# 1. Code

## 1-1. MinHeap

```
public class MinHeap {
	Element heap[];
	int size;

	MinHeap(int length) {                                    // 생성자
		heap = new Element[length+1];
		for (int i = 0; i < length+1; i++) {
			heap[i] = new Element();
			heap[i].tree = new TreeNode();
		}
		size = 0;
	}

	public void insert(Element e) {                          // 삽입 함수
		int index = ++size;

		while ((index != 1) && (e.key < heap[index/2].key)) {
			heap[index] = heap[index/2];
			index /= 2;
		}
		heap[index] = e;
	}

	public Element remove() {                                // 삭제 함수
		int parent, child;
		Element data, tmp;

		if (size < 0)
			return null;
		data = heap[1];
		tmp = heap[size--];
		parent = 1;
		child = 2;

		while (child <= size) {
			if ((child < size) && (heap[child].key > heap[child+1].key))
				child++;
			if (tmp.key <= heap[child].key)break;
			heap[parent] = heap[child];
			parent = child;
			child *= 2;
		}
		heap[parent] = tmp;
		return data;
	}
}
```

1-2. Count

```
import java.io.FileReader;

public class Count {
	Huffman h = new Huffman();
	int i, size;
	char alphabet[] = new char[27];		// 알파벳 A~Z 저장하는 배열
	int count[] = new int[27];		// 각 알파벳 빈도수 저장하는 배열

	Count() {
		for (i = 0; i < 26; i++)
			alphabet[i] = (char)(i+97);
		alphabet[i] = ' ';

		for (i = 0; i < 27; i++)
			count[i] = 0;
		size = alphabet.length;
	}

	public void countFunc() throws Exception {	// file을 불러와서 count
		String path = "D:Test.txt";			// 파일 위치 설정
		FileReader fr = new FileReader(path);		// 파일 open

		i = 0;
		while((i = fr.read()) != -1) {
			char ch = (char)i;

			if (ch >= 97 && ch <= 122)
				count[i-97]++;
			else if (ch == 32)
				count[size-1]++;
			else
				continue;
		}
		fr.close();

		int tmp = 0;
		for (int j = 0; j < count.length-tmp; j++) {
			if (count[j] == 0) {
				for (int k = j; k < count.length-1; k++) {
					count[k] = count[k+1];
					alphabet[k] = alphabet[k+1];
				}
				j--;
				tmp++;
			}
		}
		size = size - tmp;
	}

	public void print() {				// 출력함수
		for (i = 0; i < size; i++)		// 문자 출력
			System.out.printf("%5c", alphabet[i]);
		System.out.println();
		for (i = 0; i < size; i++)		// 빈도수 출력
			System.out.printf("%5d", count[i]);
		System.out.println();
	}
}
```

1-3. TreeNode

```
public class TreeNode {
	char symbol;                                    // 알파벳 저장
	int weight;                                     // 빈도수 저장
	TreeNode leftChild;                             // 왼쪽 자식
	TreeNode rightChild;                            // 오른쪽 자식
	TreeNode() {}                                   // 생성자
	TreeNode(TreeNode left, TreeNode right) {
		leftChild = left;
		rightChild = right;
	}
}
```

1-4. Huffman

```
public class Huffman {
	public TreeNode HuffmanTree() throws Exception {
		MinHeap mh = new MinHeap(27);
		Count cnt = new Count();
		Element a, b, c;

		cnt.countFunc();                            // 알파벳 개수 카운트
		cnt.print();                                // 카운트한 개수 출력

		for (int i = 0; i < cnt.size; i++) {
			TreeNode node = new TreeNode();
			node.symbol = cnt.alphabet[i];
			a = new Element();
			a.key = node.weight = cnt.count[i];
			a.tree = node;
			mh.insert(a);
		}

		for (int i = 1; i < cnt.size; i++) {        // Huffman 트리 생성
			a = new Element();
			b = new Element(mh.remove());
			c = new Element(mh.remove());
			TreeNode p = new TreeNode(b.tree, c.tree);
			a.key = p.weight = b.key + c.key;
			a.tree = p;
			mh.insert(a);
		}
		a = new Element(mh.remove());
		return a.tree;
	}

	// Huffman 코드 출력 함수
	public void HuffmanPrint(TreeNode root, String str) {
		if (root == null)                   // 빈 트리일 경우 return

			return;
		else if (root.leftChild == null && root.rightChild == null)
			System.out.println(root.symbol + ": " + str);
		else {
			String code = str;
			code += "0";
			HuffmanPrint(root.leftChild, code);
			code = str;
			code += "1";
			HuffmanPrint(root.rightChild, code);
		}
	}
}
```

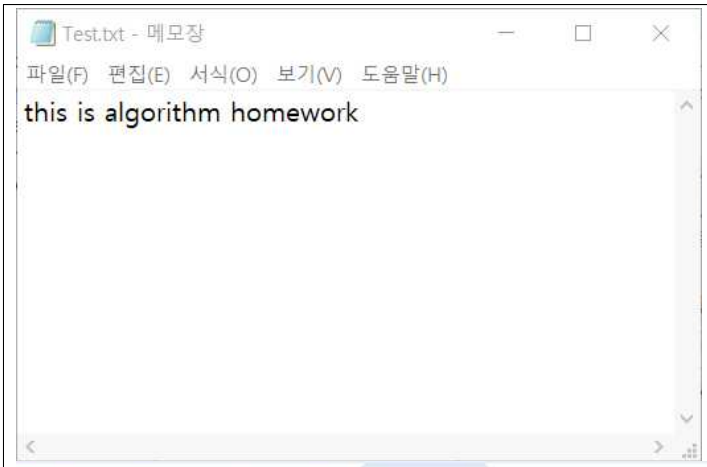
1-5. Element

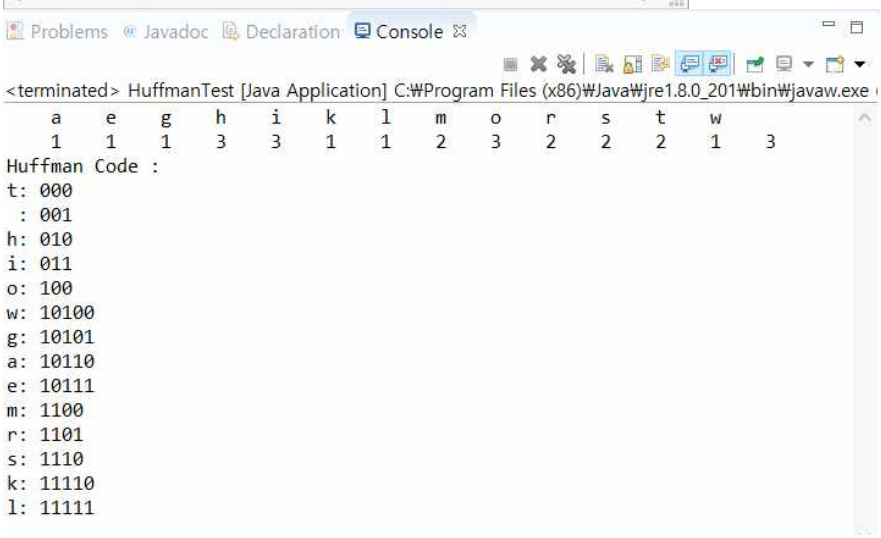
```
public class Element {
	TreeNode tree;
	int key;

	Element() {				// 생성자
		tree = null;			// tree 초기화
		key = 0;
	}
	Element(Element e) {			// 매개변수 갖는 생성자
		tree = e.tree;
		key = e.key;
	}
}
```

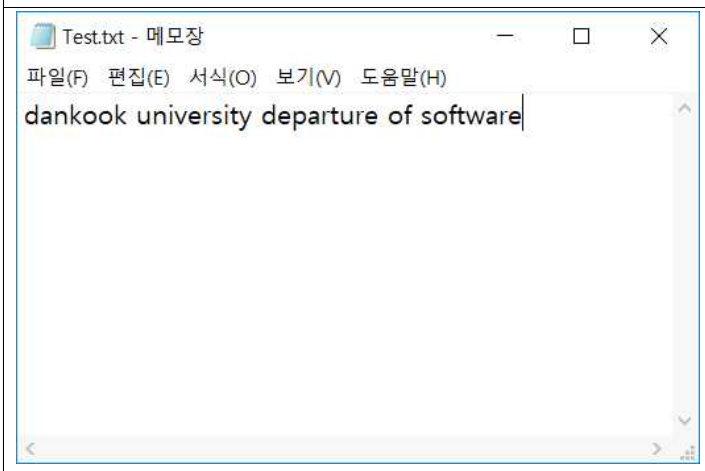
1-6. Huffman Test

```
public class HuffmanTest {
	public static void main(String args[]) throws Exception {
		Huffman h = new Huffman();
		String str = "";
		TreeNode root = new TreeNode();
		root = h.HuffmanTree();				// Huffman 트리 생성
		System.out.println("Huffman Code : ");	// Huffman 코드 출력
		h.HuffmanPrint(root, str);
	}
}
```

## 2. 실행화면


Test.txt - 메모장
파일(F) 편집(E) 서식(O) 보기(V) 도움말(H)
this is algorithm homework


Problems Javadoc Declaration Console
<terminated> HuffmanTest [Java Application] C:₩Program Files (x86)₩Java₩jre1.8.0_201₩bin₩javaw.exe
a e g h i k l m o r s t w
1 1 1 3 3 1 1 2 3 2 2 2 1 3
Huffman Code :
t: 000
: 001
h: 010
i: 011
o: 100
w: 10100
g: 10101
a: 10110
e: 10111
m: 1100
r: 1101
s: 1110
k: 11110
l: 11111


Test.txt - 메모장
파일(F) 편집(E) 서식(O) 보기(V) 도움말(H)
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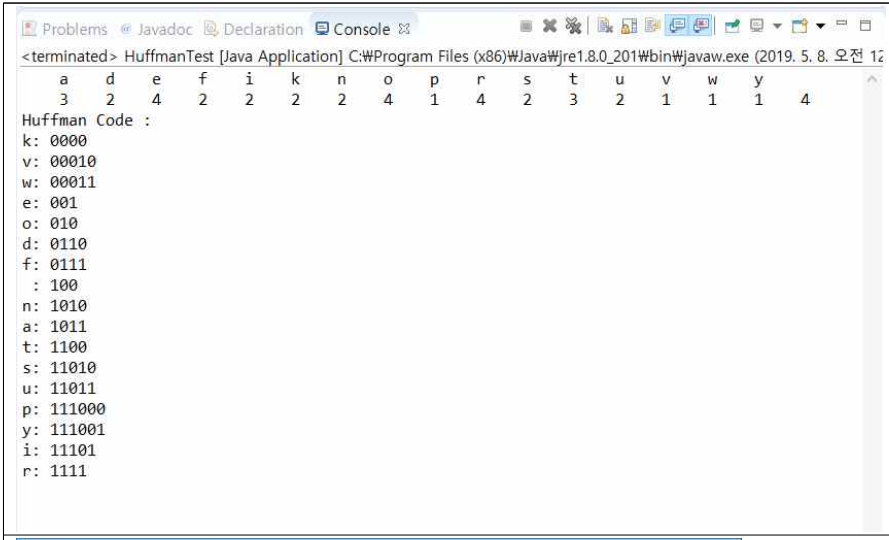
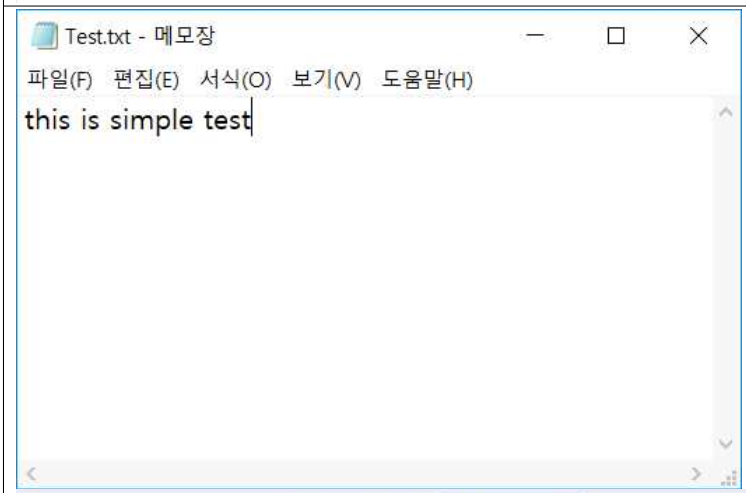
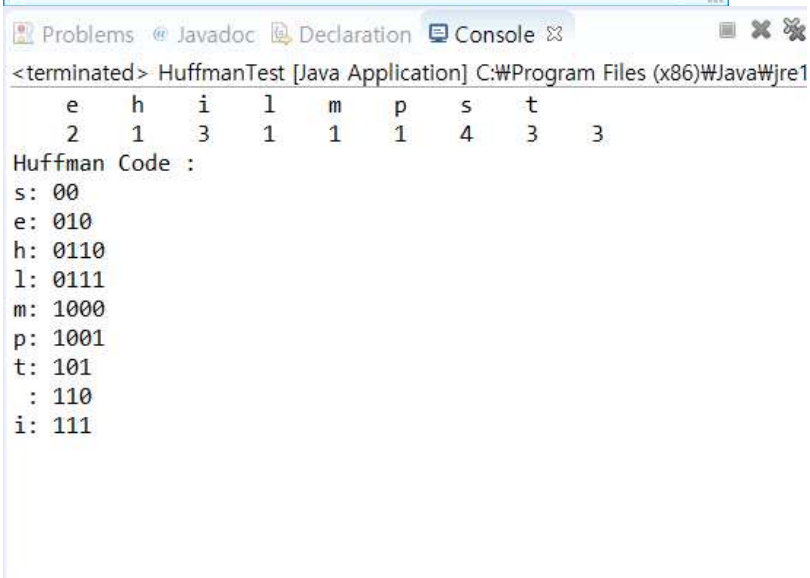

Problems Javadoc Declaration Console
<terminated> HuffmanTest [Java Application] C:₩Program Files (x86)₩Java₩jre1.8.0_201₩bin₩javaw.exe (2019. 5. 8. 오전 12
a d e f i k n o p r s t u v w y
3 2 4 2 2 2 2 4 1 4 2 3 2 1 1 1 4
Huffman Code :
k: 0000
v: 00010
w: 00011
e: 001
o: 010
d: 0110
f: 0111
: 100
n: 1010
a: 1011
t: 1100
s: 11010
u: 11011
p: 111000
y: 111001
i: 11101
r: 1111


Test.txt - 메모장
파일(F) 편집(E) 서식(O) 보기(V) 도움말(H)
this is simple test


Problems Javadoc Declaration Console
<terminated> HuffmanTest [Java Application] C:₩Program Files (x86)₩Java₩jre1
e h i l m p s t
2 1 3 1 1 1 4 3 3
Huffman Code :
s: 00
e: 010
h: 0110
l: 0111
m: 1000
p: 1001
t: 101
: 110
i: 111