

## CMPS 12M

### Introduction to Data Structures Lab

### Lab Assignment 2

The goal of this assignment is to practice using command line arguments, file input-output, and manipulation of Strings in java. File input-output and command line arguments will be necessary in programming assignment 2 and in future assignments.

#### Command Line Arguments

A java main function always reads the operating system command line from which it was called, and stores the strings on that line in the `args` array. Compile the following java program and place it in an executable jar file called `CommandLineArguments` (see lab1 to learn how to do this)

```
// CommandLineArguments.java
public class CommandLineArguments{
    public static void main(String[] args){
        int n = args.length;
        System.out.println("args.length = " + n);
        for(int i=0; i<n; i++) System.out.println(args[i]);
    }
}
```

then do `%CommandLineArguments zero one two three four` and observe the output. Run it with several other sets of strings on the command line. These strings are called command line arguments, and can be used within a program to specify and modify the program's behavior. Typically command line arguments will be either strings specifying optional behavior, text to be processed by the program directly, or names of files to be processed in some way.

#### File Input-Output

The `java.util` package contains the `Scanner` class, and the `java.io` package contains classes `PrintWriter` and `FileWriter`. These classes perform simple input and output operations on text files. Their usage is illustrated in the program `FileCopy.java` below, which merely copies one file to another, i.e. it provides essentially the same functionality as the unix command `cp` (with respect to text files only.) As you can see, the `Scanner` constructor takes a `File` object for initialization, which is itself initialized by a `String` giving the name of an input file. The `Scanner` class contains (among others) methods called `useDelimiter()`, `hasNext()` and `next()`. Read the documentation for `Scanner` (<http://docs.oracle.com/javase/7/docs/api/>) to learn about the proper usage of these methods. The `PrintWriter` constructor takes a `FileWriter` object for initialization, which is in turn initialized by a `String` giving the name of an output file. `PrintWriter` contains methods `print()` and `println()` which behave identically to the corresponding methods in `System.out`, except that output goes to a file instead of `stdout`. Note that the `FileWriter` initialization can fail if no file named `args[1]` exists in the current directory. If it fails, it will throw an `IOException`. This is a type of exception which cannot be ignored, and therefore function `main` must either catch the exception, or throw it up the chain of function calls. (In the case of function `main`, the "calling function" is the operating system). In this example, we deal with this problem by declaring `main` to throw an `IOException`, which causes the program to quit if the exception is encountered. Similar comments apply to the initialization of the `Scanner` object. See the java documentation for more details.

Compile and run `FileCopy.java`, and observe that a `Usage` statement is printed if the user does not provide at least two command line arguments. This `Usage` statement assumes that the program is being run

from an executable jar file called `FileCopy`. All of your programs which take command line arguments should include such a usage statement.

```
// FileCopy.java
// Illustrates file IO

import java.io.*;
import java.util.Scanner;

public class FileCopy{
    public static void main(String[] args) throws IOException{
        Scanner in = null;
        PrintWriter out = null;
        String line = null;
        int n;

        if(args.length < 2){
            System.out.println("Usage: FileCopy infile outfile");
            System.exit(1);
        }

        in = new Scanner(new File(args[0]));
        out = new PrintWriter(new FileWriter(args[1]));

        in.useDelimiter("\n");
        while( in.hasNext() ){
            line = in.next();
            out.println( line );
        }

        in.close();
        out.close();
    }
}
```

### String Tokenization

A common task in text processing is to parse a string by deleting the surrounding whitespace characters, keeping just the discrete words or “tokens” which remain. A token is a maximal substring which contains no whitespace characters. For instance, consider the preceding sentence to be a string. The tokens in this string are then: "A", "token", "is", "a", "maximal", "substring", "which", "contains", "no", "whitespace", "characters". Whitespace here is defined to mean spaces, newlines, and tab characters. This is one of the first tasks that a compiler for any language such as java or C must perform. The source file is broken up into tokens, each of which is then classified as: keyword, identifier, punctuation, etc. The `String` class, contains a method called `split()` which decomposes a string into tokens, then returns a `String` array containing the tokens as its elements. Compile and run the following program `FileTokens.java` illustrating these operations.

```
// FileTokens.java
// Illustrates file IO and tokenization of strings.

import java.io.*;
import java.util.Scanner;
```

```

class FileTokens{
    public static void main(String[] args) throws IOException{
        Scanner in = null;
        PrintWriter out = null;
        String line = null;
        String[] token = null;
        int i, n, lineNumber = 0;

        if(args.length < 2){
            System.out.println("Usage: FileIO infile outfile");
            System.exit(1);
        }

        in = new Scanner(new File(args[0]));
        out = new PrintWriter(new FileWriter(args[1]));

        in.useDelimiter("\n");
        while( in.hasNext() ){
            lineNumber++;
            line = in.next() + " "; // add space so split works on blank lines
            token = line.split("\\s+"); // split line around white space
            n = token.length;
            out.println("Line " + lineNumber + " contains " + n + " tokens:");
            for(i=0; i<n; i++){
                out.println(token[i]);
            }
            out.println();
        }

        in.close();
        out.close();
    }
}

```

### What to turn in

Write a java program called `FileReverse.java` that takes two command line arguments giving the names of the input and output files respectively (following the preceding examples). Your program will read each line of input, parse the tokens, then print each token backwards to the output file on a line by itself. For example given a file called `in` containing the lines:

```

abc defg
hi
jkl mnop q

```

```

rstu v
wxyz

```

the command `%FileReverse in out` will create a file called `out` containing the lines:

```

cba
gfed
ih
lkj
ponm

```

q  
utsr  
v  
zyxw

Your program will contain a recursive method called `stringReverse()` with the following signature:

```
public static String stringReverse(String s, int n)
```

This function will return a `String` that is the reversal of the first  $n$  characters of `s`. It should be based on the `reverseArray()` method discussed in class, and on the `writeBackward()` method discussed in the text. Use `stringReverse()` to perform the reversal of tokens from the input file.

Submit the files: `README`, `makefile`, and `FileReverse.java` to the assignment name `lab2`.