

Building Java Programs

Chapter 6

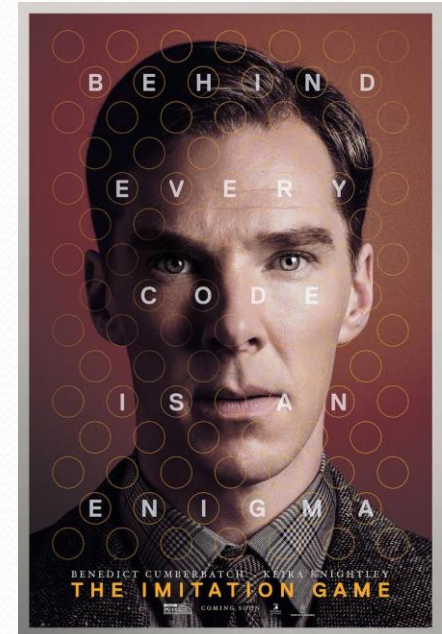
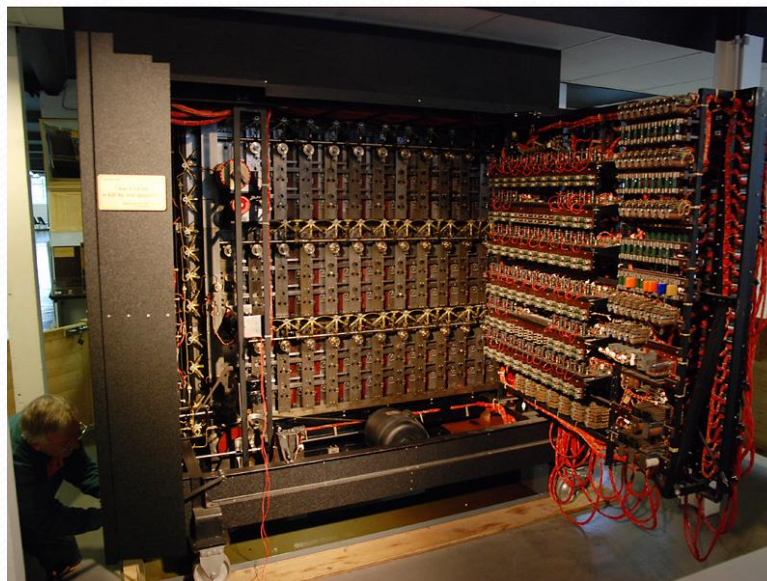
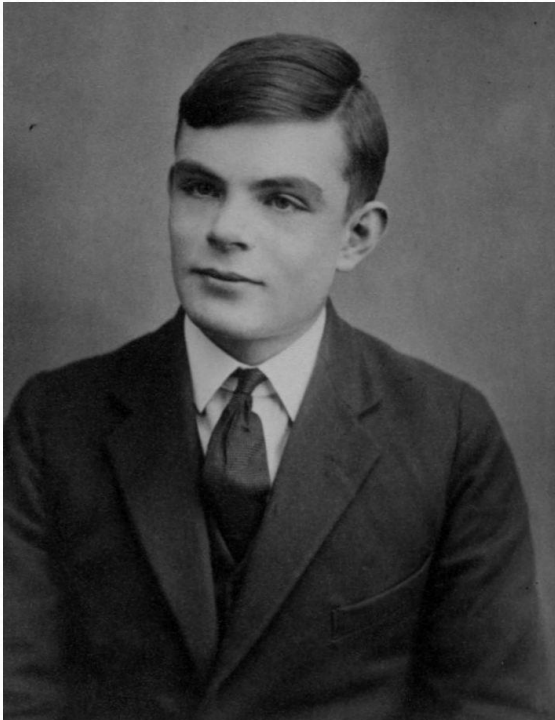
Lecture14: Line-Based File Input

reading: 6.3 - 6.5

Alan Turing

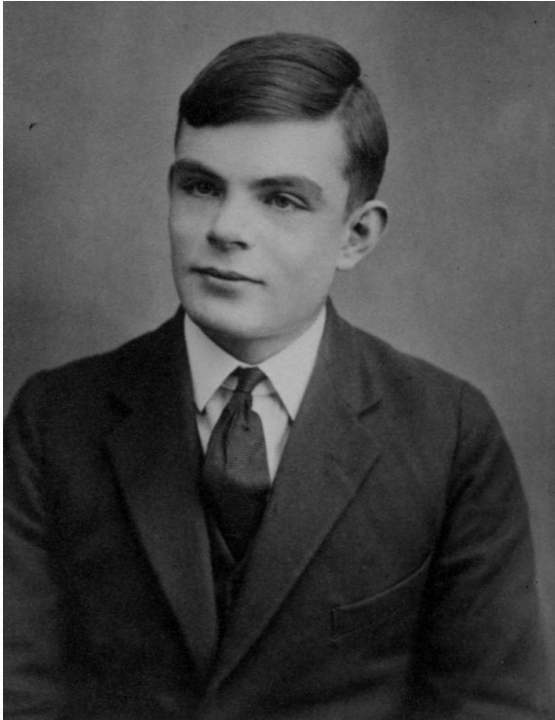
1912-1954

Breaking the Enigma



Alan Turing

1912-1954



- The limits of programming
 - Turing Complete
 - The Halting Problem
- Artificial Intelligence
 - Turing Test
 - The Imitation Game

Hours question

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

```
123 Ben 12.5 8.1 7.6 3.2
456 Greg 4.0 11.6 6.5 2.7 12
789 Victoria 8.0 8.0 8.0 8.0 7.5
```

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

```
Ben (ID#123) worked 31.4 hours (7.85 hours/day)
Greg (ID#456) worked 36.8 hours (7.36 hours/day)
Victoria (ID#789) worked 39.5 hours (7.90 hours/day)
```



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 (" +
                (totalHours / days) + " hours/day)");
        }
    }
}
```

Flawed output

```
Ben (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
<code>nextLine()</code>	returns next entire line of input (from cursor to <code>\n</code>)
<code>hasNextLine()</code>	returns <code>true</code> if there are any more lines of input to read (always true for console input)

```
Scanner input = new Scanner(new File("<filename>"));
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"
```

Mixing lines and tokens

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 Ben 12.5 8.1 7.6 3.2
456 Greg 4.0 11.6 6.5 2.7 12
789 Victoria 8.0 8.0 8.0 8.0 7.5
```

- Recall, it should produce the following output:

```
Ben (ID#123) worked 31.4 hours (7.85 hours/day)
Greg (ID#456) worked 36.8 hours (7.36 hours/day)
Victoria (ID#789) worked 39.5 hours (7.90 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();
            processEmployee(line);
        }
    }

    public static void processEmployee(String line) {
        Scanner lineScan = new Scanner(line);
        int id = lineScan.nextInt();           // e.g. 456
        String name = lineScan.next();        // e.g. "Greg"
        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)");
    }
}
```

File output

reading: 6.4 - 6.5

Output to files

- **PrintStream:** An object in the `java.io` package that lets you print output to a destination such as a file.
 - Any methods you have used on `System.out` (such as `print`, `println`) will work on a `PrintStream`.

- **Syntax:**

```
PrintStream <name> = new PrintStream(new File("<filename>"));
```

Example:

```
PrintStream output = new PrintStream(new File("out.txt"));  
output.println("Hello, file!");  
output.println("This is a second line of output.");
```

Details about `PrintStream`

```
PrintStream <name> = new PrintStream(new File("<filename>"));
```

- If the given file does not exist, it is created.
- If the given file already exists, it is overwritten.
- The output you print appears in a file, not on the console. You will have to open the file with an editor to see it.
- Do not open the same file for both reading (`Scanner`) and writing (`PrintStream`) at the same time.
 - You will overwrite your input file with an empty file (0 bytes).

System.out and PrintStream

- The console output object, `System.out`, is a `PrintStream`.

```
PrintStream out1 = System.out;
```

```
PrintStream out2 = new PrintStream(new File("data.txt"));
```

```
out1.println("Hello, console!"); // goes to console
```

```
out2.println("Hello, file!"); // goes to file
```

- A reference to it can be stored in a `PrintStream` variable.
 - Printing to that variable causes console output to appear.
- You can pass `System.out` to a method as a `PrintStream`.
 - Allows a method to send output to the console or a file.

PrintStream question

- Modify our previous Hours program to use a `PrintStream` to send its output to the file `hours_out.txt`.
 - The program will produce no console output.
 - But the file `hours_out.txt` will be created with the text:

```
Ben (ID#123) worked 31.4 hours (7.85 hours/day)
Greg (ID#456) worked 36.8 hours (7.36 hours/day)
Victoria (ID#789) worked 39.5 hours (7.9 hours/day)
```

PrintStream answer

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

public class Hours2 {
    public static void main(String[] args) throws FileNotFoundException {
        Scanner input = new Scanner(new File("hours.txt"));
        PrintStream out = new PrintStream(new File("hours_out.txt"));
        while (input.hasNextLine()) {
            String line = input.nextLine();
            processEmployee(out, line);
        }
    }

    public static void processEmployee(PrintStream out, String line) {
        Scanner lineScan = new Scanner(line);
        int id = lineScan.nextInt();           // e.g. 456
        String name = lineScan.next();        // e.g. "Greg"
        double sum = 0.0;
        int count = 0;
        while (lineScan.hasNextDouble()) {
            sum = sum + lineScan.nextDouble();
            count++;
        }

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

Prompting for a file name

- We can ask the user to tell us the file to read.
 - The filename might have spaces; use `nextLine()`, not `next()`

```
// prompt for input file name
Scanner console = new Scanner(System.in);
System.out.print("Type a file name to use: ");
String filename = console.nextLine();
Scanner input = new Scanner(new File(filename));
```

- Files have an `exists` method to test for file-not-found:

```
File file = new File("hours.txt");
if (!file.exists()) {
    // try a second input file as a backup
    System.out.print("hours file not found!");
    file = new File("hours2.txt");
}
```