare for the exam. There is a strong correlation between students who pass the exam and students who have done the assignments before taking the exam.

The assignments are numbered starting from zero, this number is prefixed with ‘T’ for theoretical and ‘L’ for laboratory assignments. Each assignment instruction, for both laboratory and theoretical ones, contains reading instructions. These reading instructions are also given here, in the following sections, along with the reading instructions for the lectures.

The only assignment which is mandatory is T0, this assignment must be handed-in within the first three weeks of the course. See Section 3 for details. The other assignments are awarded bonus points if handed in and passed before the deadline. After the deadline the assignment will be covered during a tutoring session, and hence no solutions will be accepted for submission after that.

The lectures aim to give an overview of the topic, to ease your reading of the material, and to focus on the parts usually found most difficult by students. This means you will still *have to read the book* even if you attend the lectures. The study stategy recommended for this course is to read the material during the corresponding week, attend the corresponding lecture, then do the assignment. Should any problems arise, then you bring those up during one of the tutoring sessions.

A timetable for the course is given in Table 1 on the next page. The table is adapted for a study rate at 50 percent and should be used as an indicator of when to have read what.

2.1 Introductory lecture

The lecture covers the course structure and organisation. It aims to provide an overview of tutoring and examination. To complete this lecture you should look through the course platform and all course material.

In addition to this the lecture also gives an overview of the history of UNIX, i.e. *The Creation of the UNIX Operating System* [3].

2.2 Lectures on system overview and system structure

This lecture introduces operating systems and describes the general structure. It gives an overview of Chapters 1 and 2 in [1, 2, 4].

2.3 T0 Overview

This assignment covers part one of the book [1, 2], i.e. “Overview”. This part contains the chapters “Introduction” and “System Structures”. Thus, before beginning with this assignment you should have read these chapters at least once.

Course Week	Teaching and Course Work
1	Introductory lecture. Lecture on system overview. T0 Overview. Tutoring session.
2	Lecture on system structure. Tutoring session.
3	Lectures on processes, part I. Lectures on processes, part II. Lectures on processes, part III. Lectures on processes, part IV. T1 Processes. Tutoring session.
4	Lectures on memory, part I. T2 Memory. Lectures on memory, part II. L3 Paging Algorithms. Tutoring session.
5	Lectures on storage, part I. T4 Storage. Lectures on storage, part II. Tutoring session.
6	Lecture on distributed systems. Lecture on various operating systems. Tutoring session.
7	Lecture on virtual machines. Tutoring session.
8	Independent study for exam.
9	Independent study for exam. Final tutoring session.
10	Final exam.

Table 1: A timetable for the course given at a study rate of 50 percent.

2.4 Lectures on process management

1. This lecture covers the first half of process management. It gives an overview of Chapter 3 "Process Concept" in [1]

2. This lecture covers threads. It gives an overview of Chapter 4 "Multithreaded Programming" in [1]

3. This lecture covers process scheduling and its algorithms. It gives an overview of Chapter 5 "Process Scheduling" in [1].

4. This lecture covers the second half of the topic process management. It gives an overview of Chapter 5 "Process Synchronization" and Chapter 7 "Deadlocks" in [1, 2], or Chapter 6 "Synchronization" and Chapter 7 "Deadlocks" in [4].

2.5 T1 Processes

This assignment covers part two in the course book [1, 2]. As such, before attempting this assignment you should have read chapters 3–7, these cover process management and process coordination.

2.6 Lectures on memory management

1. This lecture will give an overview of physical memory management. It gives an overview of Chapter 8 "Memory-Management Strategies" in [1]

2. This lecture will give an overview of memory management. I.e. it gives an overview of Chapter 9 "Virtual Memory" in [1, 2], or Chapter 9 "Virtual-Memory Management" in [4].

2.7 T2 Memory

This assignment covers part three of the book [1, 2], i.e. memory management. Hence, before attempting this assignment you should have read chapters 8 and 9, "Memory-Management Strategies" and "Virtual-Memory Management", respectively.

2.8 L3 Paging Algorithms

Before attempting this assignment you should have read Chapter 9 "Virtual-Memory Management" in [1, 2].

The following tools from the UNIX-like command-line can be of use:

- cat(1),
- wc(1), specifically options -w and -l; and
- grep(1).

Read the manual pages to get an overview of what these commands do.

2.9 Lectures on storage management

1. This lecture gives an overview of the technicalities of the file system. This is covered by Chapter 10 "File System" [1].

2. The lectures gives an overview of Chapter 11 "Implementing File-Systems" in [1].

2.10 T4 Storage

This assignment covers part four of the book [1, 2], i.e. storage management. Before attempting this assignment you should have read chapters 10–13, "File System", "Implementing File-Systems", "Mass-Storage Structure" and "I/O Systems", respectively.

2.11 Lecture on distributed systems

This lecture gives a short introduction to distributed systems. It gives an overview of Chapter 17 in [2]. It also contains some details from chapters 16–18 in [4]. The lecture also covers material from "An Overview of Non-Uniform Memory Access" [5].

Note that this will not be coved by the exam. However, it is an interesting topic for your future career, so you are recommended to read this material.

2.12 Lecture on various operating systems

This lectures gives an overview of BSD, GNU/Linux and the Windows operating systems. I.e. it covers Chapters 18, 19 and Appendix A in [2] or Chapters 16, 17 and Appendix A in [1].

2.13 Lecture on virtual machines

This lecture covers virtual machines. It gives an overview of Chapter 16 in [2].

Note that this will not be coved by the exam. However, it is an interesting topic for your future career, so you are recommended to read this material.

3 Examination

As noted above the course is examined using an introductory theory assignment, "T0 Overview", and a written exam. The theory assignment is graded pass (P) or fail (F) and is reported as I101 in Ladok. The final exam is graded A, B, C, D, E for pass or F, Fx for fail. The exam is reported as T101 in Ladok, and it corresponds to 7.5 credit points.

To finish the course you need to pass the above and the grade of the exam will be the final grade on the course total.

Each completed assignment, which is correct and handed in before deadline, will be awarded one bonus point for the exam.

4 What if I'm not done in time?

The deadlines on this course are of great importance. You must have completed the first assignment, *T0 Overview*, within its deadline. If you do not do this you will be deregistered from the course and your place will be open to other applicants.

The other theory and laboratory assignments must be handed in before deadline for a chance to collect bonus points. These assignments are graded sometime after deadline and at the latest before the first exam. This depends on the work load of the tutor. The correct solutions will be covered in detail during the first tutoring session after deadline, hence the inurgency to grade them quickly and if you miss the deadline you have missed the possibility.

Note that the bonus points are only valid during the first exam.

No tutoring is planned after the end of the course, i.e. after the last tutoring session scheduled in the course schedule. If you are not done with your assignments during the course and want to be guaranteed tutoring you have to reregister for the next time the course is given. Reregistration is a lower priority class of applicants for a course, all students applying for the course the first time have higher priority – this includes students in reserve places too.

A final note, if you feel that you will not be done with the course on time, it is better to stop the course at an early stage. If you register a break within three weeks of the course start, you will be in the higher priority class of applicants the next time you apply for the course. You can register such a break yourself in the Student Portal. Please contact the Student Office for further information regarding this early break from the course.

References

[1] Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne. *Operating System Concepts*. 9th ed. International Student Version. Hoboken, N.J.: John Wiley & Sons Inc, 2013.

[2] Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne. *Operating System Concepts*. 9th ed. Hoboken, N.J.: John Wiley & Sons Inc, 2013.

[3] Bell Labs. *The Creation of the UNIX Operating System*. 2002. URL: `http://www.bell-labs.com/history/unix/`.

[4] Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne. *Operating System Concepts*. 8th ed. International Student Version. Hoboken, N.J.: John Wiley & Sons Inc, 2009.

[5] Christoph Lameter. "An Overview of Non-Uniform Memory Access". In: *Communications of the ACM* 56.9 (2013). Use the PDF-version of the article. URL: `http://cacm.acm.org/magazines/2013/9/167139-an-overview-of-non-uniform-memory-access/fulltext`.