

```
1: // $Id: insertion-sort.c,v 1.10 2015-05-28 19:45:20-07 - - $
2:
3: #include <stdio.h>
4: #include <string.h>
5:
6: void sort (void* a, size_t n, size_t w, int (*cmp) (void*, void*)) {
7:     char e[w];
8:     for (size_t s = 1; s < n; ++s) {
9:         size_t h = s;
10:        memcpy (e, a + h * w, w);
11:        while (h > 0) {
12:            int c = cmp (a + (h - 1) * w, e);
13:            if (c < 0) break;
14:            memcpy (a + h * w, a + (h - 1) * w, w);
15:            h = h - 1;
16:        }
17:        memcpy (a + h * w, e, w);
18:    }
19: }
20:
21: void print (int* a, size_t n) {
22:     for (size_t i = 0; i < n; ++i) printf (" %d", a[i]);
23:     printf ("\n");
24: }
25:
26: int cmp (void* p1, void* p2) {
27:     int q1 = *(int*) p1;
28:     int q2 = *(int*) p2;
29:     return (q1 > q2) - (q1 < q2);
30: }
31:
32: int main() {
33:     static int a[] = {13, 91, 41, 22, 67, 48, 11, 16, 55, 30};
34:     size_t w = sizeof *a;
35:     size_t n = sizeof a / w;
36:     print (a, n);
37:     sort (a, n, w, cmp);
38:     print (a, n);
39: }
40:
```

```
1:      .file      "insertion-sort.c"
2:      .text
3:      .globl    cmp
4: cmp:
5: .LFB25:
6:      movl      (%rsi), %edx
7:      movl      (%rdi), %ecx
8:      xorl      %eax, %eax
9:      cmpl      %edx, %ecx
10:     setl      %dl
11:     setg      %al
12:     movzbl    %dl, %edx
13:     subl      %edx, %eax
14:     ret
15: .LFE25:
```

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16:
17:         .globl  sort
18: sort:
19: .LFB23:
20:     pushq    %rbp
21:     leaq     15(%rdx), %rax
22:     movq     %rsp, %rbp
23:     pushq    %r15
24:     andq     $-16, %rax
25:     movq     %rcx, %r15
26:     pushq    %r14
27:     pushq    %r13
28:     pushq    %r12
29:     pushq    %rbx
30:     movq     %rdx, %rbx
31:     subq     $56, %rsp
32:     movq     %rdi, -80(%rbp)
33:     movq     %rsi, -88(%rbp)
34:     subq     %rax, %rsp
35:     movq     %rdi, %rax
36:     movq     $2, -64(%rbp)
37:     addq     %rdx, %rax
38:     cmpq     $1, %rsi
39:     movq     %rsp, -56(%rbp)
40:     movq     %rax, -72(%rbp)
41:     jbe      .L2
42: .L12:
43:     movq     -64(%rbp), %rax
44:     movq     -72(%rbp), %r14
45:     movq     %rbx, %rdx
46:     movq     -56(%rbp), %rdi
47:     leaq     -1(%rax), %r13
48:     movq     %r14, %rsi
49:     call     memcpy
50:     testq    %r13, %r13
51:     je       .L5
52:     subq     %rbx, %r14
53:     jmp      .L8
54: .L6:
55:     leaq     (%r14,%rbx), %rdi
56:     movq     %r14, %rsi
57:     movq     %rbx, %rdx
58:     subq     %rbx, %r14
59:     call     memcpy
60:     testq    %r12, %r12
61:     je       .L11
62:     movq     %r12, %r13
63: .L8:
64:     movq     -56(%rbp), %rsi
65:     movq     %r14, %rdi
66:     leaq     -1(%r13), %r12
67:     call     *%r15
68:     testl    %eax, %eax
69:     jns      .L6
70:     movq     %r13, %rdi
71:     imulq    %rbx, %rdi
72: .L7:
73:     addq     -80(%rbp), %rdi
```

```
74:      movq    -56(%rbp), %rsi
75:      movq    %rbx, %rdx
76:      call    memcpy
77:      movq    -88(%rbp), %rax
78:      cmpq    %rax, -64(%rbp)
79:      jae     .L2
80: .L9:
81:      addq    %rbx, -72(%rbp)
82:      addq    $1, -64(%rbp)
83:      jmp     .L12
84: .L11:
85:      xorl    %edi, %edi
86:      jmp     .L7
87: .L2:
88:      leaq    -40(%rbp), %rsp
89:      popq    %rbx
90:      popq    %r12
91:      popq    %r13
92:      popq    %r14
93:      popq    %r15
94:      popq    %rbp
95:      ret
96: .L5:
97:      movq    -56(%rbp), %rsi
98:      movq    -80(%rbp), %rdi
99:      movq    %rbx, %rdx
100:     call    memcpy
101:     jmp     .L9
102: .LFE23:
```

```
103:
104: .LC0:
105:     .string " %d"
106:     .text
107:     .globl print
108: print:
109: .LFB24:
110:     pushq    %r12
111:     movq     %rdi, %r12
112:     pushq    %rbp
113:     movq     %rsi, %rbp
114:     pushq    %rbx
115:     xorl     %ebx, %ebx
116:     testq    %rsi, %rsi
117:     je       .L17
118: .L19:
119:     movl     (%r12,%rbx,4), %esi
120:     xorl     %eax, %eax
121:     movl     $.LC0, %edi
122:     addq     $1, %rbx
123:     call     printf
124:     cmpq     %rbp, %rbx
125:     jne     .L19
126: .L17:
127:     popq     %rbx
128:     popq     %rbp
129:     popq     %r12
130:     movl     $10, %edi
131:     jmp     putchar
132: .LFE24:
```

```
133:
134:         .globl  main
135: main:
136: .LFB26:
137:     subq    $8, %rsp
138:     movl    $10, %esi
139:     movl    $a.2584, %edi
140:     call    print
141:     movl    $cmp, %ecx
142:     movl    $4, %edx
143:     movl    $10, %esi
144:     movl    $a.2584, %edi
145:     call    sort
146:     movl    $10, %esi
147:     movl    $a.2584, %edi
148:     call    print
149:     xorl    %eax, %eax
150:     addq    $8, %rsp
151:     ret
152: .LFE26:
153:     .data
154:     .align 32
155: a.2584:
156:     .long   13
157:     .long   91
158:     .long   41
159:     .long   22
160:     .long   67
161:     .long   48
162:     .long   11
163:     .long   16
164:     .long   55
165:     .long   30
```