

OS HW2

Part 1 Trace Code

1-1. New→Ready

(1) UserProgKernel::InitializeAllThreads()

使用 for 迴圈將所有 execfile 一個個送入 UserProgKernel:: InitializeOneThread(char*, int, int)函數裡初始化。

(2) UserProgKernel:: InitializeOneThread(char*, int, int)

初始化一個新的 thread control block 後進入 Thread::Fork(VoidFunctionPtr, void*)，fork 這個 thread。

(3) Thread::Fork(VoidFunctionPtr, void*)

進入函數後執行 StackAllocate function，對 thread 分配新的 thread stack(做 context switch 時需用到)，分配完後將 interrupt status 設為 IntOff(disable interrupt)，之後送進 Scheduler::ReadyToRun(Thread *thread)根據優先順序，將 thread 分配進對應的 ready queue 裡。最後將 interrupt state 改回原先的狀態。

(4) Thread::StackAllocate(VoidFunctionPtr, void*)

一開始 AllocBoundedArray function 會把 stack 安排在兩個空 page 中間，以方便管理 thread stack 溢位情形，並只回傳有效的 stack 位置給 stack 變數。

根據不同指令集設置不同的 low high addresses。最後設置待會 context switch 會用到的 registers state(ThreadRoot、ThreadBegin、ForkExecute、thread、ThreadFinish 等無形別位置)。

(5) Scheduler::ReadyToRun(Thread*)

將 thread 根據優先順序分配進對應的 ready queue 裡等待進入 running state。

1-2. Running→Ready

(1) Machine::Run()

切換成 user mode 然後執行無限 for loop，逐條執行 userprogram 的程式指令進 OneInstruction()，隨後進入 kernel->interrupt->OneTick()。

(2) Interrupt::OneTick()

if (status == SystemMode)因為剛剛的切換所以條件不成立，於是對 totalTicks、userTicks 加一次 UserTick

將 old 的 interrupt state 設為 off，進 CheckIfDue 看看有沒有 interrupt 在等待，有的話就執行這個 interrupt

再次將 interrupt state 設為 on，在 Running→Ready case 裡如果超過 time slicing 的時間，yieldOnReturn 就會為 true 於是進入 if，把 status 切到 systemMode 因為 yield

是一個 kernel routine，

進 `kernel->currentThread->Yield()`函數，結束後把狀態切回進 `Interrupt::OneTick()`的狀態。

(3) `Thread::Yield()`

將目前的 thread 從 running state 送回 ready state，在從 ready state 中尋找下一個等待被執行的 thread (`Scheduler::FindNextToRun()`)。

紀錄現有 thread 的狀態，進 `Scheduler::Run(Thread*, bool)`將 thread 存好後移出，並把 next thread load 進 running state。

進 `Scheduler::ReadyToRun(Thread*)`把移除的 thread 根據優先順序從新擺回 ready queue，最後將 kernel interrupt state 改為進 Yield 之前的 state。

(4) `Scheduler::FindNextToRun()`

此一動作為 short-term scheduling，根據 multilevel queue 的優先順序選擇下一個執行的 thread，如果找到則回傳 next thread 的位置，如果都是空的則回傳 NULL。

(5) `Scheduler::ReadyToRun(Thread*)`

將 thread 根據優先順序分配進對應的 ready queue 裡等待進入 running state。

(6) `Scheduler::Run(Thread*, bool)`

做 context switch，將目前 thread 狀態記錄下來並移除 running state，再把 next thread load 進來 running state。

1-3. Running→Waiting

(1) `ExceptionHandler(ExecutionType) case SC_PrintInt`

根據傳過來的 ExecutionType 做對應的處置，而取到的為 `SyscallException`。

知道 ExecutionType 為 `SyscallException` 後再到對應的暫存器 (對應的暫存器為 2，2 是讀取 system call 種類的地方) 取值，進入” `SC_PrintInt`” case。進 `SC_PrintInt` case 後讀取暫存器 4 的準備要 print 出的值。

(2) `SynchConsoleOutput::PutInt()`

進 function 後將暫存器送來的 value 改為字串的形式，之後將 lock 執行 `Acquire()`只允許一次一個進 do while 迴圈。進迴圈後一次將一個字元送進 `SynchConsoleOutput::PutChar(char ch)`，執行完後等待 `waitfor semaphore > 0` 在執行下一個字元。Do while loop 做完後將 lock 釋放。

(3) `ConsoleOutput::PutChar(char)`

將一個字元送進虛擬顯示，並安排未來 i/o interrupt 的時程。

(4) `Semaphore::P()`

P 這個函數類似上課教的 `wait()`，會一直等待直到 semaphore 值大於零，否則在等待期間會把目前的 thread 排進 queue 並讓自己 ”sleep”。在這裡 semaphore 期間會

將 interrupt disable，待處理結束後再開啟。

(5) `SynchList<T>::Append(T)`

將送來的 thread 擺進 queue 的尾巴。

(6) `Thread::Sleep(bool)`

semaphore 在 waiting 的期間，必須暫停 cpu 的使用，因此必須做 context switch，

將 current thread 送至 waiting or terminated state(根據 finishing)。

(7) `Scheduler::FindNextToRun()`

此一動作為 short-term scheduling，根據 multilevel queue 的優先順序選擇下一個執行的 thread，如果找到則回傳 next thread 的位置，如果都是空的則回傳 NULL。

(8) `Scheduler::Run(Thread*, bool)`

做 context switch，將目前 thread 狀態記錄下來並移除 running state，再把 next thread load 進來 running state。

1-4. Waiting→Ready

從課程講義中我們知道這個 process 執行時代表的是 I/O complete。

(1) `Semaphore::V()`

這個 function 是從 synchconsole.cc 呼叫而來的。

```
63 void
64 SynchConsoleInput::CallBack()
65 {
66     waitFor->V();
67 }
```

進到 Semaphore 之後會先處理 interrupt 的問題，Semaphore 在控制 thread 占用 cpu 的優先次序時是不能被 interrupt 的，所以要先把 interrupt 關掉。

接下來要準備排程，所以先檢查 queue 裡面有沒有 thread，確認有 thread 後，把 ready queue 裡面第一個 item 移除並呼叫 ReadyToRun。

最後要把 interrupt 重新開啟。

(2) `Scheduler::ReadyToRun(Thread*)`

這個部分與 1-2 相同，ReadyToRun 的功能是將 thread 根據優先順序分配進對應的 ready queue 裡等待進入 running state。

1-5 Running→Terminated

從課程講義中我們知道這個 process 執行時代表的是 process 被終止了。

(1) `ExceptionHandler(ExceptionType) case SC_Exit :`

根據傳過來的 ExecutionType 做對應的處置，而取到的為 SyscallException。知道 ExecutionType 為 SyscallException 後再到對應的暫存器 (對應的暫存器為 2，2 是讀取 system call 種類的地方) 取值，進入” SC_Exit ” case。進 SC_Exit case 後讀取暫存器 4 的準備要 print 出的值。讀值出來之後切回 kernel mode 呼叫 `Thread::Finish()`

來中止當下執行的 `thread`。

(2) `Thread::Finish()` :

進到 `Finish()` 之後會先處理 `interrupt` 的問題，在處理 `thread` 占用 `CPU` 的優先次序時是不能被 `interrupt` 的，所以要先把 `interrupt` 關掉。

接下來，利用 `ASSERT` 檢查當前的 `thread` 是否與 `kernel` 裡的 `Thread` 一致。

最後呼叫 `Sleep` 來進行 `context switch`。

(3) `Thread::Sleep()` :

前幾行的 `ASSERT` 和 `DEBUG` 是確保 `OS` 正確運行的檢查機制，接著把當前 `thread` 的 `status` 設為 `BLOCKED`，在利用 `while` 迴圈不斷檢查與尋找在 `ready queue` 裡面下一個要運行的 `thread`。若沒有下一個要跑的 `thread`，`kernel` 就會回到 `IDLE()`，反之則呼叫 `Scheduler::Run()` 來執行下一個 `thread`。

(4) `Scheduler::FindNextToRun()` :

接續(3)，`FindNextToRun` 前面已多次講解，就是根據 `multilevel queue` 的優先順序選擇下一個執行的 `thread`，如果找到則回傳 `next thread` 的位置，如果都是空的則回傳 `NULL`。

(5) `Scheduler::Run(Thread*, bool)` :

接續(3)，在 `Run` 裡面主要就是控制 `OldThread(currentThread)` 和 `nextThread` 的執行與中止。當 `finishing == 1` 時，會 `currentThread` 會被 `toBeDestroyed` 刪除掉，又當 `finishing == 0` 時，`currentThread` 的狀態會被保存下來，並檢查存 `currentThread` 的柱列有沒有 `overflow`。確定沒問題之後 `currentThread` 和 `nextThread` 兩者會進行 `Context Switch`。

1-6 Ready→Running

(1),(2)與 1-5 相同

(1) `Scheduler::FindNextToRun()` :

根據 `multilevel queue` 的優先順序選擇下一個執行的 `thread`，如果找到則回傳 `next thread` 的位置，如果都是空的則回傳 `NULL`。

(2) `Scheduler::Run(Thread*, bool)` :

在 `Run` 裡面主要就是控制 `OldThread(currentThread)` 和 `nextThread` 的執行與中止。當 `finishing == 1` 時，會 `currentThread` 會被 `toBeDestroyed` 刪除掉，又當 `finishing == 0` 時，`currentThread` 的狀態會被保存下來，並檢查存 `currentThread` 的柱列有沒有 `overflow`。確定沒問題之後 `currentThread` 和 `nextThread` 兩者會進行 `Context Switch`。

(3) `SWITCH(Thread*, Thread*)` :

(4) `for loop in Machine::Run()` :

這個無窮迴圈是讓程式回到 `usermode`，並不停的接收新的 `instruction` 來執行。

`OneTick` 則是用來記錄 `CPU` 的 `clock`。

Part 2 Implementation

2.1

2.2

2.3

TestCase 1 : userprog/nachos -epb test/hw2_test1 40 5000 -epb test/hw2_test2 80 4000 -d z

```
dorianliu@dorianliu-VirtualBox:~/Desktop/nachos-4.0-hw2/code$ userprog/nachos -epb test/hw2_test1 40 5000 -epb test/hw2_test2 80 4000 -d z
[InsertToQueue]Tick[10]: Thread [1] is inserted into queue L3
[InsertToQueue]Tick[20]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[30]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[30]: Thread[2] is now selected for execution, thread[0],is replaced, and it has executed [0] ticks
Switching from: 0 to: 2
ForkExecute-> fork thread id: 2,currentTick: 40
[AddrSpace::Load over] Tick [40]: Thread [2]
[AddrSpace::Execute over] Tick [40]: Thread [2]
2[RemoveFromQueue]Tick[69]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[69]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[79]: Thread [2] is inserted into queue L2
ForkExecute-> fork thread id: 1,currentTick: 79
[AddrSpace::Load over] Tick [79]: Thread [1]
[AddrSpace::Execute over] Tick [79]: Thread [1]
[RemoveFromQueue]Tick[98]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[98]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[109]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[109]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[120]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[120]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[130]: Thread [1] is inserted into queue L3

[UpdatePriority]Tick[608]: Thread [1] changes its priority from [40] to [50]
[RemoveFromQueue]Tick[608]: Thread [1] is removed from queue L3
[InsertToQueue]Tick[608]: Thread [1] is inserted into queue L2
2[RemoveFromQueue]Tick[665]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[665]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[666]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[666]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[666]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[677]: Thread [2] is inserted into queue L2

[UpdatePriority]Tick[608]: Thread [1] changes its priority from [40] to [50]
[RemoveFromQueue]Tick[608]: Thread [1] is removed from queue L3
[InsertToQueue]Tick[608]: Thread [1] is inserted into queue L2
2[RemoveFromQueue]Tick[665]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[665]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[666]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[666]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[666]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[677]: Thread [2] is inserted into queue L2

[UpdatePriority]Tick[608]: Thread [1] changes its priority from [50] to [60]
[RemoveFromQueue]Tick[608]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[608]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[1208]: Thread [1] changes its priority from [60] to [70]
[RemoveFromQueue]Tick[1208]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[1208]: Thread [1] is inserted into queue L2
2[RemoveFromQueue]Tick[1233]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[1233]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1234]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1234]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[1234]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[1245]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1245]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[1256]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1256]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[1266]: Thread [1] is inserted into queue L2

[UpdatePriority]Tick[1308]: Thread [1] changes its priority from [70] to [80]
[RemoveFromQueue]Tick[1308]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[1308]: Thread [1] is inserted into queue L2
```

```

[UpdatePriority]Tick[1308]: Thread [1] changes its priority from [70] to [80]
[RemoveFromQueue]Tick[1308]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[1308]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[1408]: Thread [1] changes its priority from [80] to [90]
[RemoveFromQueue]Tick[1408]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[1408]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[1508]: Thread [1] changes its priority from [90] to [100]
[RemoveFromQueue]Tick[1508]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[1508]: Thread [1] is inserted into queue L1
[UpdatePriority]Tick[1608]: Thread [1] changes its priority from [100] to [110]
[RemoveFromQueue]Tick[1608]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1801]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1802]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1802]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[1802]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[1813]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1813]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[1824]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[1824]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[1834]: Thread [1] is inserted into queue L1

[UpdatePriority]Tick[2212]: Thread [1] changes its priority from [110] to [120]
[RemoveFromQueue]Tick[2369]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[2369]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2370]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2370]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[2370]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[2381]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2381]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[2392]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2392]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[2402]: Thread [1] is inserted into queue L1

[InsertToQueue]Tick[2392]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2392]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[2402]: Thread [1] is inserted into queue L1

[UpdatePriority]Tick[2712]: Thread [1] changes its priority from [120] to [130]
[RemoveFromQueue]Tick[2937]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[2937]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2938]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2938]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[2938]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[2949]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2949]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[2960]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[2960]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[2970]: Thread [1] is inserted into queue L1

[UpdatePriority]Tick[3212]: Thread [1] changes its priority from [130] to [140]
[RemoveFromQueue]Tick[3505]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3505]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3506]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[3506]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[3506]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[3517]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[3517]: Thread [2] is removed from queue L2
Switching from: 2 to: 2
[InsertToQueue]Tick[3528]: Thread [2] is inserted into queue L2
[RemoveFromQueue]Tick[3528]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[3538]: Thread [1] is inserted into queue L1

[UpdatePriority]Tick[3816]: Thread [1] changes its priority from [140] to [149]
return value:2

```

```
[RemoveFromQueue]Tick[4065]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[4065]: Thread [1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
!InsertToQueue]Tick[4076]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4076]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
!InsertToQueue]Tick[4087]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4087]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[4098]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4098]: Thread [1] is removed from queue L1
Switching from: i to: i

!InsertToQueue]Tick[4644]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4644]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
!InsertToQueue]Tick[4655]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4655]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

!InsertToQueue]Tick[4666]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4666]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

!InsertToQueue]Tick[5212]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5212]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
!InsertToQueue]Tick[5223]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5223]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

!InsertToQueue]Tick[5234]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5234]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[5780]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5780]: Thread [1] is removed from queue L1
Switching from: i to: 1
!InsertToQueue]Tick[5791]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5791]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[5802]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5802]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[6348]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6348]: Thread [1] is removed from queue L1
Switching from: i to: 1
!InsertToQueue]Tick[6359]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6359]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[6370]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6370]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[6916]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6916]: Thread [1] is removed from queue L1
Switching from: i to: 1
!InsertToQueue]Tick[6927]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6927]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[6938]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6938]: Thread [1] is removed from queue L1
Switching from: i to: 1

!InsertToQueue]Tick[7484]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7484]: Thread [1] is removed from queue L1
Switching from: i to: 1
!InsertToQueue]Tick[7495]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7495]: Thread [1] is removed from queue L1
Switching from: i to: 1
```

```

1[InsertToQueue]Tick[7484]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7484]: Thread [1] is removed from queue L1
Switching from: 1 to: i
[InsertToQueue]Tick[7495]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7495]: Thread [1] is removed from queue L1
Switching from: 1 to: i

[InsertToQueue]Tick[7506]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7506]: Thread [1] is removed from queue L1
Switching from: 1 to: i

1[InsertToQueue]Tick[8052]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8052]: Thread [1] is removed from queue L1
Switching from: 1 to: i
[InsertToQueue]Tick[8063]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8063]: Thread [1] is removed from queue L1
Switching from: 1 to: i

[InsertToQueue]Tick[8074]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8074]: Thread [1] is removed from queue L1
Switching from: 1 to: i

1[InsertToQueue]Tick[8620]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8620]: Thread [1] is removed from queue L1
Switching from: 1 to: i
[InsertToQueue]Tick[8631]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8631]: Thread [1] is removed from queue L1
Switching from: 1 to: i

[InsertToQueue]Tick[8642]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8642]: Thread [1] is removed from queue L1
Switching from: 1 to: i

return value:1
terminate called after throwing an instance of 'St9bad_alloc'
  what(): std::bad_alloc
Aborted (core dumped)

```

TestCase 2 : userprog/nachos -epb test/hw2_test1 40 5000 -epb test/hw2_test2 40 4000 -d z

```

dorianliu@dorianliu-VirtualBox:~/Desktop/nachos-4.0-hw2$ userprog/nachos -epb test/hw2_test1 40 5000 -epb test/hw2_test2 40 4000 -d z
[InsertToQueue]Tick[10]: Thread [1] is inserted into queue L3
[InsertToQueue]Tick[20]: Thread [2] is inserted into queue L3
[RemoveFromQueue]Tick[30]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[30]: Thread[1] is now selected for execution, thread[0],is replaced, and it has executed [0] ticks
Switching from: 0 to: 1
ForKExecute-> fork thread id: 1,currentTick: 40
[AddrSpace::load over] Tick [40]: Thread [1]
[AddrSpace::Execute over] Tick [40]: Thread [1]
1[RemoveFromQueue]Tick[69]: Thread [2] is removed from queue L3
[ContextSwitch]Tick[69]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [0] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[79]: Thread [1] is inserted into queue L3
ForKExecute-> fork thread id: 2,currentTick: 79
[AddrSpace::load over] Tick [79]: Thread [2]
[AddrSpace::Execute over] Tick [79]: Thread [2]
[RemoveFromQueue]Tick[98]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[98]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[109]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[109]: Thread [1] is removed from queue L3
Switching from: 1 to: 1

[InsertToQueue]Tick[120]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[120]: Thread [1] is removed from queue L3
Switching from: 1 to: 1
[InsertToQueue]Tick[130]: Thread [2] is inserted into queue L3

[UpdatePriority]Tick[608]: Thread [2] changes its priority from [40] to [50]
[RemoveFromQueue]Tick[608]: Thread [2] is removed from queue L3
[InsertToQueue]Tick[608]: Thread [2] is inserted into queue L2
1[RemoveFromQueue]Tick[665]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[665]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [100] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[666]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[666]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[666]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[677]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[677]: Thread [1] is removed from queue L3
Switching from: 1 to: 1

[InsertToQueue]Tick[688]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[688]: Thread [1] is removed from queue L3
Switching from: 1 to: 1

```

```

[InsertToQueue]Tick[688]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[688]: Thread [1] is removed from queue L3
Switching from: 1 to: 1
[InsertToQueue]Tick[698]: Thread [2] is inserted into queue L2

[UpdatePriority]Tick[1108]: Thread [2] changes its priority from [50] to [60]
[RemoveFromQueue]Tick[1108]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[1108]: Thread [2] is inserted into queue L2
[UpdatePriority]Tick[1208]: Thread [2] changes its priority from [60] to [70]
[RemoveFromQueue]Tick[1208]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[1208]: Thread [2] is inserted into queue L2
! [RemoveFromQueue]Tick[1233]: Thread [2] is removed from queue L2
[ContextSwitch]Tick[1233]: Thread[2] is now selected for execution, thread[1],is replaced, and it has executed [100] ticks
Switching from: 1 to: 2
[InsertToQueue]Tick[1234]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1234]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[1234]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1245]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1245]: Thread [1] is removed from queue L3
Switching from: 1 to: 1
[InsertToQueue]Tick[1266]: Thread [2] is inserted into queue L2

[UpdatePriority]Tick[1308]: Thread [2] changes its priority from [70] to [80]
[RemoveFromQueue]Tick[1308]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[1308]: Thread [2] is inserted into queue L2
[UpdatePriority]Tick[1408]: Thread [2] changes its priority from [80] to [90]
[RemoveFromQueue]Tick[1408]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[1408]: Thread [2] is inserted into queue L2
[UpdatePriority]Tick[1508]: Thread [2] changes its priority from [90] to [100]
[RemoveFromQueue]Tick[1508]: Thread [2] is removed from queue L2
[InsertToQueue]Tick[1508]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1508]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1508]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
! [RemoveFromQueue]Tick[1518]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[1518]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks

[ContextSwitch]Tick[1518]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1528]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1528]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1528]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[1538]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[1538]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1548]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1548]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1548]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[1558]: Thread [1] is removed from queue L3
[ContextSwitch]Tick[1558]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1568]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1568]: Thread [1] is inserted into queue L3
[RemoveFromQueue]Tick[1568]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[2008]: Thread [1] changes its priority from [40] to [50]
[RemoveFromQueue]Tick[2008]: Thread [1] is removed from queue L3
[InsertToQueue]Tick[2008]: Thread [1] is inserted into queue L2
! [RemoveFromQueue]Tick[2113]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2113]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2123]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2123]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2123]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[2133]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2133]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2143]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2143]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2143]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

```

```
[RemoveFromQueue]Tick[2153]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2153]: Thread [1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2163]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2163]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2163]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[2513]: Thread [1] changes its priority from [50] to [60]
[RemoveFromQueue]Tick[2513]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[2513]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[2613]: Thread [1] changes its priority from [60] to [70]
[RemoveFromQueue]Tick[2613]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[2613]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2708]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2708]: Thread [1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2718]: Thread [2] is inserted into queue L1
[UpdatePriority]Tick[2718]: Thread [2] changes its priority from [100] to [110]
[InsertToQueue]Tick[2718]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2718]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[2728]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2728]: Thread [1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2738]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2738]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2738]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[2748]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[2748]: Thread [1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2758]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2758]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[2758]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[2818]: Thread [1] changes its priority from [70] to [80]
[RemoveFromQueue]Tick[2818]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[2818]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[2918]: Thread [1] changes its priority from [80] to [90]
[RemoveFromQueue]Tick[2918]: Thread [1] is removed from queue L2
```

```
[UpdatePriority]Tick[2818]: Thread [1] changes its priority from [70] to [80]
[RemoveFromQueue]Tick[2818]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[2818]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[2918]: Thread [1] changes its priority from [80] to [90]
[RemoveFromQueue]Tick[2918]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[2918]: Thread [1] is inserted into queue L2
[UpdatePriority]Tick[3018]: Thread [1] changes its priority from [90] to [100]
[RemoveFromQueue]Tick[3018]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[3018]: Thread [1] is inserted into queue L1
[UpdatePriority]Tick[3118]: Thread [1] changes its priority from [100] to [110]
[RemoveFromQueue]Tick[3118]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3303]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3313]: Thread [2] is inserted into queue L1
[RemoveFromQueue]Tick[3313]: Thread [1] is removed from queue L1
[RemoveFromQueue]Tick[3313]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[3323]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3323]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3333]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3333]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3333]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[3343]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3343]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3353]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3353]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3353]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[3623]: Thread [1] changes its priority from [110] to [120]
[RemoveFromQueue]Tick[3898]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3898]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3908]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3908]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3908]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[3918]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3918]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
```

```
[RemoveFromQueue]Tick[3918]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3918]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3928]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3928]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3928]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[3938]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3938]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3948]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3948]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3948]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[4228]: Thread [1] changes its priority from [120] to [130]
2[RemoveFromQueue]Tick[4493]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[4493]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[4503]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[4503]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4503]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[4513]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[4513]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[4523]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[4523]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4523]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[4533]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[4533]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[4543]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[4543]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4543]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[4733]: Thread [1] changes its priority from [130] to [140]
```

```
[UpdatePriority]Tick[4733]: Thread [1] changes its priority from [130] to [140]
2[RemoveFromQueue]Tick[5088]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[5088]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[5098]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[5098]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5098]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[5108]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[5108]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[5118]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[5118]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5118]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[5128]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[5128]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[5138]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[5138]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5138]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[5338]: Thread [1] changes its priority from [140] to [149]
return value:2
[RemoveFromQueue]Tick[5675]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[5675]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
1[InsertToQueue]Tick[5979]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5979]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[5990]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5990]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[6001]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6001]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

1[InsertToQueue]Tick[6547]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6547]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[6558]: Thread [1] is inserted into queue L1
```

```
[InsertToQueue]Tick[6547]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6547]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[6558]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6558]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[6569]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6569]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[7115]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7115]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[7126]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7126]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[7137]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7137]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[7683]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7683]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[7694]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7694]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[7705]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7705]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8251]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8251]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[8262]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8262]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8273]: Thread [1] is inserted into queue L1
```

```
[InsertToQueue]Tick[7705]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7705]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8251]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8251]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[8262]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8262]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8273]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8273]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8819]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8819]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[8830]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8830]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[8841]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8841]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

return value:1
terminate called after throwing an instance of 'std::bad_alloc'
  what(): std::bad_alloc
Aborted (core dumped)
dorianliu@dorianliu-VirtualBox:~/Desktop/nachos-4.0-hw2$
```

TestCase 3 : userprog/nachos -epb test/hw2_test1 40 5000 -epb test/hw2_test2 100 4000 -d z

```
dorianliu@dorianliu-VirtualBox:~/Desktop/nachos-4.0-hw2/code$ userprog/nachos -epb test/hw2_test1 90 5000 -epb test/hw2_test2 100 4000 -d z
[InsertToQueue]Tick[10]: Thread [1] is inserted into queue L2
[InsertToQueue]Tick[20]: Thread [2] is inserted into queue L1
[RemoveFromQueue]Tick[30]: Thread [2] is removed from queue L1
[ContextSwitch]Tick[30]: Thread[2] is now selected for execution, thread[0],is replaced, and it has executed [0] ticks
Switching from: 0 to: 2
ForKExecute=> fork thread id: 2,currentTick: 40
[AddrSpace:::Load over] Tick [40]: Thread [2]
[AddrSpace:::Execute over] Tick [40]: Thread [2]
2[RemoveFromQueue]Tick[69]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[69]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[79]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[79]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[79]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[89]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[89]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [0] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[99]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[99]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[99]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[109]: Thread [1] is removed from queue L2
[ContextSwitch]Tick[109]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[119]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[119]: Thread [1] is inserted into queue L2
[RemoveFromQueue]Tick[119]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[509]: Thread [1] changes its priority from [90] to [100]
[RemoveFromQueue]Tick[509]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[509]: Thread [1] is inserted into queue L1
[UpdatePriority]Tick[609]: Thread [1] changes its priority from [100] to [110]
2[RemoveFromQueue]Tick[664]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[664]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[674]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[674]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[674]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[684]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[684]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
```

```
switching from: 1 to: 2

[UpdatePriority]Tick[509]: Thread [1] changes its priority from [90] to [100]
[RemoveFromQueue]Tick[509]: Thread [1] is removed from queue L2
[InsertToQueue]Tick[509]: Thread [1] is inserted into queue L1
[UpdatePriority]Tick[609]: Thread [1] changes its priority from [100] to [110]
2[RemoveFromQueue]Tick[664]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[664]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[674]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[674]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[674]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[684]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[684]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[694]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[694]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[694]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[704]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[704]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[714]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[714]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[714]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[1214]: Thread [1] changes its priority from [110] to [120]
2[RemoveFromQueue]Tick[1259]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1259]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1269]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1269]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1269]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[1279]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1279]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1289]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1289]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1289]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
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[InsertToQueue]Tick[1289]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1289]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1289]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[1299]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1299]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1309]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1309]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1309]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[1719]: Thread [1] changes its priority from [120] to [130]
2[RemoveFromQueue]Tick[1854]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1854]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 1 to: 1
[InsertToQueue]Tick[1864]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1864]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1864]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[1874]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1874]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1884]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1884]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1884]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[1894]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[1894]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[1904]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[1904]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[1904]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[2224]: Thread [1] changes its priority from [130] to [140]
2[RemoveFromQueue]Tick[2449]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[2449]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2459]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2459]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[2459]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[2469]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[2469]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2479]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2479]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[2479]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[2489]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[2489]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[2499]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[2499]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[2499]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[2724]: Thread [1] changes its priority from [140] to [149]
2[RemoveFromQueue]Tick[3044]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3044]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3054]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3054]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3054]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[3064]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3064]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3074]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3074]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3074]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[3084]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3084]: Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3094]: Thread [2] is inserted into queue L1
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Switching from: 1 to: 2

[RemoveFromQueue]Tick[3084]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3084]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3094]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3094]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3094]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[3224]: Thread [1] changes its priority from [149] to [149]
[RemoveFromQueue]Tick[3639]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3639]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3649]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3649]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3649]: Thread [2] is removed from queue L1
Switching from: 1 to: 2
[RemoveFromQueue]Tick[3659]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3659]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3669]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3669]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3669]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[RemoveFromQueue]Tick[3679]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[3679]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
[InsertToQueue]Tick[3689]: Thread [2] is inserted into queue L1
[InsertToQueue]Tick[3689]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[3689]: Thread [2] is removed from queue L1
Switching from: 1 to: 2

[UpdatePriority]Tick[3724]: Thread [1] changes its priority from [149] to [149]
[UpdatePriority]Tick[4224]: Thread [1] changes its priority from [149] to [149]
return value:2
[RemoveFromQueue]Tick[4226]: Thread [1] is removed from queue L1
[ContextSwitch]Tick[4226]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
ForKExecute=> fork thread id: 1,currenttick: 4236
[AddrSpace::Load over] Tick [4236]: Thread [1]
[AddrSpace::Execute over] Tick [4236]: Thread [1]
[AddrSpace::Execute over] Tick [4236]: Thread [1]
1[InsertToQueue]Tick[4266]: Thread [1] is inserted into queue L1

[ContextSwitch]Tick[4226]:Thread[1] is now selected for execution, thread[2],is replaced, and it has executed [100] ticks
Switching from: 2 to: 1
ForkExecute=> fork thread id: 1,currenttick: 4236
[AddrSpace::Load over] Tick [4236]: Thread [1]
[AddrSpace::Execute over] Tick [4236]: Thread [1]
[AddrSpace::Execute over] Tick [4236]: Thread [1]
1[InsertToQueue]Tick[4266]: Thread [1] is inserted into queue L1

Switching from: 1 to: 1
[InsertToQueue]Tick[4277]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4277]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[4288]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4288]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

1[InsertToQueue]Tick[4834]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4834]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[4845]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4845]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[4856]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[4856]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

1[InsertToQueue]Tick[5402]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5402]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[5413]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5413]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[5424]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5424]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

1[InsertToQueue]Tick[5970]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5970]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[5981]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5981]: Thread [1] is removed from queue L1

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1[InsertToQueue]Tick[5970]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5970]: Thread [1] is removed from queue L1
Switching from: 1 to: 1
[InsertToQueue]Tick[5981]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5981]: Thread [1] is removed from queue L1
Switching from: 1 to: 1

[InsertToQueue]Tick[5992]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[5992]: Thread [1] is removed from queue L1
Switching from: i to: 1

1[InsertToQueue]Tick[6538]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6538]: Thread [1] is removed from queue L1
Switching from: i to: 1
[InsertToQueue]Tick[6549]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6549]: Thread [1] is removed from queue L1
Switching from: i to: 1

[InsertToQueue]Tick[6560]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[6560]: Thread [1] is removed from queue L1
Switching from: i to: 1

1[InsertToQueue]Tick[7106]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7106]: Thread [1] is removed from queue L1
Switching from: i to: 1
[InsertToQueue]Tick[7117]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7117]: Thread [1] is removed from queue L1
Switching from: i to: 1

[InsertToQueue]Tick[7128]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7128]: Thread [1] is removed from queue L1
Switching from: i to: 1

1[InsertToQueue]Tick[7674]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7674]: Thread [1] is removed from queue L1
Switching from: i to: 1
[InsertToQueue]Tick[7685]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7685]: Thread [1] is removed from queue L1
Switching from: i to: 1

[InsertToQueue]Tick[7696]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7696]: Thread [1] is removed from queue L1
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[InsertToQueue]Tick[7696]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[7696]: Thread [1] is removed from queue L1
Switching from: i to: 1

1[InsertToQueue]Tick[8242]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8242]: Thread [1] is removed from queue L1
Switching from: i to: 1
[InsertToQueue]Tick[8253]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8253]: Thread [1] is removed from queue L1
Switching from: i to: 1

[InsertToQueue]Tick[8264]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8264]: Thread [1] is removed from queue L1
Switching from: i to: 1

1[InsertToQueue]Tick[8810]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8810]: Thread [1] is removed from queue L1
Switching from: i to: 1
[InsertToQueue]Tick[8821]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8821]: Thread [1] is removed from queue L1
Switching from: i to: 1

[InsertToQueue]Tick[8832]: Thread [1] is inserted into queue L1
[RemoveFromQueue]Tick[8832]: Thread [1] is removed from queue L1
Switching from: i to: 1

return value:1
terminate called after throwing an instance of 'std::bad_alloc'
  what(): std::bad_alloc
Aborted (core dumped)
dorianliu@dorianliu-VirtualBox:~/Desktop/nachos-4.0-hw2$ 
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