lab3 test&review

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Task 1 Sleeping Barber Problem

1、代码说明

① 类的定义

```
class barberCustomerMonitor
 superclass Object
 fields
   customers: Semaphore
   barbers: Semaphore
   mutex: Semaphore
   waiting: int

   --need a queue to sort the customer who is waiting
   q: array [CHAIRS] of int
   --front of the queue
   qf: int
   -- rear of the queue
   qr: int

 methods
   Init()
   barber_behave(id: int)
   customer_behave(id: int)
   cut_hair(id: int)
   get_haircut(id: int)
 endClass
```

- customers、barbers、mutex：信号量
- waiting：表示正坐在椅子上等待理发的顾客
- q：在barber_behave()函数中，barber理发时需要**按顺序**将正在理发的顾客的id输出。所以需要一个队列。
- qf：队列的头；qr：队列的尾
- 函数作用在下文讲述。

② 各个函数的作用

- Init() 略
- barber_behave(id: int)

```
    method barber_behave(id: int)
      while true
        customers.Down()
        mutex.Down()
        waiting = waiting - 1
        barbers.Up()
        mutex.Up()

        self.cut_hair(id)

      endWhile
    endMethod
```

  - 首先进行P关系的变化customers.Down()【此时若没有顾客，barber将会sleep，直到有第一个顾客来到并执行customers.Up()后才会唤醒barber】，然后上锁，对waiting进行-1操作表示当前顾客已经理发完毕；随后barbers.Up()，解锁。此时上一个顾客已经完毕，即将被下一个顾客的线程进行barbers.Down()以开始理发，所以此时我们应该在cut_hair()输出即将理发的顾客的信息。

- cut_hair(id: int)

```
 method cut_hair(id: int)
  print("The barber is cutting hair for customer ")
  printInt(q[qf])
  print("\n")

  qf = (qf+1) % CHAIRS

endMethod
```

  - cut_hair()函数主要进行输出下一个顾客的理发信息，并更新队列。

- customer_behave(id: int)

```
    method customer_behave(id: int)

      mutex.Down()

      if waiting < CHAIRS
        print("customer ")
        printInt (id)
        print (" is waiting, ")

        waiting = waiting + 1
        q[qr] = id
        qr = (qr+1) % CHAIRS


        printInt(5 - waiting)
        print(" chair(s) left \n")

        customers.Up()
        mutex.Up()
        barbers.Down()

        -- cutting time, not necessary to use
        --self.get_haircut(id)
```

```
24
25        else
26          print("The customer ")
27          printInt(id)
28          print(" is leaving since no chair to sit\n")
29          mutex.Up()
30
31        endIf
32      endMethod
```

- 首先需要上锁。随后判断是否有空闲的位置，如果有则输出入座等待的信息并更新waiting和队列。随后输出还有多少椅子空闲。因为**我们需要在确定顾客是否入座，之后才能执行barbers.Down()**，所以需要在customers.Up()和mutex.Up()后才执行barbers.Down()。而如果此时barber如果忙碌，该线程将会sleep，直到信号量barbers内的队列中轮到该线程了，才会被唤醒并开始理发。开始理发后执行get_haircut()函数，所以该函数需要体现理发时间。

- get_haircut(id:int)

```
1       method get_haircut(id:int)
2       var
3         i:int
4         -- during cutting
5         mutex.Down()
6           for i = 0 to 5
7             currentThread.Yield()
8           endFor
9         mutex.Up()
10
11
12      endMethod
```

  - 为了保证在理发过程中其他线程不会被唤醒，所以我们需要上锁。由于理发时，当前处于ready态的顾客线程只有这一个，其他顾客都在睡眠，处于barbers.Down()的等待队列中，所以currentThread.Yield()的作用仅仅只是消耗时间。

2、输出

没有设置cutting_time，即没有执行get_haircut(id)的情况：

```
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$ blitz -g os
Beginning execution...
====================  KPL PROGRAM STARTING  ====================
Initializing Thread Scheduler...
customer 1 is waiting, 4 chair(s) left
customer 2 is waiting, 3 chair(s) left
customer 3 is waiting, 2 chair(s) left
The barber is cutting hair for customer 1
The barber is cutting hair for customer 2
The barber is cutting hair for customer 3
customer 4 is waiting, 4 chair(s) left
customer 5 is waiting, 3 chair(s) left
customer 6 is waiting, 2 chair(s) left
The barber is cutting hair for customer 4
customer 7 is waiting, 2 chair(s) left
customer 8 is waiting, 1 chair(s) left
customer 9 is waiting, 0 chair(s) left
The customer 10 is leaving since no chair to sit
The barber is cutting hair for customer 5
customer 11 is waiting, 0 chair(s) left
The customer 12 is leaving since no chair to sit
The customer 13 is leaving since no chair to sit
The customer 14 is leaving since no chair to sit
The barber is cutting hair for customer 6
customer 15 is waiting, 0 chair(s) left
The customer 16 is leaving since no chair to sit
The customer 17 is leaving since no chair to sit
The customer 18 is leaving since no chair to sit
The customer 19 is leaving since no chair to sit
The customer 20 is leaving since no chair to sit
The barber is cutting hair for customer 7
customer 21 is waiting, 0 chair(s) left
The customer 22 is leaving since no chair to sit
The customer 23 is leaving since no chair to sit
The customer 24 is leaving since no chair to sit
The customer 25 is leaving since no chair to sit
The customer 26 is leaving since no chair to sit
The customer 27 is leaving since no chair to sit
The barber is cutting hair for customer 8
customer 28 is waiting, 0 chair(s) left
The customer 29 is leaving since no chair to sit
The customer 30 is leaving since no chair to sit
```

```
The customer 31 is leaving since no chair to sit
The customer 32 is leaving since no chair to sit
The customer 33 is leaving since no chair to sit
The customer 34 is leaving since no chair to sit
The customer 35 is leaving since no chair to sit
The customer 36 is leaving since no chair to sit
The barber is cutting hair for customer 9
customer 37 is waiting, 0 chair(s) left
The customer 38 is leaving since no chair to sit
The customer 39 is leaving since no chair to sit
The customer 40 is leaving since no chair to sit
The customer 41 is leaving since no chair to sit
The customer 42 is leaving since no chair to sit
The customer 43 is leaving since no chair to sit
The customer 44 is leaving since no chair to sit
The customer 45 is leaving since no chair to sit
The customer 46 is leaving since no chair to sit
The customer 47 is leaving since no chair to sit
The barber is cutting hair for customer 11
customer 48 is waiting, 0 chair(s) left
The customer 49 is leaving since no chair to sit
The customer 50 is leaving since no chair to sit
The barber is cutting hair for customer 15
The barber is cutting hair for customer 21
The barber is cutting hair for customer 28
The barber is cutting hair for customer 37
The barber is cutting hair for customer 48

*****  A 'wait' instruction was executed and no more interrupts are scheduled... halting emulation!  *****

Done!  The next instruction to execute will be:
000EC8: 09000000       ret
Number of Disk Reads    = 0
Number of Disk Writes   = 0
Instructions Executed   = 303442
Time Spent Sleeping     = 0
    Total Elapsed Time  = 303442
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$
```

有理发时间，即执行get_haircut(id)的情况：

```
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$ blitz -g os
Beginning execution...
====================  KPL PROGRAM STARTING  ====================
Initializing Thread Scheduler...
customer 1 is waiting, 4 chair(s) left
customer 2 is waiting, 3 chair(s) left
customer 3 is waiting, 2 chair(s) left
The barber is cutting hair for customer 1
The barber is cutting hair for customer 2
The barber is cutting hair for customer 3
customer 4 is waiting, 4 chair(s) left
customer 5 is waiting, 3 chair(s) left
customer 6 is waiting, 2 chair(s) left
The barber is cutting hair for customer 4
customer 7 is waiting, 2 chair(s) left
customer 8 is waiting, 1 chair(s) left
customer 9 is waiting, 0 chair(s) left
The customer 10 is leaving since no chair to sit
The customer 11 is leaving since no chair to sit
The customer 12 is leaving since no chair to sit
The customer 13 is leaving since no chair to sit
The customer 14 is leaving since no chair to sit
The customer 15 is leaving since no chair to sit
The customer 16 is leaving since no chair to sit
The customer 17 is leaving since no chair to sit
The customer 18 is leaving since no chair to sit
The customer 19 is leaving since no chair to sit
The customer 20 is leaving since no chair to sit
The customer 21 is leaving since no chair to sit
The customer 22 is leaving since no chair to sit
The customer 23 is leaving since no chair to sit
The customer 24 is leaving since no chair to sit
The customer 25 is leaving since no chair to sit
The customer 26 is leaving since no chair to sit
The customer 27 is leaving since no chair to sit
The customer 28 is leaving since no chair to sit
The customer 29 is leaving since no chair to sit
The customer 30 is leaving since no chair to sit
The customer 31 is leaving since no chair to sit
The customer 32 is leaving since no chair to sit
```

```
The customer 33 is leaving since no chair to sit
The customer 34 is leaving since no chair to sit
The customer 35 is leaving since no chair to sit
The customer 36 is leaving since no chair to sit
The barber is cutting hair for customer 5
customer 37 is waiting, 0 chair(s) left
The customer 38 is leaving since no chair to sit
The customer 39 is leaving since no chair to sit
The customer 40 is leaving since no chair to sit
The customer 41 is leaving since no chair to sit
The customer 42 is leaving since no chair to sit
The customer 43 is leaving since no chair to sit
The customer 44 is leaving since no chair to sit
The customer 45 is leaving since no chair to sit
The customer 46 is leaving since no chair to sit
The customer 47 is leaving since no chair to sit
The customer 48 is leaving since no chair to sit
The customer 49 is leaving since no chair to sit
The customer 50 is leaving since no chair to sit
The barber is cutting hair for customer 6
The barber is cutting hair for customer 7
The barber is cutting hair for customer 8
The barber is cutting hair for customer 9
The barber is cutting hair for customer 37

*****  A 'wait' instruction was executed and no more interrupts are scheduled... halting emulation!  *****

Done!  The next instruction to execute will be:
000EC8: 09000000       ret
Number of Disk Reads    = 0
Number of Disk Writes   = 0
Instructions Executed   = 441870
Time Spent Sleeping     = 0
    Total Elapsed Time  = 441870
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$
```

显然，有理发时间的情况比没有理发时间的情况，成功理发的顾客要多。符合预期。

Task 2 The Gaming Parlor Problem

1、代码说明

① 类的定义

```
1   class gamingParlorMonitor
2     superclass Object
3     fields
4
5       -- dices left
6       dice_avail: int
7       mutex: Mutex
8
9       -- to ensure that have only 1 thread in while_
10      wait_: Condition
11      wait_count: int
12
13      -- whether the dices are enough
```

```
    dice_not_enough: Condition



  methods
    Init()
    Request(number_of_dice: int)
    Return(number_of_dice: int)
    Print(str: String, count: int)
  endClass
```

- dice_avail：剩余的骰子
- mutex：锁
- wait_：用来**保证按照顺序给出骰子，不会进入饥饿状态的条件变量**：保证每一次只会有一个线程进入询问骰子的while内。下文会详细讲述。
- wait_count：用来记录当前是否有多于1个线程在等待取骰子。
- dice_not_enough：条件变量，用来标志当前骰子不足。

② 各个函数的作用

- Init() 略
- Request(number_of_dice: int)

```
method Request(number_of_dice: int)
  mutex.Lock()
  self.Print ("requests", number_of_dice)



  wait_count = wait_count + 1
  if wait_count > 1
    wait_.Wait(&mutex)
  endIf


  while dice_avail < number_of_dice
    -- dice is not enough
    dice_not_enough.Wait(&mutex)
  endWhile

  -- dice is enough now
  dice_avail = dice_avail - number_of_dice

  wait_count = wait_count - 1
  wait_.Signal(&mutex)

  self.Print("proceeded with", number_of_dice)
  mutex.Unlock()

endMethod


method Return(number_of_dice: int)
  mutex.Lock()
  dice_avail = dice_avail + number_of_dice
```

```
        self.Print("returned", number_of_dice)

        -- ensure signal when enough and the queue order unchanged
        dice_not_enough.Signal(&mutex)
        mutex.Unlock()

    endMethod
```

- 先上锁，输出必要语句。更新wait_count的值。如果目前已经有大于1的线程在索要骰子，我们将当前线程放入条件变量wait_的wait队列中。**【它将在前一个索取线程成功索取后被signal，以确保永远只有一个索取线程在索要骰子，并确保它们都是按照队列顺序一个一个索取的，以避免发生下面的状况：有两个等待索取的线程，前面的需要5个，后面的需要3个，而现在有2个骰子。更前的一个线程归还了2个骰子后，唤醒需要5个骰子的线程，骰子仍然不足，这时候就会再次sleep，但它被加入到了队列的最后面，从而可能导致它会长时间无法获得骰子，这不是我们想见到的】**当该索取线程被signal后，它进入while判断当前有的骰子是否足够。若不够，则进入dice_not_enough的等待队列。而在这一个索取线程成功索取之前，不会再有另外一个在后面的索取线程进入到条件变量dice_not_enough的等待队列中，而是都在wait_的等待队列中。当足够后，进行索取，wait_count -1，为下一个索取线程signal。最后解锁。

- Return(number_of_dice: int)

```
    method Return(number_of_dice: int)
        mutex.Lock()
        dice_avail = dice_avail + number_of_dice
        self.Print("returned", number_of_dice)

        -- ensure signal when enough and the queue order unchanged
        dice_not_enough.Signal(&mutex)
        mutex.Unlock()

    endMethod
```

- 先上锁。还骰子，对条件变量dice_not_enough进行signal，最后解锁。

- 测试函数

```
var
  gaming_monitor: gamingParlorMonitor = new gamingParlorMonitor
  playerArray: array[8] of Thread = new array of Thread {8 of new
Thread}

   function gamingParlorProblem()
     gaming_monitor.Init()

     playerArray[0].Init("A")
     playerArray[0].Fork(game, 4)
     playerArray[1].Init("B")
     playerArray[1].Fork(game, 4)
     playerArray[2].Init("C")
     playerArray[2].Fork(game, 5)
     playerArray[3].Init("D")
     playerArray[3].Fork(game, 5)
     playerArray[4].Init("E")
     playerArray[4].Fork(game, 2)
     playerArray[5].Init("F")
     playerArray[5].Fork(game, 2)
```

```
    playerArray[6].Init("G")
    playerArray[6].Fork(game, 1)
    playerArray[7].Init("H")
    playerArray[7].Fork(game, 1)

  endFunction

  function game(dice_need: int)
  var
    i: int
    j: int
    for i = 1 to 5
      gaming_monitor.Request(dice_need)

      -- play
      for j = 1 to 50
        currentThread.Yield()
      endFor

      gaming_monitor.Return(dice_need)

      -- to avoid a group play continuously
      currentThread.Yield()
    endFor

  endFunction
```

- 要点在game()：每个group进行5次索取。在每次索取后，使用数次（这里50次）currentThread.Yield()表示**play持续时间**。最后归还后，为了避免一个组连续地归还后直接索取，在归还后增加了一个currentThread.Yield()。

2、测试结果

① 没有play持续时间

```
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$ blitz -g os
Beginning execution...
====================  KPL PROGRAM STARTING  ====================
Initializing Thread Scheduler...
A requests 4
-----------------------------Number of dice now avail = 8
A proceeded with 4
-----------------------------Number of dice now avail = 4
A returned 4
-----------------------------Number of dice now avail = 8
B requests 4
-----------------------------Number of dice now avail = 8
B proceeded with 4
-----------------------------Number of dice now avail = 4
C requests 5
-----------------------------Number of dice now avail = 4
D requests 5
-----------------------------Number of dice now avail = 4
A requests 4
-----------------------------Number of dice now avail = 4
B returned 4
-----------------------------Number of dice now avail = 8
E requests 2
-----------------------------Number of dice now avail = 8
G requests 1
-----------------------------Number of dice now avail = 8
H requests 1
-----------------------------Number of dice now avail = 8
F requests 2
-----------------------------Number of dice now avail = 8
C proceeded with 5
-----------------------------Number of dice now avail = 3
B requests 4
-----------------------------Number of dice now avail = 3
C returned 5
-----------------------------Number of dice now avail = 8
D proceeded with 5
-----------------------------Number of dice now avail = 3
C requests 5
-----------------------------Number of dice now avail = 3
```

```
D returned 5
------------------------------Number of dice now avail = 8
A proceeded with 4
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
E proceeded with 2
------------------------------Number of dice now avail = 2
A returned 4
------------------------------Number of dice now avail = 6
G proceeded with 1
------------------------------Number of dice now avail = 5
E returned 2
------------------------------Number of dice now avail = 7
A requests 4
------------------------------Number of dice now avail = 7
G returned 1
------------------------------Number of dice now avail = 8
H proceeded with 1
------------------------------Number of dice now avail = 7
E requests 2
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8
F proceeded with 2
------------------------------Number of dice now avail = 6
G requests 1
------------------------------Number of dice now avail = 6
H requests 1
------------------------------Number of dice now avail = 6
B proceeded with 4
------------------------------Number of dice now avail = 2
F returned 2
------------------------------Number of dice now avail = 4
B returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
F requests 2
------------------------------Number of dice now avail = 3
B requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
```

```
C requests 5
------------------------------Number of dice now avail = 3
D returned 5
------------------------------Number of dice now avail = 8
A proceeded with 4
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
E proceeded with 2
------------------------------Number of dice now avail = 2
A returned 4
------------------------------Number of dice now avail = 6
E returned 2
------------------------------Number of dice now avail = 8
G proceeded with 1
------------------------------Number of dice now avail = 7
A requests 4
------------------------------Number of dice now avail = 7
E requests 2
------------------------------Number of dice now avail = 7
G returned 1
------------------------------Number of dice now avail = 8
H proceeded with 1
------------------------------Number of dice now avail = 7
G requests 1
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8
F proceeded with 2
------------------------------Number of dice now avail = 6
H requests 1
------------------------------Number of dice now avail = 6
B proceeded with 4
------------------------------Number of dice now avail = 2
F returned 2
------------------------------Number of dice now avail = 4
B returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
F requests 2
------------------------------Number of dice now avail = 3
B requests 4
------------------------------Number of dice now avail = 3
```

```
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
C requests 5
------------------------------Number of dice now avail = 3
D returned 5
------------------------------Number of dice now avail = 8
A proceeded with 4
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
E proceeded with 2
------------------------------Number of dice now avail = 2
A returned 4
------------------------------Number of dice now avail = 6
E returned 2
------------------------------Number of dice now avail = 8
G proceeded with 1
------------------------------Number of dice now avail = 7
A requests 4
------------------------------Number of dice now avail = 7
E requests 2
------------------------------Number of dice now avail = 7
G returned 1
------------------------------Number of dice now avail = 8
H proceeded with 1
------------------------------Number of dice now avail = 7
G requests 1
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8
F proceeded with 2
------------------------------Number of dice now avail = 6
H requests 1
------------------------------Number of dice now avail = 6
B proceeded with 4
------------------------------Number of dice now avail = 2
F returned 2
------------------------------Number of dice now avail = 4
B returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
F requests 2
------------------------------Number of dice now avail = 3
```

```
B requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
C requests 5
------------------------------Number of dice now avail = 3
D returned 5
------------------------------Number of dice now avail = 8
A proceeded with 4
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
E proceeded with 2
------------------------------Number of dice now avail = 2
A returned 4
------------------------------Number of dice now avail = 6
E returned 2
------------------------------Number of dice now avail = 8
G proceeded with 1
------------------------------Number of dice now avail = 7
E requests 2
------------------------------Number of dice now avail = 7
G returned 1
------------------------------Number of dice now avail = 8
H proceeded with 1
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8
G requests 1
------------------------------Number of dice now avail = 8
F proceeded with 2
------------------------------Number of dice now avail = 6
H requests 1
------------------------------Number of dice now avail = 6
F returned 2
------------------------------Number of dice now avail = 8
B proceeded with 4
------------------------------Number of dice now avail = 4
F requests 2
------------------------------Number of dice now avail = 4
B returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
```

```
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
D returned 5
------------------------------Number of dice now avail = 8
E proceeded with 2
------------------------------Number of dice now avail = 6
G proceeded with 1
------------------------------Number of dice now avail = 5
E returned 2
------------------------------Number of dice now avail = 7
G returned 1
------------------------------Number of dice now avail = 8
H proceeded with 1
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8
F proceeded with 2
------------------------------Number of dice now avail = 6
F returned 2
------------------------------Number of dice now avail = 8

*****  A 'wait' instruction was executed and no more interrupts are scheduled... halting emulation!  *****

Done!  The next instruction to execute will be:
000EC8: 09000000       ret
Number of Disk Reads    = 0
Number of Disk Writes   = 0
Instructions Executed   = 505420
Time Spent Sleeping     = 0
    Total Elapsed Time  = 505420
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$
```

① 有play持续时间

为了您看得方便，还是直接复制结果吧...

```
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$ blitz -g
os
Beginning execution...
====================  KPL PROGRAM STARTING  ====================
Initializing Thread Scheduler...
A requests 4
------------------------------Number of dice now avail = 8
A proceeded with 4
------------------------------Number of dice now avail = 4
B requests 4
------------------------------Number of dice now avail = 4
B proceeded with 4
------------------------------Number of dice now avail = 0
C requests 5
------------------------------Number of dice now avail = 0
D requests 5
------------------------------Number of dice now avail = 0
E requests 2
------------------------------Number of dice now avail = 0
F requests 2
```

```
------------------------------Number of dice now avail = 0
G requests 1
------------------------------Number of dice now avail = 0
H requests 1
------------------------------Number of dice now avail = 0
B returned 4
------------------------------Number of dice now avail = 4
B requests 4
------------------------------Number of dice now avail = 4
A returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
A requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
E proceeded with 2
------------------------------Number of dice now avail = 1
C requests 5
------------------------------Number of dice now avail = 1
D returned 5
------------------------------Number of dice now avail = 6
F proceeded with 2
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
G proceeded with 1
------------------------------Number of dice now avail = 3
H proceeded with 1
------------------------------Number of dice now avail = 2
E returned 2
------------------------------Number of dice now avail = 4
B proceeded with 4
------------------------------Number of dice now avail = 0
E requests 2
------------------------------Number of dice now avail = 0
G returned 1
------------------------------Number of dice now avail = 1
G requests 1
------------------------------Number of dice now avail = 1
F returned 2
------------------------------Number of dice now avail = 3
H returned 1
------------------------------Number of dice now avail = 4
A proceeded with 4
------------------------------Number of dice now avail = 0
H requests 1
------------------------------Number of dice now avail = 0
F requests 2
------------------------------Number of dice now avail = 0
B returned 4
------------------------------Number of dice now avail = 4
B requests 4
------------------------------Number of dice now avail = 4
A returned 4
```

```
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
A requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
E proceeded with 2
------------------------------Number of dice now avail = 1
C requests 5
------------------------------Number of dice now avail = 1
G proceeded with 1
------------------------------Number of dice now avail = 0
D returned 5
------------------------------Number of dice now avail = 5
H proceeded with 1
------------------------------Number of dice now avail = 4
D requests 5
------------------------------Number of dice now avail = 4
F proceeded with 2
------------------------------Number of dice now avail = 2
G returned 1
------------------------------Number of dice now avail = 3
G requests 1
------------------------------Number of dice now avail = 3
E returned 2
------------------------------Number of dice now avail = 5
B proceeded with 4
------------------------------Number of dice now avail = 1
E requests 2
------------------------------Number of dice now avail = 1
F returned 2
------------------------------Number of dice now avail = 3
H returned 1
------------------------------Number of dice now avail = 4
F requests 2
------------------------------Number of dice now avail = 4
A proceeded with 4
------------------------------Number of dice now avail = 0
H requests 1
------------------------------Number of dice now avail = 0
B returned 4
------------------------------Number of dice now avail = 4
B requests 4
------------------------------Number of dice now avail = 4
A returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
A requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
G proceeded with 1
```

```
------------------------------Number of dice now avail = 2
C requests 5
------------------------------Number of dice now avail = 2
E proceeded with 2
------------------------------Number of dice now avail = 0
D returned 5
------------------------------Number of dice now avail = 5
E returned 2
------------------------------Number of dice now avail = 7
F proceeded with 2
------------------------------Number of dice now avail = 5
D requests 5
------------------------------Number of dice now avail = 5
E requests 2
------------------------------Number of dice now avail = 5
H proceeded with 1
------------------------------Number of dice now avail = 4
B proceeded with 4
------------------------------Number of dice now avail = 0
G returned 1
------------------------------Number of dice now avail = 1
G requests 1
------------------------------Number of dice now avail = 1
F returned 2
------------------------------Number of dice now avail = 3
F requests 2
------------------------------Number of dice now avail = 3
H returned 1
------------------------------Number of dice now avail = 4
A proceeded with 4
------------------------------Number of dice now avail = 0
H requests 1
------------------------------Number of dice now avail = 0
B returned 4
------------------------------Number of dice now avail = 4
B requests 4
------------------------------Number of dice now avail = 4
A returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
A requests 4
------------------------------Number of dice now avail = 3
C returned 5
------------------------------Number of dice now avail = 8
D proceeded with 5
------------------------------Number of dice now avail = 3
C requests 5
------------------------------Number of dice now avail = 3
E proceeded with 2
------------------------------Number of dice now avail = 1
G proceeded with 1
------------------------------Number of dice now avail = 0
E returned 2
------------------------------Number of dice now avail = 2
F proceeded with 2
------------------------------Number of dice now avail = 0
E requests 2
```

```
------------------------------Number of dice now avail = 0
D returned 5
------------------------------Number of dice now avail = 5
H proceeded with 1
------------------------------Number of dice now avail = 4
B proceeded with 4
------------------------------Number of dice now avail = 0
D requests 5
------------------------------Number of dice now avail = 0
G returned 1
------------------------------Number of dice now avail = 1
G requests 1
------------------------------Number of dice now avail = 1
F returned 2
------------------------------Number of dice now avail = 3
F requests 2
------------------------------Number of dice now avail = 3
H returned 1
------------------------------Number of dice now avail = 4
A proceeded with 4
------------------------------Number of dice now avail = 0
H requests 1
------------------------------Number of dice now avail = 0
B returned 4
------------------------------Number of dice now avail = 4
A returned 4
------------------------------Number of dice now avail = 8
C proceeded with 5
------------------------------Number of dice now avail = 3
E proceeded with 2
------------------------------Number of dice now avail = 1
C returned 5
------------------------------Number of dice now avail = 6
D proceeded with 5
------------------------------Number of dice now avail = 1
G proceeded with 1
------------------------------Number of dice now avail = 0
E returned 2
------------------------------Number of dice now avail = 2
F proceeded with 2
------------------------------Number of dice now avail = 0
D returned 5
------------------------------Number of dice now avail = 5
H proceeded with 1
------------------------------Number of dice now avail = 4
G returned 1
------------------------------Number of dice now avail = 5
F returned 2
------------------------------Number of dice now avail = 7
H returned 1
------------------------------Number of dice now avail = 8

*****  A 'wait' instruction was executed and no more interrupts are
scheduled... halting emulation!  *****

Done!  The next instruction to execute will be:
000EC8: 09000000       ret
Number of Disk Reads    = 0
```

```
Number of Disk Writes   = 0
Instructions Executed   = 3144216
Time Spent Sleeping     = 0
    Total Elapsed Time  = 3144216
harryovo@harryovo-virtual-machine:~/Desktop/lab3/osai22/labs/lab3$
```