Building Java Programs

Chapter 6

Lecture 6-1: File Input with Scanner

reading: 6.1 - 6.2, 5.3

self-check: Ch. 6 #1-6

exercises: Ch. 6 #5-7

videos: Ch. 6 #1-2

Input/output (I/O)

```
import java.io.*;
```

- Create a `File` object to get info about a file on disk.

  (This doesn't actually create a new file on the hard disk.)

```
File f = new File("example.txt");
if (f.exists() && f.length() > 1000) {
    f.delete();
}
```

Method name	Description
`canRead()`	returns whether file is able to be read
`delete()`	removes file from disk
`exists()`	whether this file exists on disk
`getName()`	returns file's name
`length()`	returns number of bytes in file
`renameTo(`*file*`)`	changes name of file

Reading files

- To read a file, pass a `File` when constructing a `Scanner`.

```
Scanner name = new Scanner(new File("file name"));
```

Example:

```
File file = new File("mydata.txt");
Scanner input = new Scanner(file);
```

or, better yet:

```
Scanner input = new Scanner(new File("mydata.txt"));
```

The `throws` clause

- **`throws` clause**: Keywords on a method's header that state that it may generate an exception.

- Syntax:

```
public static type name(params) throws type {
```

  - Example:

```
public class ReadFile {
    public static void main(String[] args)
            throws FileNotFoundException {
```

  - Like saying, *"I hereby announce that this method might throw an exception, and I accept the consequences if it happens."*

Scanner exceptions

- `InputMismatchException`
  - You read the wrong type of token (e.g. read `"hi"` as `int`).
- `NoSuchElementException`
  - You read past the end of the input.
- Finding and fixing these exceptions:
  - Read the exception text for line numbers in your code (the first line that mentions your file; often near the bottom):

```
Exception in thread "main" java.util.NoSuchElementException
        at java.util.Scanner.throwFor(Scanner.java:838)
        at java.util.Scanner.next(Scanner.java:1347)
        at CountTokens.sillyMethod(CountTokens.java:19)
        at CountTokens.main(CountTokens.java:6)
```

Testing for valid input

- `Scanner` methods to see what the next token will be:

Method	Description
`hasNext()`	returns `true` if there are any more tokens of input to read *(always true for console input)*
`hasNextInt()`	returns `true` if there is a next token and it can be read as an `int`
`hasNextDouble()`	returns `true` if there is a next token and it can be read as a `double`

- These methods do not consume input;
  they just give information about the next token.
  - Useful to see what input is coming, and to avoid crashes.

Line-based file processing

reading: 6.3

self-check: #7-11

exercises: #1-4, 8-11

Hours question

- Given a file `hours.txt` with the following contents:

```
123 Kim 12.5 8.1 7.6 3.2
456 Brad 4.0 11.6 6.5 2.7 12
789 Stef 8.0 8.0 8.0 8.0 7.5
```

  - Consider the task of computing hours worked by each person:

```
Kim (ID#123) worked 31.4 hours (7.85 hours/day)
Brad (ID#456) worked 36.8 hours (7.36 hours/day)
Stef (ID#789) worked 39.5 hours (7.9 hours/day)
```

- Let's try to solve this problem token-by-token ...

Hours answer (flawed)

```
// This solution does not work!
import java.io.*;                       // for File
import java.util.*;                     // for Scanner

public class HoursWorked {
    public static void main(String[] args)
            throws FileNotFoundException {
        Scanner input = new Scanner(new
  File("hours.txt"));
        while (input.hasNext()) {
            // process one person
            int id = input.nextInt();
            String name = input.next();
            double totalHours = 0.0;
            int days = 0;
            while (input.hasNextDouble()) {
                totalHours += input.nextDouble();
                days++;
            }
            System.out.println(name + " (ID#" + id +
                               ") worked " + totalHours + " hours
```

Flawed output

```
Susan (ID#123) worked 487.4 hours (97.48 hours/day)
Exception in thread "main"
java.util.InputMismatchException
        at java.util.Scanner.throwFor(Scanner.java:840)
        at java.util.Scanner.next(Scanner.java:1461)
        at java.util.Scanner.nextInt(Scanner.java:2091)
        at HoursWorked.main(HoursBad.java:9)
```

- The inner `while` loop is grabbing the next person's ID.
- We want to process the tokens, but we also care about the line breaks (they mark the end of a person's data).

- A better solution is a hybrid approach:
  - First, break the overall input into lines.
  - Then break each line into tokens.

Line-based Scanner methods

Method	Description
`nextLine()`	returns the next entire line of input
`hasNextLine()`	returns `true` if there are any more lines of input to read (always true for console input)

- `nextLine` consumes from the input cursor to the next `\n` .

```
Scanner input = new Scanner(new File("file name"));
while (input.hasNextLine()) {
    String line = input.nextLine();
    process this line;
}
```

Consuming lines of input

```
23   3.14 John Smith   "Hello world"
                45.2      19
```

- The Scanner reads the lines as follows:

```
23\t3.14 John Smith\t"Hello world"\n\t\t45.2  19\n
^
```

  - `String line = input.nextLine();`

```
23\t3.14 John Smith\t"Hello world"\n\t\t45.2  19\n
                                  ^
```

  - `String line2 = input.nextLine();`

```
23\t3.14 John Smith\t"Hello world"\n\t\t45.2  19\n
                                          ^
```

  - Each \n character is consumed but not returned.

Scanners on Strings

- A `Scanner` can tokenize the contents of a `String`:

```
Scanner name = new Scanner(String);
```

  - Example:

```
String text = "15  3.2 hello   9  27.5";
Scanner scan = new Scanner(text);

int num = scan.nextInt();
System.out.println(num);              // 15

double num2 = scan.nextDouble();
System.out.println(num2);             // 3.2

String word = scan.next();
System.out.println(word);             // hello
```

Tokenizing lines of a file

Input file input.txt:	Output to console:
The quick brown fox jumps over the lazy dog.	Line has 6 words Line has 3 words

```
// Counts the words on each line of a file
Scanner input = new Scanner(new File("input.txt"));
while (input.hasNextLine()) {
    String line = input.nextLine();
    Scanner lineScan = new Scanner(line);

    // process the contents of this line
    int count = 0;
    while (lineScan.hasNext()) {
        String word = lineScan.next();
        count++;
    }
    System.out.println("Line has " + count + " words");
}
```

Hours question

- Fix the `Hours` program to read the input file properly:

```
123 Kim 12.5 8.1 7.6 3.2
456 Brad 4.0 11.6 6.5 2.7 12
789 Stef 8.0 8.0 8.0 8.0 7.5
```

  - Recall, it should produce the following output:

```
Kim (ID#123) worked 31.4 hours (7.85 hours/day)
Brad (ID#456) worked 36.8 hours (7.36 hours/day)
Stef (ID#789) worked 39.5 hours (7.9 hours/day)
```

Hours answer, corrected

```
// Processes an employee input file and outputs each employee's hours.
import java.io.*;    // for File
import java.util.*;  // for Scanner

public class Hours {
    public static void main(String[] args) throws FileNotFoundException {
        Scanner input = new Scanner(new File("hours.txt"));
        while (input.hasNextLine()) {
            String line = input.nextLine();
            Scanner lineScan = new Scanner(line);
            int id = lineScan.nextInt();           // e.g. 456
            String name = lineScan.next();         // e.g. "Brad"
            double sum = 0.0;
            int count = 0;
            while (lineScan.hasNextDouble()) {
                sum = sum + lineScan.nextDouble();
                count++;
            }

            double average = sum / count;
            System.out.println(name + " (ID#" + id + ") worked " +
                               sum + " hours (" + average + " hours/day)");
        }
    }
}
```

Hours v2 question

- Modify the `Hours` program to search for a person by ID:
  - Example:

```
Enter an ID: 456
Brad worked 36.8 hours (7.36 hours/day)
```

  - Example:

```
Enter an ID: 293
ID #293 not found
```

Hours v2 answer 1

```
// This program searches an input file of employees' hours worked
// for a particular employee and outputs that employee's hours data.

import java.io.*;    // for File
import java.util.*;  // for Scanner

public class HoursWorked {
    public static void main(String[] args) throws FileNotFoundException {
        Scanner console = new Scanner(System.in);
        System.out.print("Enter an ID: ");
        int searchId = console.nextInt();       // e.g. 456

        Scanner input = new Scanner(new File("hours.txt"));
        String line = findPerson(input, searchId);
        if (line.length() > 0) {
            processLine(line);
        } else {
            System.out.println("ID #" + searchId + " was not found");
        }
    }

    ...
```

Hours v2 answer 2

```
// Locates and returns the line of data about a particular person.
public static String findPerson(Scanner input, int searchId) {
    while (input.hasNextLine()) {
        String line = input.nextLine();
        Scanner lineScan = new Scanner(line);
        int id = lineScan.nextInt();          // e.g. 456
        if (id == searchId) {
            return line;                      // we found them!
        }
    }
    return "";           // not found, so return an empty line
}

// Totals the hours worked by the person and outputs their info.
public static void processLine(String line) {
    Scanner lineScan = new Scanner(line);
    int id = lineScan.nextInt();              // e.g. 456
    String name = lineScan.next();            // e.g. "Brad"
    double hours = 0.0;
    int days = 0;
    while (lineScan.hasNextDouble()) {
        hours += lineScan.nextDouble();
        days++;
    }

    System.out.println(name + " worked " + hours + " hours ("
            + (hours / days) + " hours/day)");
}
}
```