Program 3 (Synchronization)

Reza Naeemi

Purpose

In this assignment you will implement the monitors utlized by ThreadOS. While standard Java monitors are only able to wake up one (using notify) or all (using notifyall()) sleeping threads, the ThreadOS monitors (implemented in SynchQueue.java) allows threads to sleep and wake up on a specific conditon. These monitors are used to implement two separate but key aspects of ThreadOS.

Firstly, using this SynchQueue.java monitor, you will implement SysLib.join( ) and SysLib.exit( ) system calls. The SysLib.join( ) system call will allow the parent thread to wait until a child thread terminates. Secondly, in the Disk IO subsystem, the monitors are used to prevent threads from busy waiting on disk read and write operations. Specifically, in the assignment you will preempt the current thread if it a empts to execute a disk read or write operation on a busy disk, put it into the SynchQueue's FIFO list, and continue with other scheduled threads for execution. In this way, one can prevent I/O-bound threads from wasting CPU power.

Documentation

The reason that Part2 Kernel is faster than the Kernel from Part1 is because busy wait is removed, and the it is not looping endlessly until the disk becomes free. It is notify when it becomes free.

```
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 2$ ls
Boot.class          FileTable.class        Kernel_quiz.java    Scheduler-MFQS       Test2b.class   Test2.java    Test7.class          TestThread2c.java
Boot.java           FileTableEntry.class   Loader.class        Scheduler-RoundRobin Test2b.java    Test3.class   Test7.java           TestThread2.class
Cache.class         FileTableEntry.java    Loader.java         Shell.class          Test2c.class   Test4.class   TestPingPong.class   TestThread2d.class
Cache$Entry.class   HelloWorld.class       PingPong.class      SuperBlock.class     Test2c.java    Test5.class   TestPingPong.java    TestThread2d.java
Directory.class     HelloWorld.java        PingPong.java       SyncQueue.class      Test2.class    Test5.java    TestThread1.class    TestThread2.java
DISK                Inode.class            QueueNode.class      SysLib.class         Test2d.class   Test6.class   TestThread1.java     TestThread3.class
Disk.class          Kernel.class           Scheduler.class      SysLib.java          Test2d.java    Test6.java    TestThread2b.class
Disk.java           Kernel.java            Scheduler_fil.java   TCB.class            Test2e.class   Test7a.class  TestThread2b.java
FileSystem.class    Kernel_org.class       Scheduler.java       TCB.java             Test2e.java    Test7a.java   TestThread2c.class
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 2$ cd ..
parallels@ubuntu:~/Dropbox/Java/CSS 430$ cd Program\ 3/
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3$ ls
Part 1  Part 2  WorkingBackup
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3$ cd Part\ 1/
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 1$ ls
Boot.class           FileTableEntry.java    Loader.java          SyncQueue.class         Test2.class    Test6.java    TestThread2c.class
Boot.java            HelloWorld.class       PingPong.class       SyncQueue.class.notmine Test2d.class   Test7a.class  TestThread2c.java
Cache.class          HelloWorld.java        PingPong.java        SyncQueue.java          Test2d.java    Test7a.java   TestThread2.class
Cache$Entry.class    Inode.class            QueueNode.class      SysLib.class            Test2e.class   Test7.class   TestThread2d.class
Directory.class      Kernel.class           QueueNode.class.notmine SysLib.java          Test2e.java    Test7.java    TestThread2d.java
DISK                 Kernel.class.notmine   QueueNode.java       TCB.class               Test2.java     TestPingPong.class TestThread2.java
Disk.class           Kernel.java            Scheduler.class      TCB.java                Test3.class    TestPingPong.java  TestThread3.class
Disk.java            Kernel.java.notmine    Scheduler_fil.java   Test2b.class            Test4.class    TestThread1.class
FileSystem.class     Kernel_org.class       Scheduler.java       Test2b.java             Test5.class    TestThread1.java
FileTable.class      Kernel_quiz.java       Shell.class          Test2c.class            Test5.java     TestThread2b.class
FileTableEntry.class Loader.class           SuperBlock.class     Test2c.java             Test6.class    TestThread2b.java
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 1$ java Boot
threadOS ver 1.0:
Type ? for help
threadOS: a new thread (thread=Thread[Thread-3,2,main] tid=0 pid=-1)
-->l Shell
l Shell
threadOS: a new thread (thread=Thread[Thread-5,2,main] tid=1 pid=0)
shell[1]% Test2
Test2
threadOS: a new thread (thread=Thread[Thread-7,2,main] tid=2 pid=1)
threadOS: a new thread (thread=Thread[Thread-9,2,main] tid=3 pid=2)
threadOS: a new thread (thread=Thread[Thread-11,2,main] tid=4 pid=2)
threadOS: a new thread (thread=Thread[Thread-13,2,main] tid=5 pid=2)
threadOS: a new thread (thread=Thread[Thread-15,2,main] tid=6 pid=2)
threadOS: a new thread (thread=Thread[Thread-17,2,main] tid=7 pid=2)
Thread[b]: response time = 3998 turnaround time = 5000 execution time = 1002
Thread[e]: response time = 7001 turnaround time = 7502 execution time = 501
Thread[c]: response time = 4999 turnaround time = 8007 execution time = 3008
Thread[a]: response time = 2997 turnaround time = 8013 execution time = 5016
Thread[d]: response time = 6000 turnaround time = 12019 execution time = 6019
shell[2]%
```

```
threadOS: a new thread (thread=Thread[Thread-19,2,main] tid=8 pid=2)
comp finished...
comp finished...
comp finished...
disk finished...
^Cparallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 2$ ls
Boot.class              FileTableEntry.java    Loader.class         SysLib.class    Test2e.class        Test7a.class         TestThread2.class
Boot.java               HelloWorld.class       Loader.java          SysLib.java     Test2e.java         Test7a.java          TestThread2d.class
Cache.class             HelloWorld.java        PingPong.class       TCB.class       Test2.java          Test7.class          TestThread2d.java
Cache$Entry.class       Inode.class            PingPong.java        TCB.java        Test3.class         Test7.java           TestThread2.java
Directory.class         Kernel.class           QueueNode.class      Test2b.class    Test3.class.notmine TestPingPong.class   TestThread3a.class
DISK                    Kernel.class.notmine   Scheduler.class      Test2b.java     Test3.java          TestPingPong.java    TestThread3a.java
Disk.class              Kernel.java            Scheduler_fil.java   Test2c.class    Test4.class         TestThread1.class    TestThread3b.class
Disk.java               Kernel.java.notmine    Scheduler.java       Test2c.java     Test5.class         TestThread1.java     TestThread3b.java
FileSystem.class        Kernel.old             Shell.class          Test2.class     Test5.java          TestThread2b.java    TestThread3.class
FileTable.class         Kernel_org.class       SuperBlock.class     Test2d.class    Test6.class         TestThread2c.class
FileTableEntry.class    Kernel_quiz.java       SyncQueue.class      Test2d.java     Test6.java          TestThread2c.java
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 2$ javac Kernel.java
Note: Kernel.java uses unchecked or unsafe operations.
Note: Recompile with -Xlint:unchecked for details.
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 2$ java Boot
threadOS ver 1.0:
Type ? for help
threadOS: a new thread (thread=Thread[Thread-3,2,main] tid=0 pid=-1)
-->l Shell
l Shell
threadOS: a new thread (thread=Thread[Thread-5,2,main] tid=1 pid=0)
shell[1]% Test3 3
Test3
threadOS: a new thread (thread=Thread[Thread-7,2,main] tid=2 pid=1)
threadOS: a new thread (thread=Thread[Thread-9,2,main] tid=3 pid=2)
threadOS: a new thread (thread=Thread[Thread-11,2,main] tid=4 pid=2)
threadOS: a new thread (thread=Thread[Thread-13,2,main] tid=5 pid=2)
threadOS: a new thread (thread=Thread[Thread-15,2,main] tid=6 pid=2)
threadOS: a new thread (thread=Thread[Thread-17,2,main] tid=7 pid=2)
threadOS: a new thread (thread=Thread[Thread-19,2,main] tid=8 pid=2)
comp finished...
comp finished...
comp finished...
disk finished...
disk finished...
disk finished...
elapsed time = 117597 msec
shell[2]% exit
exit
-->q
q
parallels@ubuntu:~/Dropbox/Java/CSS 430/Program 3/Part 2$
```