

Zach Dubinsky

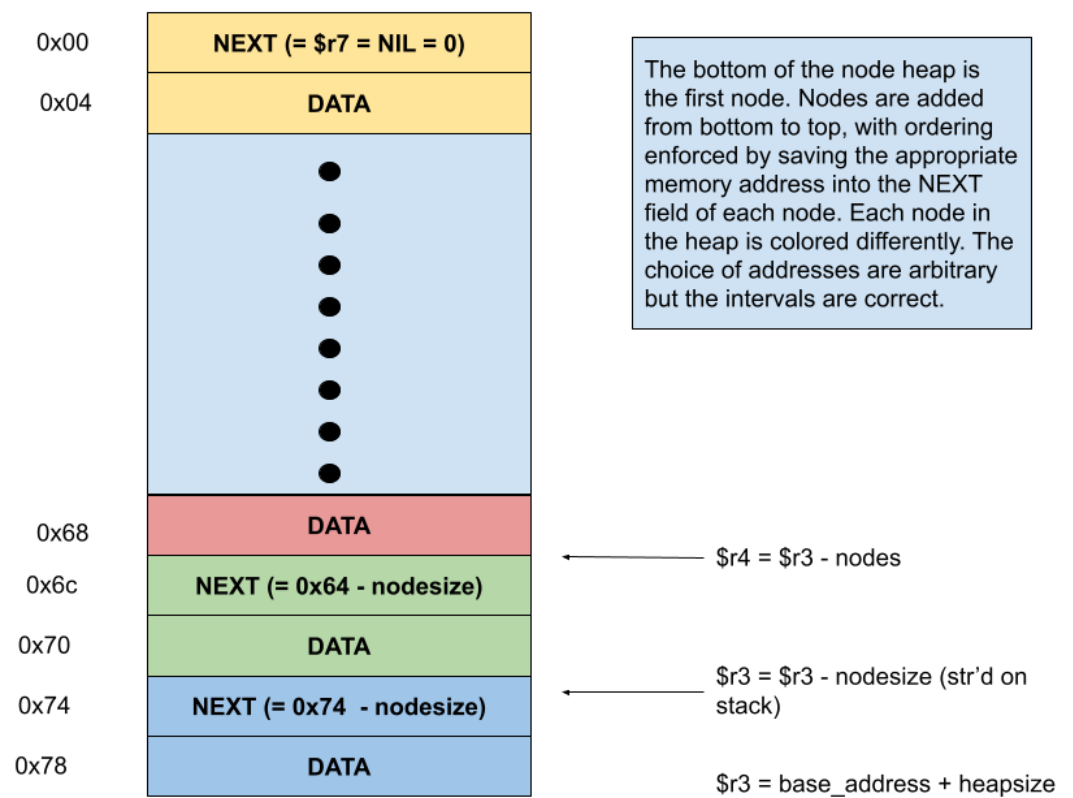
CSC-270-01

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Prof. Rieffel

## Lab 7

### 1. Diagram of mknodes



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. [66]

```
(gdb) x 0x1061c
0x1061c <heap>: 0x0002106c
(gdb) x/30xw 0x2106c
0x2106c: 0x00000000 0x00000000 0x00000000 0x00000000
0x2107c: 0x00000000 0x00000000 0x00000000 0x00000000
0x2108c: 0x00000000 0x00000000 0x00000000 0x00000000
0x2109c: 0x00000000 0x00000000 0x00000000 0x00000000
0x210ac: 0x00000000 0x00000000 0x00000000 0x00000000
0x210bc: 0x00000000 0x00000000 0x00000000 0x00000000
0x210cc: 0x00000000 0x00000000 0x00000000 0x00000000
0x210dc: 0x00000000 0x00000000 0x00000000 0x00000000
(gdb) continue
Continuing.

Breakpoint 2, 0x0001045c in main ()
(gdb) disassemble
Dump of assembler code for function main:
0x00010440 <+0>: push    {lr}           ; (str lr, [sp, #-4]!)
0x00010444 <+4>: push    {r0}           ; (str r0, [sp, #-4]!)
0x00010448 <+8>: mov     r7, #0
0x0001044c <+12>: ldr     r0, [pc, #456]   ; 0x1061c <heap>
0x00010450 <+16>: mov     r1, #120        ; 0x78
0x00010454 <+20>: mov     r2, #8
0x00010458 <+24>: bl      0x104a8 <mknodes>
=> 0x0001045c <+28>: mov     r2, r0
0x00010460 <+32>: mov     r1, r7
0x00010464 <+36>: mov     r4, #0
0x00010468 <+40>: ldr     r5, [pc, #436]   ; 0x10624 <arr_len>
0x0001046c <+44>: ldr     r5, [r5]
0x00010470 <+48>: ldr     r6, [pc, #424]   ; 0x10620 <arr>
End of assembler dump.
(gdb) x /45xw0x2106c
0x2106c: 0x00000000 0x00000000 0x0002106c 0x00000000
0x2107c: 0x00021074 0x00000000 0x0002107c 0x00000000
0x2108c: 0x00021084 0x00000000 0x0002108c 0x00000000
0x2109c: 0x00021094 0x00000000 0x0002109c 0x00000000
0x210ac: 0x000210a4 0x00000000 0x000210ac 0x00000000
0x210bc: 0x000210b4 0x00000000 0x000210bc 0x00000000
0x210cc: 0x000210c4 0x00000000 0x000210cc 0x00000000
0x210dc: 0x000210d4 0x00000000 0x000210dc 0x00000000
0x210ec: 0x74754f00 0x20000000 0x55557200 0x4cfc0000
0x210fc: 0x20000000 0x4cfc0000 0x74754f00 0x20000000
0x2110c: 0x4cfc0000 0x20000000 0x20000000 0x20000000
0x2111c: 0x00000000 0x00000000 0x00000000 0x00000000
(gdb) 
```

Data memory before *mknodes*, where the heap has been allocated will go (all 0's).

The free list created by *mknodes*.

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
0x2109c:	0x00021094	0x00000000	0x0002109c	0x00000000
0x210ac:	0x000210a4	0x00000000	0x000210ac	0x00000000
0x210bc:	0x000210b4	0x00000000	0x000210bc	0x00000000
0x210cc:	0x000210c4	0x00000000	0x000210cc	0x00000000
0x210dc:	0x00000000	0x00000005	0x0a006425	0x2c002000
0x210ec:	0x74754f00	0x20666f20	0x65657266	0x646f6e20
0x210fc:	0x202c7365	0x6d726574	0x74616e69	0x20676e69
0x2110c:	0x676f7270	0x2e6d6172	0x0000000a	0x00000000
0x2111c:	0x00000000			

(gdb) █

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
0x2109c:	0x00021094	0x00000000	0x0002109c	0x00000000
0x210ac:	0x000210a4	0x00000000	0x000210ac	0x00000000
0x210bc:	0x000210b4	0x00000000	0x000210bc	0x00000000
0x210cc:	0x000210c4	0x00000000	0x00000000	0x00000006
0x210dc:	0x000210d4	0x00000005	0x0a006425	0x2c002000
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
0x2109c:	0x00021094	0x00000000	0x0002109c	0x00000000
0x210ac:	0x000210a4	0x00000000	0x000210ac	0x00000000
0x210bc:	0x000210b4	0x00000000	0x000210bc	0x00000000
0x210cc:	0x000210dc	0xffffffff	0x00000000	0x00000006
0x210dc:	0x000210d4	0x00000005	0x0a006425	0x2c002000
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
0x2109c:	0x00021094	0x00000000	0x0002109c	0x00000000
0x210ac:	0x000210a4	0x00000000	0x000210ac	0x00000000
0x210bc:	0x000210b4	0x00000000	0x00000000	0x0000000c
0x210cc:	0x000210dc	0xffffffff	0x000210c4	0x00000006
0x210dc:	0x000210d4	0x00000005	0x0a006425	0x2c002000
0x210ec:	0x74754f00	0x20666f20	0x65657266	0x646f6e20
0x210fc:	0x202c7365	0x6d726574	0x74616e69	0x20676e69
0x2110c:	0x676f7270	0x2e6d6172	0x0000000a	0x00000000
0x2111c:	0x00000000			

(gdb) █

```
0x10010 heap: 0x0002106c
(gdb) x/35xw0x2106c
0x2106c: 0x00000000 0x00000000 0x0002106c 0x00000000
0x2107c: 0x00021074 0x00000000 0x0002107c 0x00000000
0x2108c: 0x00021084 0x00000000 0x0002108c 0x00000000
0x2109c: 0x00021094 0x00000000 0x000210dc 0x00000002
0x210ac: 0x00000000 0x0000044e 0x000210cc 0xffffffff92
0x210bc: 0x000210ac 0x00000070 0x000210bc 0x0000000c
0x210cc: 0x000210a4 0xffffffff 0x000210c4 0x00000006
0x210dc: 0x000210d4 0x00000005 0x0a006425 0x20002000
0x210ec: 0x74754f00 0x20006f20 0x65657266
(gdb) continue
Continuing.
-110, -1, 2, 5, 6, 12, 112, 1102,
[inferior 1 (process 3157) exited with code 0264]
(gdb) 
```

Elements in the list are ordered which is validated by the printing and confirmed by data memory.