Operating System Concepts
Final Exam

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Class hours: 14:20-17:20 Wednesday Course Nr. 901 49000
Room: BL 103 Fall 2015

Student name: Student ID:

1. What is a clustered computer system ? (5pts/5)

2. Please explain a challenge in synchronization that is unique to clustered system, but not to other types of multiprocessor systems. (5pts/10)

3. Explain why Java programs running on Android systems do not use the standard Java API and virtual machine. (5pts/15)

4. What is the *init* process in UNIX and Linux ? (5pts/20)
   Please explain its role and operation in system booting. (5pts/25)

5. Using Amdahl's Law, calculate the speedup gain of an application that has 80 percent parallel components for

(a) 4 processing cores (3pts/28)

(b) 16 processing cores. (3pts/31)

6. Consider the following code segment:

```
pid_t p;
p = fork();
if (p == 0) {
   fork();
}
else if (p < 0) {
   thread_create(…);
   fork();
}
fork();
```

(a) Please discuss how many unique processes can be created ? (4pts/35)

(b) Please discuss how many unique threads can be created ? (5pts/40)

7. Consider two processes P1, P2, and P3, with periods 50ms, 75ms, and 80ms respectively and periodical computation times 15ms, 10ms, 40ms respectively.

   (a) Can these three processes be scheduled using rate-monotonic scheduling ? Illustrate your answer using a Gantt chart. (6pts/46)

   (b) Can these three processes be scheduled using EDF scheduling ? Illustrate your answer using a Gantt chart. (6pts/52)

8. Assume that two tasks A and B are running on a Linux system with nice values +5 and -5 respectively. Using the CFS scheduler as a guide, describe how the respective values of *vruntime* vary between the two processes if A is I/O-bound and B is CPU-bound. (4pts/56)

9. Explain the disadvantage of implementing synchronization primitives by disabling interrupts in a multi-core computer system. (5pts/61)

10. Describe how to implementing a mutex lock without busy waiting while with guarantee on bounded waiting. (5pts/66)

11. Propose a method for solving the dining philosophers problem without causing starvation. (5pts/71)

12. Consider the following snapshot of a system:

	Allocation				Max			
	A	B	C	D	A	B	C	D
P0	3	0	1	4	5	1	1	7
P1	2	2	0	1	3	2	1	1
P2	3	1	1	2	3	3	1	3
P3	0	5	0	1	4	5	1	1
P4	3	3	1	2	6	3	2	5

Using the banker's algorithm, determine whether or not each of the following states is safe. If it is, illustrate a safe sequence. Otherwise, illustrate why the state is unsafe.

(a) Available = (0,3,0,1) (4pts/75)

(b) Available = (1,1,1,3) (4pts/79)

13. Please explain the technology of stable storage in database management. (5pts/84)

14. Consider the following page reference string:

1,2,4,7,2,5,1,4,6,5,7,1,0,5,4,0,2,3,0,5

Assuming demand paging with 5 frames, please show the frame contents of the pages after each page reference for the following page-replacement algorithms.

(a) LRU replacement (6pts/90)

(b) LFU algorithm, i.e., counting algorithm that replaces page with the smallest count. (5pts/95)

15. Consider a paging system with the page table stored in memory and a TLB with 95% of all page table references found in the TLBs. Suppose memory access time is 20 nanoseconds and TLB checking costs 2 nanoseconds. What is the effective memory access time? (5pts/100)