2005 Paper 8 Question 5

Advanced Systems Topics

A computer system provides a compare-and-swap (CAS) operation which is used in the following manner:

```
seen = CAS (address, old, new)
```

It loads the contents of `address`, compares that value against `old` and if it matches stores the value `new` at the same address. All of this is performed atomically and the value read from the address is returned as `seen`.

(*a*) Making use of CAS, write pseudo-code for a simple multi-reader spin-lock. Your design should permit concurrent readers to enter their critical sections in parallel but ensure that writers gain exclusive access. Be sure to provide pseudo-code for each of the four operations supported by the lock, and describe the layout of the lock's data fields in memory. [10 marks]

(*b*) Why might this simple spin-lock perform poorly on a large multi-processor system? How might you improve the lock to achieve better performance on such a system? [4 marks]

A programmer analyses a multi-threaded application and discovers that the majority of the execution time is spent contending for access to a shared data structure.

(*c*) Describe *three* methods for reducing lock contention amongst threads accessing a highly-concurrent data structure. In each case briefly describe a situation or workload to which the method is particularly well suited. [6 marks]