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"));
```

File paths

- **absolute path**: specifies a drive or a top `"/"` folder

  `C:/Documents/smith/hw6/input/data.csv`

  - Windows can also use backslashes to separate folders.

- **relative path**: does not specify any top-level folder

  `names.dat`
  `input/kinglear.txt`

  - Assumed to be relative to the *current directory*:

```
Scanner input = new Scanner(new File("data/readme.txt"));
```

  If our program is in `H:/hw6`,
  Scanner will look for `H:/hw6/data/readme.txt`

Compiler error w/ files

- The following program does not compile:

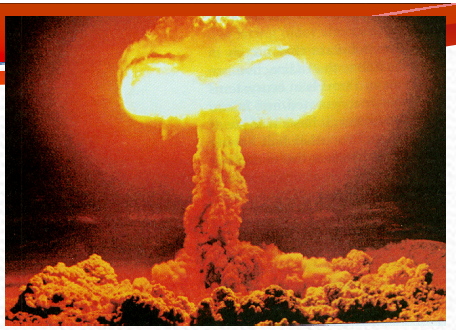
```
import java.io.*;      // for File
import java.util.*;    // for Scanner

public class ReadFile {
    public static void main(String[] args) {
        Scanner input = new Scanner(new File("data.txt"));
        String text = input.next();
        System.out.println(text);
    }
}
```

- The following error occurs:

```
ReadFile.java:6: unreported exception java.io.FileNotFoundException;
must be caught or declared to be thrown
        Scanner input = new Scanner(new File("data.txt"));
                        ^
```

Exceptions



- **exception**: An object representing a runtime error.
  - dividing an integer by 0
  - calling `charAt` on a `String` and passing too large an index
  - trying to read the wrong type of value from a `Scanner`
  - trying to read a file that does not exist
  - We say that a program with an error "*throws*" an exception.
  - It is also possible to "*catch*" (handle or fix) an exception.

- **checked exception**: An error that must be handled by our program (otherwise it will not compile).
  - We must specify how our program will handle file I/O failures.

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."*

Input tokens

- **token**: A unit of user input, separated by whitespace.
  - A `Scanner` splits a file's contents into tokens.

- If an input file contains the following:

```
23   3.14
  "John Smith"
```

The `Scanner` can interpret the tokens as the following types:

Token	Type(s)
`23`	`int`, `double`, `String`
`3.14`	`double`, `String`
`"John`	`String`
`Smith"`	`String`

Files and input cursor

- Consider a file `numbers.txt` that contains this text:

```
308.2
   14.9 7.4  2.8

3.9 4.7    -15.4
    2.8
```

- A `Scanner` views all input as a stream of characters:

```
308.2\n   14.9 7.4  2.8\n\n3.9 4.7   -15.4\n  2.8\n
^
```

- **input cursor**: The current position of the `Scanner`.

Consuming tokens

- **consuming input**: Reading input and advancing the cursor.
  - Calling `nextInt` etc. moves the cursor past the current token.

```
308.2\n   14.9 7.4  2.8\n\n3.9 4.7   -15.4\n  2.8\n
^
```

```
double x = input.nextDouble();    // 308.2
308.2\n   14.9 7.4  2.8\n\n3.9 4.7   -15.4\n  2.8\n
      ^
```

```
String s = input.next();          // "14.9"
308.2\n   14.9 7.4  2.8\n\n3.9 4.7   -15.4\n  2.8\n
               ^
```

File input question

- Recall the input file `numbers.txt`:

```
308.2
   14.9 7.4  2.8

3.9 4.7    -15.4
    2.8
```

- Write a program that reads the first 5 values from the file and prints them along with their sum.

```
number = 308.2
number = 14.9
number = 7.4
number = 2.8
number = 3.9
Sum = 337.2
```

File input answer

```
// Displays the first 5 numbers in the given file,
// and displays their sum at the end.

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

public class Echo {
    public static void main(String[] args)
            throws FileNotFoundException {
        Scanner input = new Scanner(new File("numbers.txt"));
        double sum = 0.0;
        for (int i = 1; i <= 5; i++) {
            double next = input.nextDouble();
            System.out.println("number = " + next);
            sum = sum + next;
        }
        System.out.printf("Sum = %.1f\n", sum);
    }
}
```

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)
```

Reading an entire file

- Suppose we want our program to process the entire file.
  (It should work no matter how many values are in the file.)

```
number = 308.2
number = 14.9
number = 7.4
number = 2.8
number = 3.9
number = 4.7
number = -15.4
number = 2.8
Sum = 329.3
```

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.

Using hasNext methods

- To avoid exceptions:

```
Scanner console = new Scanner(System.in);
System.out.print("How old are you? ");
if (console.hasNextInt()) {
    int age = console.nextInt();   // will not crash!
    System.out.println("Wow, " + age + " is old!");
} else {
    System.out.println("You didn't type an integer.");
}
```

- To detect the end of a file:

```
Scanner input = new Scanner(new File("example.txt"));
while (input.hasNext()) {
    String token = input.next();   // will not crash!
    System.out.println("token: " + token);
}
```

File input question 2

- Modify the Echo program to process the entire file:
  (It should work no matter how many values are in the file.)

```
number = 308.2
number = 14.9
number = 7.4
number = 2.8
number = 3.9
number = 4.7
number = -15.4
number = 2.8
Sum = 329.3
```

File input answer 2

```
// Displays each number in the given file,
// and displays their sum at the end.

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

public class Echo {
    public static void main(String[] args)
            throws FileNotFoundException {
        Scanner input = new Scanner(new File("numbers.txt"));
        double sum = 0.0;
        while (input.hasNextDouble()) {
            double next = input.nextDouble();
            System.out.println("number = " + next);
            sum = sum + next;
        }
        System.out.printf("Sum = %.1f\n", sum);
    }
}
```

File input question 3

- Modify the `Echo` program to handle files that contain non-numeric tokens (by skipping them).

- For example, it should produce the same output as before when given this input file, `numbers2.txt`:

```
308.2  hello
   14.9 7.4  bad stuff   2.8

3.9 4.7  oops  -15.4
:-)    2.8  @#*($&
```

File input answer 3

```
// Displays each number in the given file,
// and displays their sum at the end.
import java.io.*;      // for File
import java.util.*;    // for Scanner

public class Echo2 {
    public static void main(String[] args)
            throws FileNotFoundException {
        Scanner input = new Scanner(new File("numbers2.txt"));
        double sum = 0.0;
        while (input.hasNext()) {
            if (input.hasNextDouble()) {
                double next = input.nextDouble();
                System.out.println("number = " + next);
                sum = sum + next;
            } else {
                input.next();   // throw away the bad token
            }
        }
        System.out.printf("Sum = %.1f\n", sum);
    }
}
```

Election question

- Write a program that reads a file `poll.txt` of poll data.
  - Format: *State Obama% McCain% ElectoralVotes Pollster*

```
CT 56 31 7 Oct U. of Connecticut
NE 37 56 5 Sep Rasmussen
AZ 41 49 10 Oct Northern Arizona U.
```

- The program should print how many electoral votes each candidate leads in, and who is leading overall in the polls.

```
Obama: 214 votes
McCain: 257 votes
```

Election answer

```
// Computes leader in presidential polls, based on input file such as:
// AK 42 53 3 Oct Ivan Moore Research
import java.io.*;      // for File
import java.util.*;    // for Scanner

public class Election {
    public static void main(String[] args) throws FileNotFoundException {
        Scanner input = new Scanner(new File("polls.txt"));
        int obamaVotes = 0, mccainVotes = 0;

        while (input.hasNext()) {
            if (input.hasNextInt()) {
                int obama = input.nextInt();
                int mccain = input.nextInt();
                int eVotes = input.nextInt();
                if (obama > mccain) {
                    obamaVotes = obamaVotes + eVotes;
                } else if (mccain > obama) {
                    mccainVotes = mccainVotes + eVotes;
                }
            } else {
                input.next();   // skip non-integer token
            }
        }

        System.out.println("Obama: " + obamaVotes + " votes");
        System.out.println("McCain: " + mccainVotes + " votes");
    }
}
```