Zach Dubinsky

CSC-270-01

3/17/22

Prof. Rieffel

Lab 7

## 1. Diagram of mknodes

0x00	NEXT (= \$r7 = NIL = 0)	The bottom of the node heap is
0x04	DATA	the first node. Nodes are added from bottom to top, with ordering
	•	enforced by saving the appropriate memory address into the NEXT field of each node. Each node in the heap is colored differently. The choice of addresses are arbitrary but the intervals are correct.
0x68	DATA	+
0x6c	NEXT (= 0x64 - nodesize)	φ14 – φ13 - Hodes
0x70	DATA	¢r2 = ¢r2 nodocizo (str'd on
0x74	NEXT (= 0x74 - nodesize)	\$r3 = \$r3 - nodesize (str'd on stack)
0x78	DATA	\$r3 = base_address + heapsize

2. I have included screenshots of my test on the *insert* subroutine. The first image shows the allocated empty space that the heap occupies. The second shows the heap after it has become a free list of nodes by *mknodes*. Note that, with the exception of the first two words, every other word is empty or an address. The former corresponds to the data portion of a node, and the latter corresponds to the address of the next node in the chain. My next two pictures show four subsequent calls to *insert* and the change that occurs in data memory. Finally, the last image shows data memory for the linked list when all elements of the array have been inserted. The output to the console is also included.

```
x1061c <heap>: 0x0002106c
gdb) x/30xw 0x2106c
0x2106c:
                 0x00000000
                                   0x00000000
                                                     0x00000000
                                                                       0x00000000
                 0x00000000
0x2107c:
                                   0x00000000
                                                     0x00000000
                                                                       0x00000000
                                   0x00000000
9x2108c:
                 0x00000000
                                                     0x00000000
                                                                       0x00000000
0x2109c:
                 0x00000000
                                   0x00000000
                                                     0x00000000
                                                                       0x00000000
                 0x00000000
                                   0x00000000
                                                     0x00000000
                                                                       0x00000000
0x210ac:
9x210bc:
                 0x00000000
                                   0x00000000
                                                     0x00000000
                                                                       0x00000000
                                                     0x00000000
9x210cc:
                 ехеееееее
                                   ехевевеве
                                                                       ехеееееее
                 0x00000000
                                   0x00000000
9x210dc:
gdb) continue
continuing.
                                                           Data memory before mknodes,
Breakpoint 2, 0x0001045c in main ()
                                                           where the heap has been allocated
gdb) disassemble
                                                           will go (all 0's).
cump of assembler code for function main:
                                   {lr}
{r0}
   0x00010440 <+0>:
                          push
                                                                [sp, #-4]!)
[sp, #-4]!)
   0x00010444 <+4>:
                          push
                                                       (str re,
   0x00010448 <+8>:
                                       #0
[pc,
                          mov
   0x0001044c <+12>:
                          ldr
                                                      0x1061c <heap>
                                   rθ,
                                             #456]
                                   r1, #120
   0x00010450
              <+16>:
                          mov
                                                      0x78
   0x00010454
   0x00010458
              <+24>:
                          b1
                                   0x104a8
                                           <mknodes>
                                                                   The free list created by
  0x0001045c
               <+28>:
                          mov
   0x00010460
              <+32>:
                          mov
                                       r7
                                                                  mknodes.
   0x00010464 <+36>;
                          mov
                                   r4,
                                       #0
                                                     ; 0x10624 <arr_len>
   0x00010468
              <+40>:
                          ldr
                                       [pc,
                                             #436]
              <+44>:
   0x0001046c
                          ldr
                                        [r5]
   0x00010470
                                       [pc,
                                                     ; 0x10620 <arr>
End of assembler dump.
(gdb) x /45xw0x2106c
                 0x00000000
                                   0x00000000
                                                    0x0002106c
                                                                      0x00000000
0x2106c:
0x2107c:
                 0x00021074
                                   0x00000000
                                                    0x0002107c
                                                                      0x00000000
0x2108c:
                 0x00021084
                                   0x00000000
                                                     0x0002108c
                                                                      0x00000000
0x2109c:
                 0x00021094
                                   0x00000000
                                                    0x0002109c
                                                                      0x00000000
                 0x000210a4
                                                    0x000210ac
0x210ac:
                                   0x00000000
                                                                      0x00000000
                 0x000210b4
                                   0x00000000
                                                                      0x00000000
                                                    0x000210bc
9x210bc:
9x210cc:
                 0x000210c4
                                   0x00000000
                                                    0x000210cc
                                                                      0x00000000
9x210dc:
                 0x000210d4
                                   0x00000000
9x210ec:
9x210fc:
9x2110c:
)x2111c:
```

```
Breakpoint 3, 0x00010484 in add_loop ()
(qdb) x/45xw 0x2106c
0x2106c:
                 0x00000000
                                  0x00000000
                                                   0x0002106c
                                                                    0x00000000
0x2107c:
                 0x00021074
                                  0x00000000
                                                   0x0002107c
                                                                    0x00000000
0x2108c:
                 0x00021084
                                  0x00000000
                                                   0x0002108c
                                                                    0x00000000
0x2109c:
                 0x00021094
                                  0x00000000
                                                   0x0002109c
                                                                    0x00000000
                 0x000210a4
                                  0x00000000
                                                   0x000210ac
                                                                    0x00000000
0x210ac:
0x210bc:
                 0x000210b4
                                  0x00000000
                                                   0x000210bc
                                                                    0x00000000
                 0x000210c4
                                  0x00000000
                                                   0x000210cc
0x210cc:
                                                                    0x00000000
0x210dc:
                 0x00000000
                                  0x00000005
                                                   0x0a006425
                                                                    0x2c002000
0x210ec:
                 0x74754f00
                                  0x20666f20
                                                   0x65657266
                                                                    0x646f6e20
                                                   0x74616e69
0x210fc:
                                  0x6d726574
                                                                    0x20676e69
                 0x202c7365
0x2110c:
                 0x676f7270
                                  0x2e6d6172
                                                   0x00000000a
                                                                    0x00000000
0x2111c:
                 0x00000000
gdb)
```

```
Breakpoint 3, 0x00010484 in add_loop ()
(gdb) x/45xw 0x2106c
0x2106c:
                 0x00000000
                                   0x00000000
                                                    0x0002106c
                                                                     0x00000000
0x2107c:
                 0x00021074
                                   0x00000000
                                                    0x0002107c
                                                                     0x00000000
                 0x00021084
                                  0x00000000
                                                    0x0002108c
                                                                     0x00000000
0x2108c:
                 0x00021094
0x2109c:
                                  0x00000000
                                                    0x0002109c
                                                                     0x00000000
0x210ac:
                 0x000210a4
                                   0x00000000
                                                    0x000210ac
                                                                      0x00000000
                                                    0x000210bc
0x210bc:
                 0x000210b4
                                  0x00000000
                                                                     0x00000000
                 0x000210c4
                                  0x00000000
                                                    0x00000000
                                                                     0x00000006
0x210cc:
                 0x000210d4
0x210dc:
                                   0x00000005
                                                    0x0a006425
                                                                     0x2c002000
                 0x74754f00
                                   0x20666f20
                                                                     0x646f6e20
0x210ec:
                                                    0x65657266
                 0x202c7365
                                  0x6d726574
                                                    0x74616e69
                                                                     0x20676e69
0x210fc:
                 0x676f7270
0x2110c:
                                  0x2e6d6172
                                                    0x0000000a
                                                                     0x00000000
0x2111c:
                 0x00000000
(gdb) continue
Continuing.
Breakpoint 3, 0x00010484 in add_loop ()
(gdb) x/45xw 0x2106c
                 0x00000000
                                  0x00000000
0x2106c:
                                                    0x0002106C
                                                                     execeeeee
0x2107c:
                 0x00021074
                                   0x00000000
                                                    0x0002107c
                                                                     0x00000000
                                                    0x0002108c
0x2108c:
                 0x00021084
                                   0x00000000
                                                                     0x00000000
0x2109c:
                 0x00021094
                                   0x00000000
                                                    0x0002109c
                                                                     0x00000000
                 0x000210a4
                                                    0x000210ac
                                                                     0x00000000
                                  0x00000000
0x210ac:
0x210bc:
                 0x000210b4
                                   0x00000000
                                                    0x000210bc
                                                                     0x00000000
0x210cc:
                 0x000210dc
                                   0xffffffff
                                                    0x00000000
                                                                     0x00000006
                 0x000210d4
                                                    0x0a006425
                                                                     0x2c002000
0x210dc:
                                  0x00000005
0x210ec:
                 0x74754f00
                                  0x20666f20
                                                    0x65657266
                                                                     0x646f6e20
0x210fc:
                 0x202c7365
                                   0x6d726574
                                                    0x74616e69
                                                                      0x20676e69
0x2110c:
                 0x676f7270
                                  0x2e6d6172
                                                    0x0000000a
                                                                     0x00000000
0x2111c:
                 0x00000000
(gdb) continue
Continuing.
Breakpoint 3, 0x00010484 in add_loop ()
(gdb) x/45xw 0x2106c
0x2106c:
                 0x00000000
                                   0x00000000
                                                    0x0002106c
                                                                     0x00000000
0x2107c:
                 0x00021074
                                  0x00000000
                                                    0x0002107c
                                                                     0x00000000
0x2108c:
                 0x00021084
                                   0x00000000
                                                    0x0002108c
                                                                     0x00000000
                 0x00021094
                                   0x00000000
                                                    0x0002109c
0x2109c:
                                                                      0x00000000
                 0x000210a4
                                  0x00000000
                                                    0x000210ac
                                                                     0x00000000
0x210ac:
0x210bc:
                 0x000210b4
                                   0x00000000
                                                    0x00000000
                                                                     0x0000000c
0x210cc:
                 0x000210dc
                                   0xffffffff
                                                    0x000210c4
                                                                     0x00000006
0x210dc:
                 0x000210d4
                                  0x00000005
                                                    0x0a006425
                                                                     0x2c002000
                                  0x20666f20
                                                    0x65657266
                 0x74754f00
                                                                     0x646f6e20
0x210ec:
0x210fc:
                 0x202c7365
                                  0x6d726574
                                                    0x74616e69
                                                                     0x20676e69
0x2110c:
                 0x676f7270
                                   0x2e6d6172
                                                    0x0000000a
                                                                     0x00000000
0x2111c:
                 0x00000000
(gdb)
```

```
(gdb) x/35xw0x2106c
0x2106c:
                  0x00000000
                                    0x00000000
                                                      0x0002106c
                                                                        0x00000000
0x2107c:
                  0x00021074
                                                      0x0002107c
                                    0x00000000
                                                                        0x00000000
0x2108c:
                  0x00021084
                                    0x00000000
                                                      0x0002108c
                                                                        0x00000000
0x2109c:
                  0x00021094
                                    0x00000000
                                                      0x000210dc
                                                                        0x000000002
0x210ac:
                                                      0x000210cc
                                                                        0xffffff92
                  0x00000000
                                    0x0000044e
                                                                        0x0000000c
0x210bc:
                  0x000210ac
                                    0x00000070
                                                      0x000210bc
                                    0xffffffff
                                                      0x0000210c4
                                                                        0x00000006
0x210cc:
                  0x000210a4
                  0x000210d4
0x210dc:
                                    0x00000005
                                                      0205057200
0x210ec:
(gdb) continue
                                                          Elements in the list are ordered which is
 ontinuing.
110, -1, 2, 5, 6, 12, 112, 1102,
                                                          validated by the printing and confirmed
 Inferior 1 (process 3157) exited with code 0264]
                                                         by data memory.
```