BinaryTrees1

0.2.0

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Chapter 1

Class Index

1.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 2

File Index

2.1 File List

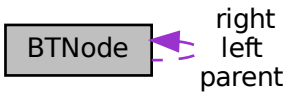
Here is a list of all files with brief descriptions:

Chapter 3

Class Documentation

3.1 BTNode Class Reference

Collaboration diagram for BTNode:



Public Member Functions

- BTNode (int dataVal)
- char nodeName ()
- int nodeData ()
- BTNode ()
- int nodeNum ()

Public Attributes

- BTNode * left
- BTNode * right
- BTNode * parent
- int num

Static Public Attributes

- static int count = 0

3.1.1 Detailed Description

Binary Tree Node

This is from Open Data Structures in C++ by Pat Morin

Definition at line 19 of file binSearch.cpp.

3.1.2 Constructor & Destructor Documentation

3.1.2.1 BTNode() [1/2]

```
BTNode::BTNode (
            int dataVal )  [inline]
```

BTNode constructor

Definition at line 33 of file binSearch.cpp.

```
33                      {
34       left = NULL;
35       right = NULL;
36       parent = NULL;
37       objName = name++;
38       payload = dataVal;
39       cout « "name = " « name « ", payload = " « payload « endl;
40   }
```

3.1.2.2 BTNode() [2/2]

```
BTNode::BTNode ( )  [inline]
```

BTNode constructor

Definition at line 29 of file main.cpp.

```
29           {
30       left = NULL;
31       right = NULL;
32       parent = NULL;
33       num = count++;
34   }
```

3.1.3 Member Function Documentation

3.1.3.1 nodeData()

```
int BTNode::nodeData ( )  [inline]
```

This reports the node's data

Definition at line 52 of file binSearch.cpp.

```
52                  {
53       return(payload);
54   }
```

3.1.3.2 nodeName()

```
char BTNode::nodeName ( )  [inline]
```

This reports the node's name

Definition at line 45 of file binSearch.cpp.

```
45                  {
46       return(objName);
47   }
```

3.1.3.3 nodeNum()

```
int BTNode::nodeNum ( )  [inline]
```

This reports the node's number

Definition at line 39 of file main.cpp.

```
39                  {
40       return(num);
41   }
```

3.1.4 Member Data Documentation

3.1.4.1 count

```
int BTNode::count = 0  [static]
```

Definition at line 24 of file main.cpp.

3.1.4.2 left

```
BTNode * BTNode::left
```

Definition at line 26 of file binSearch.cpp.

3.1.4.3 num

```
int BTNode::num
```

Definition at line 23 of file main.cpp.

3.1.4.4 parent

```
BTNode * BTNode::parent
```

Definition at line 28 of file binSearch.cpp.

3.1.4.5 right

```
BTNode * BTNode::right
```

Definition at line 27 of file binSearch.cpp.

The documentation for this class was generated from the following files:

- /home/drseth/CPTR227/20210224BinaryTreeStart/src/binSearch.cpp
- /home/drseth/CPTR227/20210224BinaryTreeStart/src/main.cpp

Chapter 4

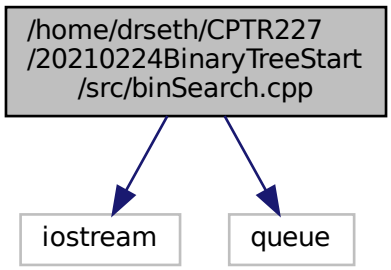
File Documentation

4.1 /home/drseth/CPTR227/20210224BinaryTreeStart/src/binSearch.cpp File Reference

This is a demonstration of binary search trees.

```
#include <iostream>
#include <queue>
```

Include dependency graph for binSearch.cpp:



Classes

- class BTNode

Functions

- BTNode * addNode (BTNode *rootNode, BTNode *n)
- BTNode * addNode (BTNode *rootNode, int dataval)
- BTNode * genExampleTree (BTNode *root)
- void printTree (BTNode *rootNode)
- void printBT (const string &prefix, BTNode *node, bool isLeft)
- void printBT (BTNode *node)
- int main (int, char **)

4.1.1 Detailed Description

This is a demonstration of binary search trees.

This is a demo from CPTR 227 class

Author

Seth McNeill

Date

2021 March 02

4.1.2 Function Documentation

4.1.2.1 addNode() [1/2]

```
BTNode* addNode (
            BTNode * rootNode,
            BTNode * n )
```

This function adds a node to a binary search tree.

Parameters

rootNode	is the pointer to the tree's root node
n	is the node to add

Returns

pointer to rootNode if successful, NULL otherwise

Definition at line 68 of file binSearch.cpp.

```
68                                              {
69     BTNode* prev = NULL;
70     BTNode* w = rootNode;
71     if(rootNode == NULL) { // starting an empty tree
72         rootNode = n;
73     } else {
74         // Find the node n belongs under, prev, n's new parent
75         while(w != NULL) {
76             prev = w;
77             if(n->nodeData() < w->nodeData()){
78                 w = w->left;
79             } else if(n->nodeData() > w->nodeData()) {
80                 w = w->right;
81             } else { // data already in the tree
82                 return(NULL);
83             }
84         }
85         // now prev should contain the node that should be n's parent
86         // Add n to prev
87         if(n->nodeData() < prev->nodeData()) {
88             prev->left = n;
89         } else {
```

```
90              prev->right = n;
91          }
92      }
93      return(rootNode);
94  }
```

4.1.2.2 addNode() [2/2]

```
BTNode* addNode (
              BTNode * rootNode,
              int dataval )
```

Adds a new node with the passed data value

Parameters

rootNode	pointer to root node
dataval	an integer for the new node's data

Returns

pointer to root node or NULL if not successful

Definition at line 104 of file binSearch.cpp.

```
104                                                 {
105     BTNode* newNode = new BTNode(dataval);
106     cout « "newNode " « newNode->nodeName() « ":" « newNode->nodeData() « endl;
107     if(addNode(rootNode, newNode) == NULL) {
108         cout « dataval « " already in tree" « endl;
109     } else {
110         cout « dataval « " succesfully added" « endl;
111     }
112     return(rootNode);
113 }
```

4.1.2.3 genExampleTree()

```
BTNode* genExampleTree (
              BTNode * root )
```

This generates a simple tree to play with

It is a bit of a hack.

Definition at line 120 of file binSearch.cpp.

```
120                                         {
121 /*
122     for(int ii = 1; ii < 7; ii++) {
123         addNode(root, ii);
124     }
125     addNode(root, 3);
126 */
127     addNode(root, 7);
128     addNode(root, 3);
129     addNode(root, 1);
130     addNode(root, 5);
131     addNode(root, 11);
```

```
132     addNode(root, 4);
133     addNode(root, 9);
134     addNode(root, 6);
135     addNode(root, 8);
136     addNode(root, 13);
137     addNode(root, 12);
138     addNode(root, 14);
139     return root;
140 }
```

4.1.2.4 main()

```
int main (
              int ,
              char **  )
```

Definition at line 226 of file binSearch.cpp.

```
226                     {
227     BTNode* rootNode = new BTNode(0); // pointer to the root node
228     genExampleTree(rootNode);
229     //printTree(rootNode);
230     printBT(rootNode);
231 }
```

4.1.2.5 printBT() [1/2]

```
void printBT (
              BTNode * node )
```

An overload to simplify calling printBT

Parameters

node	is the root node of the tree to be printed

Definition at line 221 of file binSearch.cpp.

```
222 {
223     printBT("", node, false);
224 }
```

4.1.2.6 printBT() [2/2]

```
void printBT (
              const string & prefix,
              BTNode * node,
              bool isLeft )
```

Print a binary tree

This example is modified from: https://stackoverflow.com/a/51730733

Parameters

prefix	is a string of characters to start the line with
node	is the current node being printed
isLeft	bool true if the node is a left node

Definition at line 199 of file binSearch.cpp.

```
200 {
201     if( node != NULL )
202     {
203         cout « prefix;
204 
205         cout « (isLeft ? "|--" : "--" );
206 
207         // print the value of the node
208         cout « node->nodeName() « ':' « node->nodeData() « std::endl;
209 
210         // enter the next tree level - left and right branch
211         printBT( prefix + (isLeft ? "|   " : "    "), node->left, true);
212         printBT( prefix + (isLeft ? "|   " : "    "), node->right, false);
213     }
214 }
```

4.1.2.7 printTree()

```
void printTree (
            BTNode * rootNode )
```

Prints out a representtation of a binary search tree

This is particularly interesting since it requires traversing the tree in a breadth-first manner rather than a depth-first manner as we have been up until now. Some good references: https://stackoverflow.com/questions/36802354/print-binary-tree-in-a-pretty-way-using-c

Parameters

rootNode	is a pointer to the root node

Definition at line 153 of file binSearch.cpp.

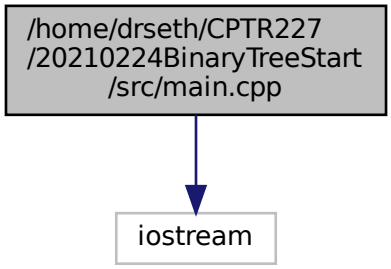
```
153                                 {
154     queue<BTNode*> todo; // queue of nodes left to visit
155     BTNode* cur;   // current node
156     BTNode* last;  // last node
157     queue<int> depth; // keeps track of the depth of each node
158     int curDepth; // depth of the previous node
159     int prevDepth; // depth of the previous node
160     todo.push(rootNode); // start the queue with the rootNode
161     depth.push(0); // root node is at depth 0
162 
163     while(!todo.empty()) {
164         cur = todo.front(); // collect the first node in the queue
165         curDepth = depth.front();
166         if(curDepth > prevDepth) { // next row of nodes encountered
167             cout « endl;
168         }
169         // print the current node
170         cout « curDepth « '-' « cur->nodeName() « ":" « cur->nodeData() « '\t';
171         // add children to the list
172         if(cur->left != NULL) {
173             todo.push(cur->left);
174             depth.push(curDepth + 1);
175         }
176         if(cur->right != NULL) {
177             todo.push(cur->right);
178             depth.push(curDepth + 1);
```

```
179         }
180         // remove the first node from the queue
181         todo.pop();
182         prevDepth = depth.front();
183         depth.pop();
184     }
185     cout « endl;
186 }
```

4.2 /home/drseth/CPTR227/20210224BinaryTreeStart/src/main.cpp File Reference

This is a demonstration of simple binary trees.

`#include <iostream>`
Include dependency graph for main.cpp:



Classes

- class BTNode

Functions

- int depth (BTNode ∗u)
- void traverse (BTNode ∗rootNode)
- void nonRecursiveTraverse (BTNode ∗rootNode)
- int height (BTNode ∗u)
- BTNode ∗ genExampleTree (BTNode ∗root)
- int main (int, char ∗∗)

4.2.1 Detailed Description

This is a demonstration of simple binary trees.

This is a demo from CPTR 227 class

Author

Seth McNeill

Date

2021 February 24

4.2.2 Function Documentation

4.2.2.1 depth()

```
int depth (
            BTNode * u )
```

Calculates the depth (number of steps between node and root) of a node

Parameters

pointer	to BTNode to measure the depth of

Returns

integer count of depth

Definition at line 54 of file main.cpp.

```
54                          {
55     int d = 0; // depth counter
56     while(u != NULL) {
57         u = u->parent;
58         d++;
59     }
60     return(--d);
61 }
```

4.2.2.2 genExampleTree()

```
BTNode* genExampleTree (
            BTNode * root )
```

This generates a simple tree to play with

It is a bit of a hack.

Definition at line 134 of file main.cpp.

```
134                                         {
135     BTNode* one = new BTNode();
136     BTNode* two = new BTNode();
137     BTNode* three = new BTNode();
138     BTNode* four = new BTNode();
139     BTNode* five = new BTNode();
140     BTNode* six = new BTNode();
141     cout « "Created the nodes" « endl;
142     root->left = one;
143     cout « "Added root->left" « endl;
144     one->parent = root;
145     root->right = two;
146     two->parent = root;
147     two->left = three;
148     three->parent = two;
149     two->right = four;
150     four->parent = two;
151     one->left = five;
152     five->parent = one;
153     five->left = six;
154     six->parent = five;
```

```
155     cout « "root's number: " « root->nodeNum() « endl;
156     cout « "one's number: " « one->nodeNum() « endl;
157     cout « "two's number: " « two->nodeNum() « endl;
158     cout « "three's number: " « three->nodeNum() « endl;
159     cout « "four's number: " « four->nodeNum() « endl;
160     cout « "five's number: " « five->nodeNum() « endl;
161     cout « "six's number: " « six->nodeNum() « endl;
162     cout « "six's depth is " « depth(six) « endl;
163     cout « "root's height is " « height(root) « endl;
164     return root;
165 }
```

4.2.2.3 height()

```
int height (
            BTNode * u )
```

This calculates the height (max number of steps until leaf node)

Parameters

pointer	to a BTNode

Returns

integer count of height

Definition at line 120 of file main.cpp.

```
120                         {
121     if (u == NULL) {
122         cout « "Reached NULL end of branch" « endl;
123         return(-1);
124     }
125     cout « "Calculating the height of node " « u->nodeNum() « endl;
126     return(1 + max(height(u->left), height(u->right)));
127 }
```

4.2.2.4 main()

```
int main (
            int ,
            char **  )
```

Definition at line 168 of file main.cpp.

```
168                         {
169     BTNode* rootNode = new BTNode(); // pointer to the root node
170     genExampleTree(rootNode);
171     cout « endl « "Traversing the binary tree" « endl;
172     traverse(rootNode);
173     cout « endl « "Non-recursive traversing" « endl;
174     nonRecursiveTraverse(rootNode);
175 }
```

4.2.2.5 nonRecursiveTraverse()

```
void nonRecursiveTraverse (
            BTNode * rootNode )
```

Traverses all nodes in a binary tree non-recursively

Parameters

A	pointer to the root node of interest

Definition at line 85 of file main.cpp.

```
85                                          {
86     BTNode* u = rootNode; // Current node of interest
87     BTNode* prev = NULL;  // Previously looked at node
88     BTNode* next;         // The next node to look at
89
90     while(u != NULL) {
91         cout « "Traversing node " « u->nodeNum() « endl;
92         if(prev ==  u->parent) {
93             if(u->right != NULL) {
94                 next = u->right;
95             } else if(u->left != NULL) {
96                 next = u->left;
97             } else {
98                 next = u->parent;
99             }
100         } else if(prev == u->right) {
101             if(u->left != NULL){
102                 next = u->left;
103             } else {
104                 next = u->parent;
105             }
106         } else {
107             next = u->parent;
108         }
109         prev = u;
110         u = next;
111     }
112 }
```

4.2.2.6 traverse()

```
void traverse (
             BTNode * rootNode )
```

Traverses all the nodes in a binary tree.

Parameters

A	pointer to the root node of interest

Definition at line 69 of file main.cpp.

```
69                                  {
70     if(rootNode == NULL) {
71         cout « "reached NULL" « endl;
72         return;
73     }
74     cout « "Traversing node " « rootNode->nodeNum() « endl;
75     traverse(rootNode->right);
76     traverse(rootNode->left);
77 }
```

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