```
2 #include <stdio.h>
3#include <stdlib.h>
4 #include <stdbool.h>
7 struct Node {
   int value;
   struct Node *left;
9
   struct Node *right;
10
11 };
12
13 void init tree(struct Node *root) {
   void init tree helper(struct Node *current, int current depth) {
14
     // initalize child nodes
15
     current->left = malloc(sizeof(struct Node));
16
     current->right = malloc(sizeof(struct Node));
17
     // keep initializing nodes until depth 3:
18
     // iterate only until depth 2 because children are initalized
19
     if(current depth < 2) {</pre>
20
       init_tree_helper(current->left, current_depth + 1);
21
       init tree helper(current->right, current depth + 1);
22
     }
23
24
   init tree helper(root, 0);
25
26
   // add second to last row (depth 4)
27
   root->left->left->left = malloc(sizeof(struct Node));
28
   root->left->right->right= malloc(sizeof(struct Node));
29
   root->right->left->left = malloc(sizeof(struct Node));
30
   root->right->right->right->right= malloc(sizeof(struct Node)):
31
```

1/* C program by Dave Russillo. Made on for CS1311. */

```
// add last row (depth 5)
32
   root->right->right->right->right = malloc(sizeof(struct Node));
33
34
35
     * Result:
36
37
38
39
40
41
42
43
45
46
47
48
49
50
51 }
52
53
54 void populate_tree(struct Node *root) {
   void populate_tree_helper(struct Node *current, int difference, int set_value) {
55
      current->value = set_value;
56
      // set next difference to half of current
57
      difference = difference / 2;
58
      // minimum difference must be 1
59
      if(difference == 0) {
60
        difference = 1;
61
62
```

```
if(current->left != NULL) {
63
        // subtract difference on left
64
        populate_tree_helper(current->left, difference, set_value - difference);
65
66
      if(current->right != NULL) {
67
        // add difference on right
68
        populate_tree_helper(current->right, difference, set_value + difference);
70
71
    populate_tree_helper(root, 10, 10);
72
73
     * Result:
74
75
77
                                        19
87
                                         20
88
90 }
91
93 void print_preorder(struct Node *current) {
```

```
// print current value
94
    printf("%d ", current->value);
95
96
    // iterate on left node
97
    if(current->left != NULL) {
98
       print_preorder(current->left);
99
100
101
    // iterate on right node
102
    if(current->right!= NULL) {
103
       print preorder(current->right);
104
105
106
107
108
109 void print_inorder(struct Node *current) {
    // iterate on left node
110
    if(current->left != NULL) {
111
       print inorder(current->left);
112
113
114
    // print current value
115
    printf("%d ", current->value);
116
117
    // iterate on right node
118
    if(current->right!= NULL) {
119
       print inorder(current->right);
120
121
122 }
123
124
```

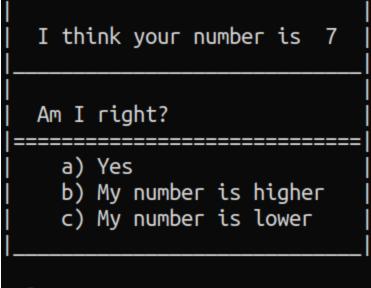
```
125 void print_postorder(struct Node *current) {
    // iterate on left node
126
    if(current->left != NULL) {
127
      print_postorder(current->left);
128
129
130
    // iterate on right node
131
    if(current->right!= NULL) {
132
      print postorder(current->right);
133
134
135
    // print current value
136
    printf("%d ", current->value);
137
138 }
139
140
141 void take user input(struct Node *current) {
    char choice = ' ';
    bool valid choice = false;
143
144
    printf("
145
146
                I think your number is %2d
147
            ш
                                               \n"
148
            ш
                                               |\n"
149
                                               \n"
                Am I right?
150
              ========|\n"
151
            ш
                                               |\n"
                  a) Yes
152
            ш
                  b) My number is higher
                                               |\n"
153
                                               |\n"
                  c) My number is lower
154
                                               |\n\n", current->value);
155
```

```
while(!valid choice) {
156
       printf("..? ");
157
       choice = getchar();
158
       valid choice = choice == 'a' || choice == 'b' || choice == 'c';
159
       while(getchar() != '\n');
160
       if(!valid choice) {
161
         printf("Invalid answer! Try again.\n");
162
163
164
     if(choice == 'c') {
165
       if(current->left != NULL) {
166
         take_user_input(current->left);
167
168
       } else {
         printf("Invalid number!\n");
169
170
     } else if(choice == 'b') {
171
       if(current->right != NULL) {
172
         take user input(current->right);
173
       } else {
174
175
         printf("Invalid number!\n");
176
177
     } else {
       printf("I guessed right! Your number is %d.\n\n", current->value);
178
179
180 }
181
182
183 int main(void) {
     struct Node *root = malloc(sizeof(struct Node));
184
185
     init tree(root);
     populate tree(root);
186
187
    print preorder(root);
188
    printf("\n");
189
    print inorder(root);
190
    printf("\n");
191
    print postorder(root);
192
    printf("\n\n");
193
194
    printf("Think of a number between 1 and 20 and I will try to guess it.\n"
195
             "Press enter to start ...");
196
    while(getchar() != '\n');
197
    printf("\n\n");
198
199
    take user input(root);
200
201
202
    return 0;
203
204
```

```
10 5 3 2 1 4 7 6 8 9 15 13 12 11 14 17 16 18 19 20 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 1 2 4 3 6 9 8 7 5 11 12 14 13 16 20 19 18 17 15 10
```

Think of a number between 1 and 20 and I will try to guess it. Press enter to start ...

 I think your number is 10
 Am I right?
a) Yes b) My number is higher c) My number is lower
? c
 I think your number is 5
 Am I right?
=====================================
? b



..? c

I think your number is 6

Am I right?

- a) Yes
- b) My number is higher
- c) My number is lower

..? a

I guessed right! Your number is 6.

I think your number is 10 Am I right? b) My number is higher c) My number is lower ..? b I think your number is 15 Am I right? b) My number is higher c) My number is lower

.? b

I think your number is 17	
Am I right?	
a) Yes b) My number is higher c) My number is lower	
.? b	
I think your number is 18	
Am I right?	

- a) Yesb) My number is higherc) My number is lower

..? b

