Universidad de Guadalajara

Centro Universitario de Ciencias Exactas e Ingenierías

IL365 - Estructura de Datos - D01

Actividad de Aprendizaje #12

El Árbol Binario de Búsqueda, Implementación Dinámica

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Autoevaluación			
Concepto	**Si**	**No**	**Acumulación**
Bajé el trabajo de internet o alguien me lo pasó (aunque sea de forma parcial)	**-100 pts**	**0 pts**	**0**
Incluí el código fuente **en formato de texto (sólo si funciona cumpliendo todos los requerimientos)**	**+25pts**	**0 pts**	**25**
Incluí las **impresiones de pantalla (sólo si funciona cumpliendo todos los requerimientos)**	**+25pts**	**0 pts**	**25**
Incluí una **portada** que identifica mi trabajo (nombre, código, materia, fecha, título)	**+25 pts**	**0 pts**	**25**
Incluí una **descripción y conclusiones** de mi trabajo	**+25 pts**	**0 pts**	**25**
		Suma:	**100**

Introducción:

Un árbol es una estructura jerárquica aplicada sobre una colección de elementos u objetos llamados nodos; a raíz de esto podemos decir que el árbol binario es aquel en el cual cada nodo tiene no más de dos descendientes, es decir, que puede tener descendiente izquierdo o derecho o cero descendientes.

La búsqueda en árboles binarios es un método de búsqueda simple, dinámico y eficiente; el valor de cada nodo es mayor que los valores de su sub-árbol izquierdo y es menor que los valores de sub-árbol derecho y, además, ambos subárboles son árboles binarios de búsqueda.

Una vez comprendidas estas definiciones y el modelo correspondiente de los árboles binarios de búsqueda, esta semana trabajamos con un algoritmo que permite insertar elementos aleatorios a un árbol binario, hacer un recorrido en PreOrder, InOrder y PostOrder, así como también poder conocer la altura total del árbol, además de la altura del subárbol en lado izquierdo y subárbol del lado derecho.

Código Fuente:

arbolBinario.hpp

```
#ifndef ARBOLBINARIO_HPP_INCLUDED
#define ARBOLBINARIO_HPP_INCLUDED
#include <iostream>
#include <string>
#include <exception>

template <class T>
class ArbolB {
    private:
        class Node {
            private:
                T* dataPtr;
                Node* left;
                Node* right;

            public:
                class Exception: public std::exception {
                    private:
                        std::string msg;
                    public:
                        explicit Exception(const char* message): msg(message) {}
                        explicit Exception(const std::string& message):
msg(message) {}
                        virtual ~Exception()throw() {}
                        virtual const char* what() const throw() {
                            return msg.c_str();
                            }
                    };

                Node();
                Node(const T&);
                ~Node();

                T* getDataPtr() const;
                T getData() const;
                Node*& getLeft();
                Node*& getRight();

                void setDataPtr(T*);
                void setData(const T&);
                void setLeft(Node*&);
                void setRight(Node*&);
            };

    public:
        typedef Node* Position;

    private:
```

```
    Position root;

    void copyAll(const ArbolB<T>&);
    void insertData(Position&, const T&);
    void deleteData(Position&, const T&);

    Position& findData(Position&, const T&);
    Position& getLowest(Position&);
    Position& getHighest(Position&);

    void preOrder(Position&);
    void inOrder(Position&);
    void posOrder(Position&);



public:
    class Exception: public std::exception {
        private:
            std::string msg;
        public:
            explicit Exception(const char* message): msg(message) {}
            explicit Exception(const std::string& message): msg(message) {}
            virtual ~Exception()throw() {}
            virtual const char* what() const throw() {
                return msg.c_str();
                }
        };

    ArbolB();
    ArbolB(const ArbolB<T>&);
    ~ArbolB();

    bool isEmpty() const;
    bool isLeaf(Position&) const;

    void insertData(const T&);
    void deleteData(const T&);
    void deleteAll();
    T retrieve(Position&) const;

    int getHeight(Position&);
    int getHeight();
    int getHeightRight();
    int getHeightLeft();
    Position& findData(const T&);
    Position& getLowest();
    Position& getHighest();

    void preOrder();
    void inOrder();
    void posOrder();
```

```
        ArbolB& operator = (const ArbolB&);
    };

#endif // ARBOLBINARIO_HPP_INCLUDED


///IMPLEMENTACION NODO

using namespace std;
template <class T>
ArbolB<T>::Node::Node() : dataPtr(nullptr), left(nullptr), right(nullptr) { }

template <class T>
ArbolB<T>::Node::Node(const T& m) : dataPtr(new T(m)), left(nullptr),
right(nullptr) {
    if(dataPtr == nullptr) {
        throw Exception("Memoria insuficiente, se creara un nodo");
        }
    }

template <class T>
ArbolB<T>::Node::~Node() {
    delete dataPtr;
    }

template <class T>
T* ArbolB<T>::Node::getDataPtr() const {
    return dataPtr;
    }

template <class T>
T ArbolB<T>::Node::getData() const {
    if(dataPtr == nullptr) {
        throw Exception("Dato inexistente, getData");
        }
    return *dataPtr;
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::Node::getLeft() {
    return left;
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::Node::getRight() {
    return right;
    }

template <class T>
void ArbolB<T>::Node::setDataPtr(T* pos) {
    dataPtr = pos;
    }
```

```
template <class T>
void ArbolB<T>::Node::setData(const T& e) {
    if(dataPtr == nullptr) {
        if((dataPtr = new T(e)) == nullptr) {
            throw Exception("Memoria no disponible, setData");
            }
        }
    else {
        *dataPtr = e;
        }
    }

template <class T>
void ArbolB<T>::Node::setLeft(Position& pos) {
    left = pos;
    }

template <class T>
void ArbolB<T>::Node::setRight(Position& pos) {
    right = pos;
    }

///IMPLEMENTACION ARBOL

template <class T>
ArbolB<T>::ArbolB() : root(nullptr) {}

template <class T>
ArbolB<T>::ArbolB(const ArbolB& t) : root(nullptr) {
    copyAll(t);
    }

template <class T>
ArbolB<T>::~ArbolB() {
    deleteAll();
    }

template <class T>
void ArbolB<T>::copyAll(const ArbolB<T>& l) {
    Position newNode;

    try {
        if((newNode = new Node(l.aux->getData())) == nullptr) {
            throw Exception("Memoria no disponible, copyAll");
            }
        }
    catch(Exception ex) {
        throw Exception(ex.what());
        }
    root = new Node(l.root->getData());
    root->getLeft() = l.root->getLeft();
    root->getRight() = l.root->getRight();
    }
```

```
template <class T>
bool ArbolB<T>::isEmpty() const {
    return root == nullptr;
    }

template <class T>
void ArbolB<T>::insertData(const T& d) {
    insertData(root, d);
    }

template <class T>
void ArbolB<T>::insertData(Position& r, const T& d) {
    if(r == nullptr) {
        try {
            if((r= new Node(d)) == nullptr) {
                throw Exception("Memoria no disponible, insertData");
                }
            }
        catch(typename Node::Exception ex) {
            throw Exception(ex.what());
            }
        }
    else {
        if(d < r->getData()) {
            insertData(r->getLeft(), d);
            }
        else {
            insertData(r->getRight(), d);
            }
        }
    }

template <class T>
void ArbolB<T>::deleteData(const T& d) {
    deleteData(root, d);
    }

template <class T>
void ArbolB<T>::deleteData(Position& e, const T& d) {
    if(e == nullptr) {
        return;
        }

    if(e->getData() == d) {
        if(isLeaf(e)) { ///si es hoja
            delete e;
            e = nullptr;
            return;
            }

        ///caso de dos hojas
        if(e->getLeft() != nullptr && e->getRight() != nullptr) {
```

```
            T myData(getHighest(e->getLeft())->getData());

            deleteData(e->getLeft(), myData);
            e->setData(myData);
            return;
            }

        ///Casi una sola hoja
        Position aux(e);
        e = e->getLeft() == nullptr ? e->getRight() : e->getLeft();
        delete aux;
        return;
        }

    if(d < e->getData()) {
        deleteData(e->getLeft(), d);
        }
    else {
        deleteData(e->getRight(), d);
        }
    }

template <class T>
T ArbolB<T>::retrieve(Position& r) const {
    return r->getData();
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::findData(const T& e) {
    return findData(root, e);
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::findData(Position& r, const T& e) {
    if(r == nullptr || r->getData() == e) {
        return r;
        }

    if(e < r->getData()) {
        return findData(r->getLeft(), e);
        }
    else {
        return findData(r->getRight(), e);
        }
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::getLowest() {
    return getLowest(root);
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::getLowest(Position& r) {
```

```
    if(r == nullptr || r->getLeft() == nullptr) {
        return r;
        }
    return getLowest(r->getLeft());
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::getHighest() {
    return getHighest(root);
    }

template <class T>
typename ArbolB<T>::Position& ArbolB<T>::getHighest(Position& r) {
    if(r == nullptr || r->getRight() == nullptr) {
        return r;
        }
    return getHighest(r->getRight());
    }

template <class T>
bool ArbolB<T>::isLeaf(Position& r) const {
    return r != nullptr && r->getLeft() == r->getRight();
    }

template <class T>
int ArbolB<T>::getHeight() {
    return getHeight(root);
    }

template <class T>
int ArbolB<T>::getHeight(Position& r) {
    if(r == nullptr) {
        return 0;
        }

    int lH(getHeight(r->getLeft()));
    int rH(getHeight(r->getRight()));

    return(lH > rH ? lH : rH) + 1;
    }

template <class T>
int ArbolB<T>::getHeightRight() {
    return getHeight(root->getRight());
    }

template <class T>
int ArbolB<T>::getHeightLeft() {
    return getHeight(root->getLeft());
    }

template <class T>
void ArbolB<T>::preOrder() {
```

```
    preOrder(root);
    }

template <class T>
void ArbolB<T>::preOrder(Position& r) {
    if(r == nullptr) {
        return;
        }
    std::cout << r->getData() << ", ";
    preOrder(r->getLeft());
    preOrder(r->getRight());
    }

template <class T>
void ArbolB<T>::inOrder() {
    inOrder(root);
    }

template <class T>
void ArbolB<T>::inOrder(Position& r) {
    if(r == nullptr) {
        return;
        }
    inOrder(r->getLeft());
    std::cout << r->getData() << ", ";
    inOrder(r->getRight());
    }

template <class T>
void ArbolB<T>::posOrder() {
    posOrder(root);
    }

template <class T>
void ArbolB<T>::posOrder(Position& r) {
    if(r == nullptr) {
        return;
        }
    posOrder(r->getLeft());
    posOrder(r->getRight());
    std::cout << r->getData() << ", ";
    }

template <class T>
void ArbolB<T>::deleteAll() {
    if(root == nullptr) {
        return;
        }
    deleteData(root->getLeft(), root->getData());
    deleteData(root->getRight(), root->getData());
    delete root;
    root = nullptr;
    }
```

```
template <class T>
ArbolB<T>& ArbolB<T>::operator = (const ArbolB& e) {
    deleteAll();
    copyAll(e);
    return *this;
    }
```

menu.hpp

```
#ifndef MENU_HPP_INCLUDED
#define MENU_HPP_INCLUDED
#include <string>
#include <random>
#include <chrono>
#include <iostream>
#include <windows.h>
#include <functional>
#include "arbolBinario.hpp"

class Menu {
    private:
        void view(ArbolB<int>&);
    public:
        Menu(ArbolB<int>&);
    };
#endif // MENU_HPP_INCLUDED
```

menu.cpp

```
#include "menu.hpp"

using namespace std;

Menu::Menu(ArbolB<int> &tree) {
    system("Color E5");
    view(tree);
    }

void Menu::view(ArbolB<int> &tree) {

    int num, i=0, val;
    std::chrono::steady_clock::time_point begin, end;
    default_random_engine
generator(chrono::system_clock::now().time_since_epoch().count());
    uniform_int_distribution<int>distribution(0,100000);
    auto random = bind(distribution, generator);

    cout<<"Cuantos numeros desea insertar en el arbol?"<<endl;
    cin>>num;
    cin.ignore();
    cout<<endl<<endl;
```

```
    while(i < num) {
        val = random();
        cout<<"Insertando: "<< val << endl;
        tree.insertData(val);
        i++;
        }

    cout << endl << endl << endl;

    cout << "------------ RECORRIDO PRE-ORDER ------------" << endl << endl;
    tree.preOrder();
    cout << endl << endl;

    cout << "------------ RECORRIDO IN-ORDER ------------" << endl << endl;
    tree.inOrder();
    cout << endl << endl;

    cout << "------------ RECORRIDO POST-ORDER ------------" << endl << endl;
    tree.posOrder();
    cout << endl << endl;

    cout << "------------ ELEMENTO MENOR EN EL ARBOL ------------" << endl << endl;
    cout<< "- " << tree.retrieve(tree.getLowest());
    cout << endl << endl;

    cout << "------------ ELEMENTO MAYOR EN EL ARBOL ------------" << endl << endl;
    cout<< "- " << tree.retrieve(tree.getHighest());
    cout << endl << endl;

    cout << "------------ ALTURA DEL ARBOL ------------" << endl << endl;
    cout<< "- " << tree.getHeight();
    cout << endl << endl;

    cout << "------------ ALTURA DEL SUB-ARBOL IZQUIERDO ------------" << endl <<
endl;
    cout<< "- " << tree.getHeightLeft();
    cout << endl << endl;

    cout << "------------ ALTURA DEL SUB-ARBOL DERECHO ------------" << endl <<
endl;
    cout<< "- " << tree.getHeightRight();
    cout << endl << endl;

    cout << "Eliminando arbol..." << endl << endl;
    tree.deleteAll();
    cout << "Se elimino correctamente :)"<<endl;

    }
```

main.cpp

```
#include "menu.hpp"
int main() {
    ArbolB<int> m;
    Menu start(m);
    }
```

Impresiones de Pantalla:

Prueba 1:

```
"C:\Users\cerva\Escritorio\F.Prog\Estructura de datos\arbolBin\bin\Debug\arbolBin.exe"
Cuantos numeros desea insertar en el arbol?
1000


Insertando: 3557
Insertando: 84797
Insertando: 36468
Insertando: 4236
Insertando: 98742
Insertando: 7390
Insertando: 8143
Insertando: 70673
Insertando: 62088
Insertando: 87755
Insertando: 46076
Insertando: 81825
Insertando: 80911
Insertando: 33275
Insertando: 39276
Insertando: 88328
Insertando: 87089
Insertando: 63524
Insertando: 17682
Insertando: 77278
Insertando: 73550
Insertando: 20890
Insertando: 90336
Insertando: 18692
Insertando: 54348
Insertando: 98274
Insertando: 39831
Insertando: 23468
Insertando: 22105
Insertando: 8654
Insertando: 43094
Insertando: 55655
Insertando: 65090
Insertando: 31150
Insertando: 22524
Insertando: 61155
Insertando: 1051
Insertando: 74713
Insertando: 63699
Insertando: 50681
Insertando: 68302
Insertando: 15125
Insertando: 10489
Insertando: 87800
Insertando: 13025
Insertando: 19448
Insertando: 53383
Insertando: 74010
Insertando: 37643
Insertando: 47063
Insertando: 57185
Insertando: 86660
```

```
"C:\Users\cerva\Escritorio\F.Prog\Estructura de datos\arbolBin\bin\Debug\arbolBin.exe"
Insertando: 63489
Insertando: 31577
Insertando: 9628
Insertando: 24377
Insertando: 484
Insertando: 51075
Insertando: 93670
Insertando: 53607
Insertando: 37923
Insertando: 50943
Insertando: 74532
Insertando: 26775
Insertando: 95677
Insertando: 94773



------------ RECORRIDO PRE-ORDER ------------

3557, 1051, 558, 341, 85, 105, 233, 460, 484, 655, 825, 943, 837, 2627, 2479, 2230, 1961, 1183, 1075, 1131, 1704, 1342, 1209, 1302, 1221, 1529, 1497, 2219, 2318, 2559, 2529, 3029, 2733, 2677, 28
86, 3509, 3428, 3323, 3480, 84797, 36468, 4236, 3737, 3960, 3911, 4057, 7390, 7191, 6755, 6043, 5705, 4252, 5335, 4426, 5104, 5002, 4636, 5063, 5328, 5155, 5159, 5581, 5402, 5371, 5361, 5388, 54
75, 5412, 5966, 5771, 5735, 6030, 6283, 6249, 6558, 6695, 6699, 6881, 7054, 7130, 7101, 7381, 8143, 7445, 7709, 7577, 8003, 7855, 33275, 17682, 8654, 8584, 8217, 8197, 8145, 8148, 8230, 8553, 84
25, 8593, 15125, 10489, 9339, 8844, 9025, 9289, 9148, 9273, 9651, 9577, 9459, 9621, 9628, 10464, 9875, 10189, 13025, 12614, 11871, 11278, 10966, 10779, 10591, 10610, 10939, 11223, 11161, 11044,
10993, 11045, 11164, 11523, 11380, 11428, 11766, 11549, 12461, 12301, 12688, 13013, 12957, 12744, 13815, 13054, 13175, 13470, 13192, 13367, 13760, 13739, 13595, 14341, 14190, 14051, 14003, 13879
, 14143, 14230, 15096, 14376, 14968, 14608, 14893, 15065, 15563, 15899, 15864, 16277, 16059, 15997, 15921, 16048, 16195, 16074, 16273, 16451, 16907, 16844, 16824, 16791, 17000, 17235, 17666, 208
90, 18692, 18002, 17687, 17765, 17899, 18000, 18650, 18556, 18301, 18059, 19448, 19255, 19000, 18974, 18801, 18705, 19030, 19157, 19066, 19123, 19189, 19759, 19650, 19867, 20324, 20265, 20536, 2
0412, 23468, 22105, 21101, 20930, 20922, 21047, 21165, 21881, 21255, 21339, 21336, 21584, 21751, 21962, 21983, 22065, 22524, 22309, 22288, 22130, 22377, 22318, 22334, 22411, 22721, 22710, 22527,
 23229, 23004, 23161, 23454, 31150, 28084, 23643, 23546, 27761, 26017, 25273, 25134, 23821, 23685, 23781, 24358, 24287, 24284, 24095, 24320, 24446, 24377, 24458, 24795, 24759, 25146, 25454, 2534
0, 25397, 25491, 25612, 26009, 26344, 26335, 26296, 26274, 26694, 26630, 26739, 26991, 26814, 26763, 26775, 27638, 27131, 27026, 27037, 27859, 28042, 28343, 28268, 29544, 29936, 28386, 28866, 29
431, 28945, 29424, 29348, 29418, 29424, 29659, 29559, 30082, 29870, 29825, 29922, 29919, 30257, 30667, 30359, 30283, 30559, 30446, 30514, 31037, 31224, 32422, 31656, 31573, 31406, 31577, 31979,
31832, 31714, 32366, 32411, 33177, 33031, 32860, 32743, 32550, 32615, 32854, 33175, 33258, 35280, 34562, 33582, 33932, 33671, 33927, 33908, 34075, 34116, 34643, 34624, 34582, 35253, 34943, 34669
, 35229, 34965, 35638, 35365, 35454, 35685, 35715, 35687, 35699, 35975, 35936, 36259, 70673, 62088, 46076, 39276, 37643, 36864, 36592, 36586, 36578, 36663, 36601, 37561, 36879, 37364, 37359, 374
81, 37566, 38629, 38415, 38320, 38888, 37872, 37923, 38275, 38309, 38761, 38774, 39140, 39210, 39831, 39508, 39277, 39415, 39591, 43094, 39965, 39852, 41108, 40532, 40919, 40756, 40780, 41752, 4
1247, 41168, 41112, 41302, 41285, 41274, 41641, 41360, 41463, 41367, 41632, 41671, 41687, 41886, 41810, 42956, 42272, 42101, 41989, 42011, 42786, 42331, 42423, 42378, 42640, 42501, 42937, 44480,
 43489, 43257, 43248, 43129, 43364, 43315, 43336, 43448, 44171, 43798, 43663, 43704, 44244, 45564, 45479, 44834, 44638, 45132, 45024, 44872, 45362, 45428, 45496, 45737, 45578, 45728, 45807, 4589
4, 54348, 50681, 47063, 46880, 46706, 46260, 46355, 46382, 46857, 46974, 47060, 49067, 48761, 47820, 47476, 47215, 47401, 47490, 47800, 47775, 47512, 48637, 47965, 48479, 47981, 48448, 48278, 48
813, 48980, 48860, 50349, 49750, 49293, 49195, 49453, 49574, 49745, 50174, 50026, 49865, 50114, 50290, 50239, 50318, 50573, 50480, 50353, 50476, 50549, 50579, 50610, 53383, 51697, 50834, 51389,
51182, 51004, 50943, 51075, 51563, 53057, 51925, 51703, 51859, 52429, 52037, 52022, 52361, 52217, 52529, 52444, 52830, 52580, 52853, 53171, 53128, 53337, 53187, 53768, 53440, 53586, 53650, 53607
, 54117, 54041, 53850, 53887, 53876, 54094, 54278, 54172, 54338, 55655, 55000, 54452, 54445, 54357, 54939, 54833, 54471, 54801, 54976, 55338, 55283, 55231, 55601, 61155, 57185, 56317, 56086, 557
20, 55699, 55737, 55881, 56044, 57050, 56735, 56733, 56898, 57184, 60511, 59238, 58673, 58618, 57432, 57267, 58055, 57693, 57979, 57977, 57907, 57886, 58346, 58554, 58503, 58642, 58666, 58944, 5
8763, 59225, 59077, 58998, 59115, 59234, 60219, 59734, 59532, 59285, 59441, 59548, 60154, 60021, 59843, 59804, 60139, 60209, 60428, 60388, 60383, 60713, 60599, 60583, 60822, 61111, 60844, 61900,
 61387, 61339, 61412, 61888, 61464, 61894, 61968, 63524, 62203, 62134, 62096, 62918, 62779, 63090, 62929, 62945, 63306, 63253, 63400, 63489, 65090, 63699, 63656, 64698, 64562, 64414, 64352, 6399
6, 64207, 64143, 64334, 64361, 64389, 64899, 64748, 64942, 64934, 65068, 68302, 65838, 65491, 65170, 65289, 65346, 65297, 65707, 65617, 65575, 65684, 65728, 67239, 67184, 66757, 66359, 66
194, 66733, 66390, 66982, 66914, 66948, 67079, 67192, 67457, 67421, 67465, 67959, 67479, 67673, 68788, 68486, 68430, 68695, 68702, 70210, 70064, 69193, 68954, 68829, 69560, 69374, 69311, 69448,
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------------ ELEMENTO MENOR EN EL ARBOL ------------

- 85

------------ ELEMENTO MAYOR EN EL ARBOL ------------

- 99985

------------ ALTURA DEL ARBOL ------------

- 23

------------ ALTURA DEL SUB-ARBOL IZQUIERDO ------------

- 11
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- 85

------------ ELEMENTO MAYOR EN EL ARBOL ------------

- 99985

------------ ALTURA DEL ARBOL ------------

- 23

------------ ALTURA DEL SUB-ARBOL IZQUIERDO ------------

- 11

------------ ALTURA DEL SUB-ARBOL DERECHO ------------

- 22

Eliminando arbol...

Se elimino correctamente :)

Process returned 0 (0x0)   execution time : 17.880 s
Press any key to continue.
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Prueba 2:

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"C:\Users\cerva\Escritorio\F.Prog\Estructura de datos\arbolBin\bin\Debug\arbolBin.exe"
Cuantos numeros desea insertar en el arbol?
1200


Insertando: 10945
Insertando: 58095
Insertando: 74600
Insertando: 60309
Insertando: 84376
Insertando: 67173
Insertando: 39877
Insertando: 99542
Insertando: 53870
Insertando: 63570
Insertando: 94692
Insertando: 40960
Insertando: 98863
Insertando: 27043
Insertando: 94603
Insertando: 39983
Insertando: 76778
Insertando: 62569
Insertando: 62511
Insertando: 88465
Insertando: 76812
Insertando: 29665
Insertando: 64332
Insertando: 98990
Insertando: 73641
Insertando: 37134
Insertando: 3179
Insertando: 42470
Insertando: 75252
Insertando: 18841
Insertando: 63483
Insertando: 26304
Insertando: 81689
Insertando: 1627
Insertando: 51697
Insertando: 45688
Insertando: 51757
Insertando: 51769
Insertando: 60731
Insertando: 67059
Insertando: 26918
Insertando: 1979
Insertando: 74114
Insertando: 96806
Insertando: 69240
Insertando: 85635
Insertando: 27951
Insertando: 54396
Insertando: 6462
Insertando: 15830
Insertando: 58187
Insertando: 19708
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"C:\Users\cerva\Escritorio\F.Prog\Estructura de datos\arbolBin\bin\Debug\arbolBin.exe"
Insertando: 92873
Insertando: 60282
Insertando: 34540
Insertando: 96033
Insertando: 63895
Insertando: 57638
Insertando: 97920



------------ RECORRIDO PRE-ORDER ------------

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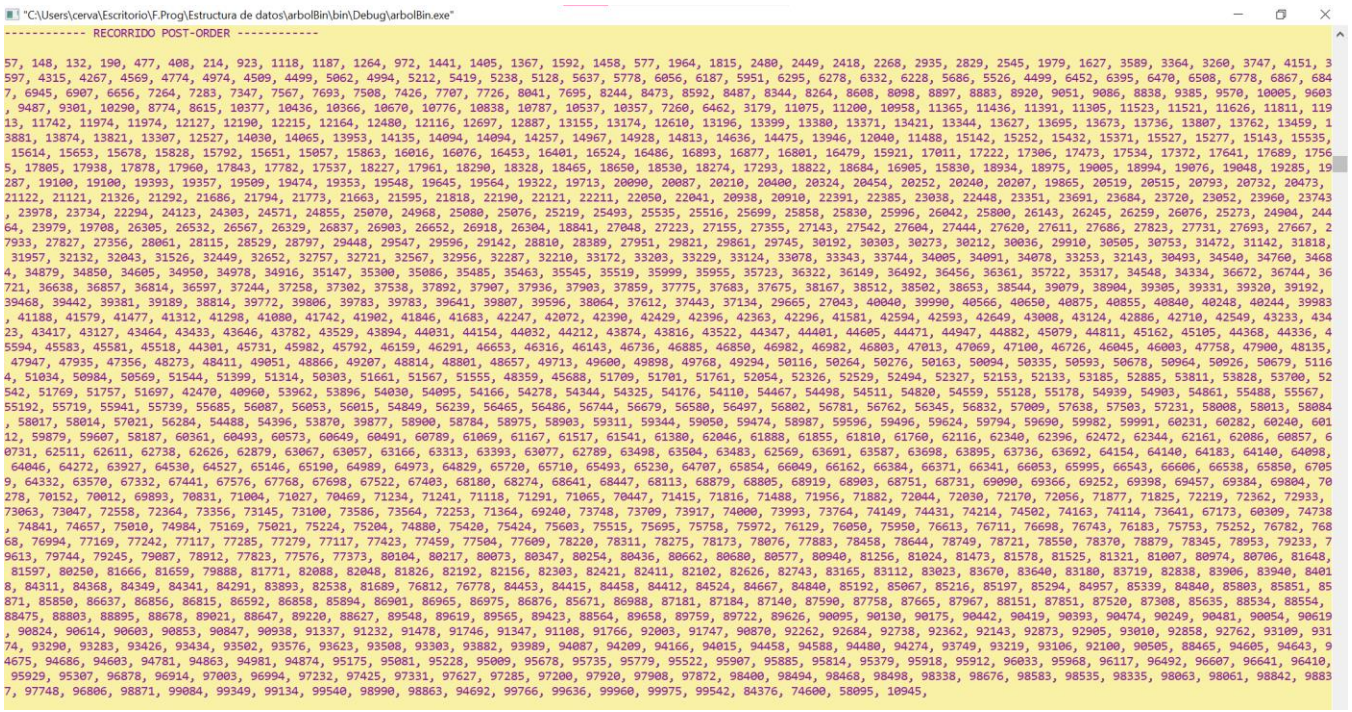
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- 57
---------- ELEMENTO MAYOR EN EL ARBOL ----------
- 99975
---------- ALTURA DEL ARBOL ----------
- 21
---------- ALTURA DEL SUB-ARBOL IZQUIERDO ----------
- 14
---------- ALTURA DEL SUB-ARBOL DERECHO ----------
- 20
Eliminando arbol...
Se elimino correctamente :)
Process returned 0 (0x0)   execution time : 28.210 s
Press any key to continue.

Prueba 3:

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Cuantos numeros desea insertar en el arbol?
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Insertando: 77675
Insertando: 42160
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Insertando: 14973
Insertando: 53141
Insertando: 21222
Insertando: 64584
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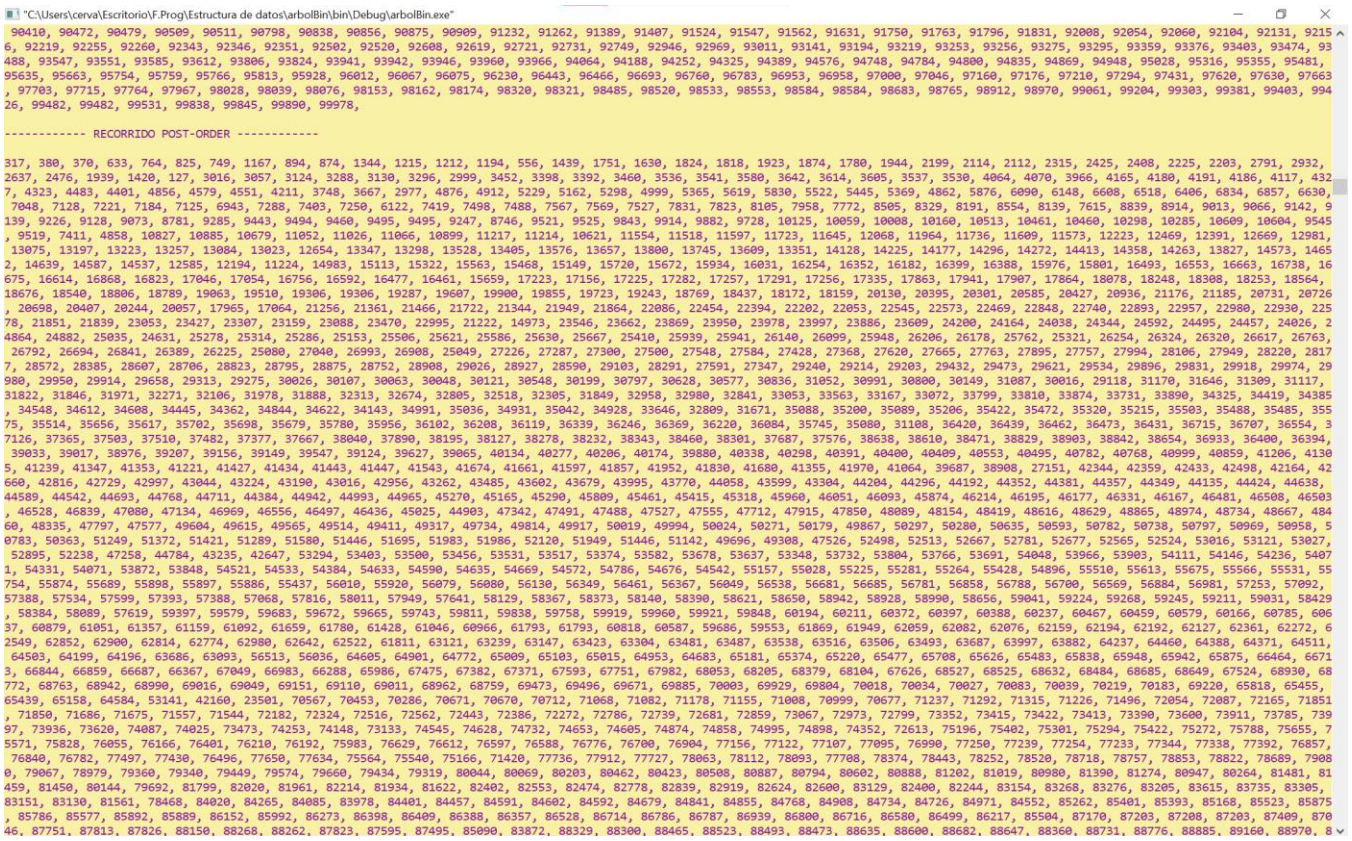
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---------- ALTURA DEL ARBOL ----------
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---------- ALTURA DEL SUB-ARBOL IZQUIERDO ----------
- 20
---------- ALTURA DEL SUB-ARBOL DERECHO ----------
- 19
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Conclusión

En lo personal, desconocía el algoritmo de los árboles binarios, solo los había escuchado o teorizado, pero no me había tocado entrar en la parte de la codificación, es algo interesante como se forma el algoritmo para tomar los valores tanto del subárbol del lado izquierdo como el del lado derecho y que todo en conjunto sea el árbol completo.

Fue una práctica interesante, lo que más trabajo me costó fue crear la función para eliminar un dato del árbol y eliminar todo el árbol; para poder crear el algoritmo me guie del pseudocódigo proporcionado en las diapositivas del profesor y para eliminar todo el árbol, me guie del algoritmo de la Lista Dummy, a partir de ahí, ya solo cree unas modificaciones para el árbol y lo hice más simple y práctico; aunque no aparece la función de eliminar un dato del árbol en el reporte porque no es parte de los requerimientos del problema de la semana, si comprobé su funcionamiento al momento de depurar el código, dando resultados exitosos.