CS503 Paper Review

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Monitors: An Operating System Structuring Concept
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1. **Give three technical reasons why this is a good paper.**
   - Reason I: The main focus of this paper is to present a a structure that aids in process synchronization. Particularly, a structure that works well at an operating system level. A strength of this paper is that it defines a parallelization method that seems very natural. One of the key advantages of monitors is that they create a direct link between the data being locked, methods that modify the locked data, and the mechanism responsible for providing the locking/unlocking. This seems to be a very natural way to structure this relationship. As a result of this structuring monitor design seems to be very intuitive. This ease of structuring will allow programmers to put their effort into other difficulties dealing with the synchronization of processes. Particularly, it will allow programmers to put more attention into how waiting processes are rescheduled once they are signaled. This give the a programmer more fine grained control of process synchronization which will lead to greatly increased performance.

   - Reason II: Another strength of this paper is that it provides a very generalized description of a method for process synchronization. This generalized form greatly aids in the analysis of correctness in concurrent programming algorithms. The paper presents various instances of classical concurrent programming problems and gives solutions to these problems employing the use of monitors. These sample solutions seem very intuitive due to the inherent natural structuring of monitors. Some of the problems are even proven to be correct through the use of invariants, which is likely to be much more difficult with the use of other parallelization methods. This formal nature of monitors should ease the high-level design of parallel systems and particularly increase the accuracy of their analysis.

   - Reason III: As stated earlier one of the greatest features of monitors is their intuitive nature. This intuitive nature not only aids in formal analysis but it also allows much of process synchronization to be done by the compiler. It is easy to see why this is a great advantage. Parallelization is very difficult and prone to error. One of the large strengths of this paper is that it presents a parallelization method that is largely controlled by the compiler. The use of monitors allows the compiler to generate a large amount of code that handles the parallelization automatically. This is due to the enforcement of mutual exclusion between various processes being provided as part of the basic monitor structure. If the programmer correctly defines the data structures and the methods that modify the data structures it can be guaranteed that no errors will occur due to process synchronization. This includes guarding against race conditions through the naturally enforced mutual exclusion and allows the programmer to easily define what data specific processes get to modify.

2. **Describe at least one technical weakness or limitation of the paper and propose possible improvement.**
   - There are a few weaknesses of the monitors described in the paper. The paper makes many simplifications when considering the size of the system that will employ the use of monitors. While these simplifications make the underlying concepts easy to understand it is likely that these simplifications will not apply in large scale systems. Particularly, an operating system deals with not only a large number of processes but also a large number of files or pieces of data. It may be difficult for the operating system to precisely and correctly determine what data should be grouped into what monitor. Another weakness of the proposed mechanism is that it only considers and environment with no malicious actors. If some malicious process is able to modify a file associated with a monitor synchronization will no longer work. A solution to this problem could be to employ the use of reference monitors along side the monitor mechanism.

The review should be limited to one page