Project 3- Text Processing
CSCI 230 T Th 11:10 am
Compiler: g++
OS: Windows 10/WSL

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Notes

Status

Both HuffmanCoding and Trie portion of the project are completed with no errors.

Extra Credit

Did the improved standard trie that gives the amount of times a word occurs.

Design Decisions

For the HuffmanCoding input, my program will only work with window style line endings. If its not then it will not read a new line character. The solution for that is commented out in the code; to fix it I would just need to add a newline after each call to getline and the remove the final newline character since it will add an extra one.

For the trie I decided to ignore the numbers simply because the child array is much smaller. In order to include the numbers while still using a lookup table as the child array it would have to be much larger since numbers are not right next to the lowercase letters in the ascii table.

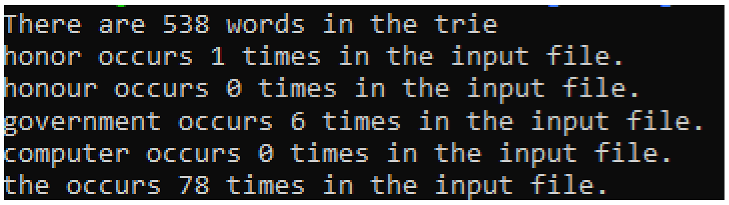
output

moneyOut.txt

```
  0000
    100
d  1011
e  11
m  001
n  011
o  010
r  0001
y  1010

____________
Number of characters: 18
Number of bits: 54
Compressed: 000000101000011110000101001111101010001111111011111011
```

Trie Output



```
There are 538 words in the trie
honor occurs 1 times in the input file.
honour occurs 0 times in the input file.
government occurs 6 times in the input file.
computer occurs 0 times in the input file.
the occurs 78 times in the input file.
```

Source Code

main.cpp

```cpp
#include <vector>
#include <fstream>
#include <algorithm>
#include <iostream>
#include "HuffmanCoding.hpp"
#include "Trie.hpp"

int main()
{
    HuffmanCoding test("docs/moneyIn.txt", "docs/moneyOut.txt");
    test.compress();
    Trie declaration("docs/usdeclarPC.txt");
    std::string searchTerms[]{"honor", "honour", "government", "computer", "the"};
    int occurences = 0;
    std::cout << "There are " << declaration.size() << " words in the trie\n";
    for (std::string s : searchTerms)
    {
        occurences = declaration.search(s);
        std::cout << s << " occurs " << occurences << " times in the input file.\n";
    }
}
```

HuffmanNode.hpp

```cpp
#pragma once

class HuffmanNode
{
public:
    HuffmanNode(char c, int f, HuffmanNode *l, HuffmanNode *r)
    {
        data.first = c;
        data.second = f;
        left = l;
        right = r;
    }
    HuffmanNode(std::pair<char, int> d, HuffmanNode *l, HuffmanNode *r)
    {
        left = l;
        right = r;
        data = d;
    }
    int frequency()
    {
        return data.second;
    }
    char getChar()
    {
        return data.first;
    }
    bool isExternal()
    {
        return left == NULL && right == NULL;
    }
    HuffmanNode *getLeft()
    {
        return left;
    }
    HuffmanNode *getRight()
    {
        return right;
    }

private:
    std::pair<char, int> data;
    HuffmanNode *left;
    HuffmanNode *right;
};
```

HuffmanCoding.hpp

```
#pragma once
#include <map>
#include "HuffmanNode.hpp"

class HuffmanCoding
{
public:
    HuffmanCoding(const char *inFile, const char *outFile);
    void compress();

protected:
    void buildFreqTable();
    HuffmanNode *buildTree();
    typedef std::pair<char, int> pair;
    void getCodes(HuffmanNode *node, std::string prefix,
                  std::map<char, std::string> &output);

private:
    std::map<char, int> freqTable;
    const char *inputFileName;
    const char *outputFilename;
    std::string text;
};
```

HuffmanCoding.cpp

```
#include <fstream>
#include <string>
#include <queue>
#include "HuffmanCoding.hpp"
#include "HuffmanNode.hpp"

class Greater
{
public:
    bool operator()(HuffmanNode *a, HuffmanNode *b) const
    {
        return a->frequency() > b->frequency();
    }
};

HuffmanCoding::HuffmanCoding(const char *inFile, const char *outFile)
    : inputFileName(inFile), outputFilename(outFile)
{
}
```

```
void HuffmanCoding::buildFreqTable()
{
    std::ifstream inFile(inputFileName);
    std::string temp;
    while (std::getline(inFile, temp))
    {
        text += temp;
        //Have to add a new line since getline doesn't include it
        //!Only on LF line endings?
        //   text.push_back('\n');
    }
    //removes extra newline
    //text.pop_back();
    for (char c : text)
    {
        if (freqTable.count(c))
        {
            freqTable[c]++;
        }
        else
        {
            freqTable[c] = 1;
        }
    }
}

HuffmanNode *HuffmanCoding::buildTree()
{
    buildFreqTable();
    std::priority_queue<HuffmanNode *, std::vector<HuffmanNode *>, Greater> nodes;
    for (auto p : freqTable)
    {
        nodes.push(new HuffmanNode(p, NULL, NULL));
    }
    HuffmanNode *left;
    HuffmanNode *right;
    int freqSum;
    while (nodes.size() > 1)
    {
        left = nodes.top();
        nodes.pop();
        right = nodes.top();
        nodes.pop();
        freqSum = left->frequency() + right->frequency();

        nodes.push(new HuffmanNode('0', freqSum, left, right));
    }
    HuffmanNode *root = nodes.top();
    nodes.pop();
    return root;
}

void HuffmanCoding::getCodes(HuffmanNode *node, std::string prefix,
                             std::map<char, std::string> &output)
{
    if (node->isExternal())
    {
        output[node->getChar()] = prefix;
    }
    else
    {
        getCodes(node->getLeft(), prefix + "0", output);
        getCodes(node->getRight(), prefix + "1", output);
    }
}

void HuffmanCoding::compress()
{
    HuffmanNode *root = buildTree();
    std::map<char, std::string> codes;
    getCodes(root, "", codes);
    std::string result;
    std::ofstream outfile(outputFilename);
    for (char c : text)
    {
        result += codes[c];
    }
    for (auto p : codes)
    {
        outfile << p.first << ' ' << p.second << '\n'; //Output the table containing the character codes
    }
    outfile << "\n--------\nNumber of characters: " << root->frequency()
            << "\nNumber of bits: " << result.length() << "\nCompressed: "
            << result;
}
```

Trie.hpp

```
#pragma once
#include <string>

const int ALPHABET_SIZE = 26;

class TrieNode
{
public:
    TrieNode() : isEndOfWord(false), count(0)
    {
        for (int i = 0; i < ALPHABET_SIZE; i++)
        {
            children[i] = NULL;
        }
    }

    TrieNode *children[26];
    bool isEndOfWord;
    int count;
};

class Trie
{
public:
    Trie(std::string file);
    void insert(const std::string &word);
    int search(const std::string &word); //Returns the number of times the word occurs in the text
    int size() const;                    //Returns the number of unique words stored in a tree
private:
    int n;
    TrieNode *root;
};
```

Trie.cpp

```
#include "Trie.hpp"
#include <algorithm>
#include <fstream>
#include <iostream>

Trie::Trie(std::string file) : n(0), root(new TrieNode())
{
    std::ifstream infile(file);
    std::string word;
    while (infile >> word)
    {
        //Removes anything that is not a letter from the word
        word.erase(std::remove_if(word.begin(), word.end(), [](char c) { return !isalpha(c); }), word.end());
        //If the word was just a number don't add the empty string to the trie
        if (word.length() == 0)
        {
            continue;
        }
        for (int i = 0; i < word.length(); i++)
        {
            word[i] = std::tolower(word[i]);
        }
        insert(word);
    }
}

int Trie::size() const
{
    return n;
}

void Trie::insert(const std::string &word)
{
    TrieNode *node = root;
    int index = 0;
    for (char c : word)
    {
        index = c - 'a';
        if (node->children[index] == NULL)
        {
            node->children[index] = new TrieNode();
        }
        node = node->children[index];
    }

    if (!(node->isEndOfWord))
    {
        node->isEndOfWord = true;
        n++;
    }
    node->count++;
}

int Trie::search(const std::string &word)
{
    TrieNode *node = root;
    int index = 0;
    for (char c : word)
    {
        index = c - 'a';
        if (node->children[index] == NULL)
        {
            return 0;
        }
        node = node->children[index];
    }
    return node->count;
}
```