CST 334 (Operating Systems)

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# Lab: Free Space Management

The purpose of this lab is to help you get hands-on experience with memory allocation.

This lab is based on the malloc simulator provided by the authors of our text. Look in the following directory on mlc104 if you want to run the simulator yourself later.

/home/CLASSES/brunsglenn/OSTEP/HW-Freespace

**Simulation 1**. Assume the initial state of the free list is [ addr: 1000, sz: 100 ]

Write the state of the free list after each operation. Keep the free list sorted by memory address, and do not perform coalescing. Also, if the operation is Alloc(), write the returned address, or write "error" if the Alloc() would cause an error.

For example, the answer to the first problem is: address 1000 is returned, and the new state of the free list is [ addr: 1001, sz: 99 ]. All answers are shown in the hints section.

1. p0 = Alloc(1)
2. Free(p0)
3. p1 = Alloc(7)
4. Free(p1)
5. p2 = Alloc(5)
6. p3 = Alloc(8)
7. Free(p3)
8. Free(p2)
9. p4 = Alloc(1)
10. p5 = Alloc(5)

**Simulation 2**. Assume the initial state of the free list is [ addr: 500, sz: 20 ]

Write the state of the free list after each operation. Keep the free list sorted by memory address again, but this time perform coalescing after each Free() operation, if possible.

1. p0 = Alloc(6)
2. p1 = Alloc(7)
3. Free(p0)
4. p2 = Alloc(9)
5. p3 = Alloc(3)
6. Free(p1)
7. Free(p3)
8. p4 = Alloc(7)
9. Free(p4)
10. p5 = Alloc(8)

If you still have time, try running the simulator yourself.

## Hints:

Correct output for **simulation 1**:

p0 = Alloc(1) returned 1000

Free List: [ addr:1001 sz:99 ]

Free(p0)

Free List: [ addr:1000 sz:1 ] [ addr:1001 sz:99 ]

p1 = Alloc(7) returned 1001

Free List: [ addr:1000 sz:1 ] [ addr:1008 sz:92 ]

Free(p1)

Free List: [ addr:1000 sz:1 ] [ addr:1001 sz:7 ] [ addr:1008 sz:92 ]

p2 = Alloc(5) returned 1001

Free List: [ addr:1000 sz:1 ] [ addr:1006 sz:2 ] [ addr:1008 sz:92 ]

p3 = Alloc(8) returned 1008

Free List: [ addr:1000 sz:1 ] [ addr:1006 sz:2 ] [ addr:1016 sz:84 ]

Free(p3)

Free List: [ addr:1000 sz:1 ] [ addr:1006 sz:2 ] [ addr:1008 sz:8 ] [ addr:1016 sz:84 ]

Free(p2)

Free List: [ addr:1000 sz:1 ] [ addr:1001 sz:5 ] [ addr:1006 sz:2 ] [ addr:1008 sz:8 ]

[ addr:1016 sz:84 ]

p4 = Alloc(1) returned 1000

Free List: [ addr:1001 sz:5 ] [ addr:1006 sz:2 ] [ addr:1008 sz:8 ] [ addr:1016 sz:84 ]

p5 = Alloc(5) returned 1001

Free List: [ addr:1006 sz:2 ] [ addr:1008 sz:8 ] [ addr:1016 sz:84 ]

Correct output for **simulation 2**:

p0 = Alloc(6) returned 500

Free List: [ addr:506 sz:14 ]

p1 = Alloc(7) returned 506

Free List: [ addr:513 sz:7 ]

Free(p0])

Free List: [ addr:500 sz:6 ] [ addr:513 sz:7 ]

p2 = Alloc(9) error

Free List: [ addr:500 sz:6 ] [ addr:513 sz:7 ]

p3 = Alloc(3) returned 500

Free List: [ addr:503 sz:3 ] [ addr:513 sz:7 ]

Free(p1])

Free List: [ addr:503 sz:17 ]

Free(p3])

Free List: [ addr:500 sz:20 ]

p4 = Alloc(7) returned 500

Free List: [ addr:507 sz:13 ]

Free(p4])

Free List: [ addr:500 sz:20 ]

p5 = Alloc(8) returned 500

Free List: [ addr:508 sz:12 ]