TENTAMEN / *EXAM*

TDDB68/TDDE47

Processprogrammering och operativsystem /
Concurrent programming and operating systems

2020-06-09 Part C

Instructions for part C (also see the instructions on the web page):

- Answer the questions below using a word processing tool of your choice and convert it to a PDF.
- Submit your solution in Lisam no later than 18.30 (20.00 if you have extended exam time).
- You are not allowed to copy text from other sources. Urkund will be used to check for plagiarism.
- Motivate answers clearly and elaborate your reasoning. You should demonstrate that you are able to *identify concurrency problems, design solutions to these problems and analyse trade-offs of design choices as* well as to *describe and analyse different requirements, functionality, and architectures for operating systems*.
- Keep to the subject and be precise in your statements. Elaborating on a topic does not mean adding random discussions with very long text. Except for the first question where the pseudocode might take up some space, it is recommended to keep the answer to *at most* one page per question.

1. **Synchronization** (3p)
   Describe the concept of lock-free synchronization. What are the pros/cons of this approach?

2. **Deadlocks** (3p)
   Explain the concept of deadlocks. Why do they occur? What are ways of dealing with this problem, and what are the pros/cons of each these approaches? Describe the possible solutions from two different perspectives: application programmer and designer of the support environment (e.g., the operating system or the programming language).

3. **Memory management** (3p)
   Consider a page-based virtual memory system with a page size of $2^{12} = 4096$ bytes where virtual memory addresses have 32 bits. If using *multi-level paging*, determine how many levels of paging are required (assuming each table must fit in one page), and describe the structure of the virtual addresses (purpose, position and size of its bit fields). What is the maximum size of all page tables that could in theory be used by one process?