CSL862 Major Exam
Advanced Topics in Software Systems
Sem I, 2013-14
November 23, 2013

Answer all 13 questions   Max. Marks: 68

1. Consider the following code from a microkernel driver, as given in the paper:

```
driver thread:
do
  wait for (msg, sender) ;
  if sender = my hardware interrupt
  then read/write i/o ports ;
        reset hardware interrupt
  else . . .
od .
```


a. At what privilege level is this code run? [2]

b. What are the advantages of doing this, over traditional monolithic kernels? [4]

c. How does a microkernel ensure security/protection? Explain using this example. [4]

2. In the L3 microkernel, explain why direct message copy is better than:

a. Simple message transfer using pipes or message queues, as on monolithic kernels like Linux. [4]

b. Sharing user level memory between client and server. [4]

3. Using the example of CPU management, show how resource management is done differently in an exokernel (compared to monolithic kernels like Unix), and what are the resulting advantages. Then use the example of memory management. [10]

4. Why does Aegis (the exokernel) need to provide some guaranteed mappings to its process? Can this be avoided? [4]

5. Why did the exokernel decide to use two different calls for synchronous and asynchronous control flow transfers (Scall and Acall)? [4]

6. Compared to the translation validation paper, what extra information can a parameterized equivalence checker use to automatically prove the correctness of optimizations? [4]

7. Consider the relation with three columns, {parent, name, child}, representing a directory tree relation (as also given in Figure 2 of the Concurrent Data Representation Synthesis paper). Draw all the different decompositions that can possibly represent this relation, assuming single-threaded execution (no concurrency). Decompositions that are isomorphic up to the choice of data structures for the map edges are counted as a single decomposition. i.e., two decompositions are different only if their structures are different. How many decompositions did you draw? [10]

8. Explain how the "Concurrent Data Representation Synthesis" paper ensures:
a. Serializability [2]
b. Deadlock freedom [4]

9. What does the autotuner decide? On what basis, does it make the decision? [4].

10. How does a query planner decide a query plan? It is possible that it makes bad decisions? [4]

11. In the talk on "Reachability Modulo Theories",
a. what is the difference between "assume" and "assert"? Explain using an example. [2]
b. Why is "searching for bugs" recursively enumerable? [2]