NTNU – Trondheim
Norwegian University of Science and Technology

Department of Computer and Information Science

Examination paper for TDT4186 Operating Systems

Academic contact during examination: Mads Nygård

Phone: 905 96 534

Examination date: 22nd of May 2015

Examination time (from-to): 09:00-13:00

Permitted examination support material:

D: No printed or hand-written support material is allowed. A specific basic calculator is allowed.

Other information:

Short and concise answers are wanted for each exercise.
Read the text very carefully, and consider what is actually asked for in each exercise.
If you think that some information is missing in the text, describe the assumptions that you make.
Each of the five exercises counts equally, and each of the four sub-exercises counts equally.

Language: English

Number of pages (front page excluded): 2

Number of pages enclosed: 0

Checked by:

_____

Date   Signature

Exercise 1: Operating Systems

a) Indicate shortly why we need operating systems – and what distinguishes them from other large software systems

b) Discuss shortly different types of operating systems typically in use – and what distinguishes them from each other

c) Indicate shortly typical models for process states in operating systems – and what the difference is between process switches and mode switches

d) Discuss shortly different ways of organizing operating systems – and advantages and disadvantages with microkernel based operating systems

Exercise 2: Process Synchronization

a) Indicate shortly what mutual exclusion is – and why operating systems have to offer mechanisms for it

b) Discuss shortly the difference between active and passive waiting in operating systems – and when we have to or may use each of the two variants

c) Discuss shortly the differences between deadlock prevention, deadlock avoidance and deadlock detection – and advantages and disadvantages with each of the three ways of handling deadlocks

d) Describe quite concisely how a bounded buffer may be implemented with monitors

Exercise 3: Memory Management

a) Indicate shortly what virtual memory is – and why operating systems have to offer mechanisms for it

b) Discuss shortly how buddy systems work – and in which ways they may be considered to combine dynamic partitioning and fixed partitioning in operating systems

c) Discuss shortly why page replacement algorithms play such an important role in operating systems – and indicate shortly some good page replacement algorithms in existing operating systems

d) Describe quite concisely how the U-Clock / Clock page replacement algorithm works

Exercise 4: Process Scheduling

a) Indicate shortly some different goals for process scheduling – and why real time systems go for other goals than non-real time systems

b) Discuss shortly some extra challenges that multiprocessor architectures and multicore architectures respectively represent in operating systems – and indicate shortly some relevant ways to solve these extra challenges

c) Discuss shortly what priority inversion means – and when and why this typically is used

d) Describe quite concisely how the highest response ratio next algorithm works

Exercise 5: I/O Management

a) Indicate shortly some different ways to serve parallel disk requests – and some selected result parameters influenced by this

b) Discuss shortly the differences between using contiguous file allocation, chained file allocation and indexed file allocation – and advantages and disadvantages with each of the three different ways to handle disk allocation

c) Discuss shortly the differences between explicit I/O stemming from program code in user processes and implicit I/O stemming from system needs related to virtual memory – and indicate shortly why the least recently used policy is more relevant with explicit I/O than with implicit I/O

d) Describe quite concisely how the frequency based replacement policy works related to I/O caching