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

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)");
    }
}
```

Building Java Programs

Chapter 6

Lecture 6-3: Searching Files

reading: 6.3, 6.5

Recall: Line-based 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;
}
```

Recall: Tokenizing lines

- A String `Scanner` can tokenize each line of a file.

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

    process the contents of this line...;
}
```

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)");
    }
}
```

IMDb movies problem

- Consider the following Internet Movie Database (IMDb) data:

```
1 9.1 196376 The Shawshank Redemption (1994)
2 9.0 139085 The Godfather: Part II (1974)
3 8.8 81507 Casablanca (1942)
```

- Write a program that displays any movies containing a phrase:

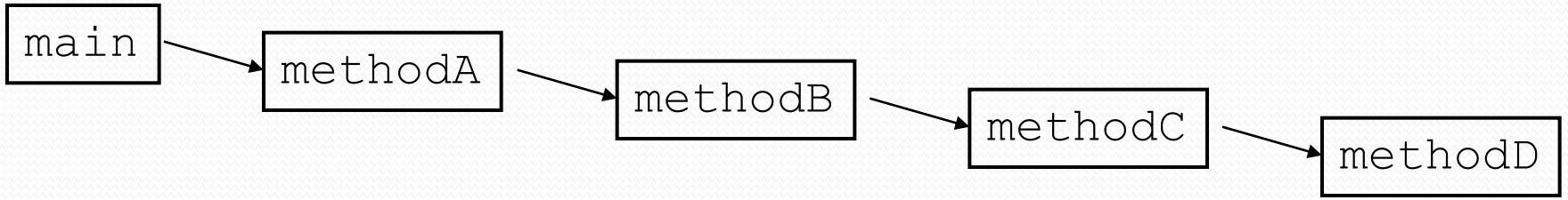
```
Search word? part

Rank    Votes   Rating  Title
2       139085  9.0     The Godfather: Part II (1974)
40      129172  8.5     The Departed (2006)
95      20401   8.2     The Apartment (1960)
192     30587   8.0     Spartacus (1960)
4 matches.
```

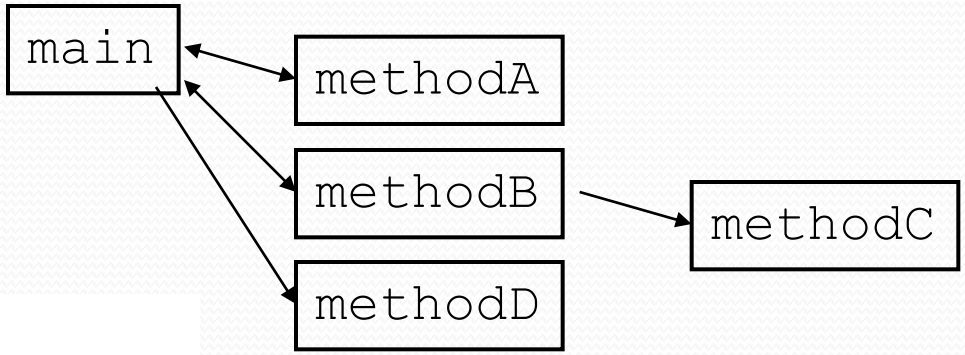
  - Is this a token or line-based problem?

"Chaining"

- `main` should be a concise summary of your program.
  - It is bad if each method calls the next without ever returning (we call this *chaining*):



- A better structure has `main` make most of the calls.
  - Methods must return values to `main` to be passed on later.



Bad IMDb "chained" code 1

```
// Displays IMDB's Top 250 movies that match a search string.
import java.io.*;     // for File
import java.util.*;   // for Scanner

public class Movies {
    public static void main(String[] args) throws FileNotFoundException {
        getWord();
    }

    // Asks the user for their search word and returns it.
    public static void getWord() throws FileNotFoundException {
        System.out.print("Search word: ");
        Scanner console = new Scanner(System.in);
        String searchWord = console.next();
        searchWord = searchWord.toLowerCase();
        System.out.println();

        Scanner input = new Scanner(new File("imdb.txt"));
        search(input, searchWord);
    }
    ...
```

Bad IMDb "chained" code 2

```
...

// Breaks apart each line, looking for lines that match the search word.
public static String search(Scanner input, String searchWord) {
    int matches = 0;
    while (input.hasNextLine()) {
        String line = input.nextLine();
        String lineLC = line.toLowerCase();     // case-insensitive match
        if (lineLC.indexOf(searchWord) >= 0) {
            matches++;
            System.out.println("Rank\tVotes\tRating\tTitle");
            display(line);
        }
    }

    System.out.println(matches + " matches.");
}

// Displays the line in the proper format on the screen.
public static void display(String line) {
    Scanner lineScan = new Scanner(line);
    int rank = lineScan.nextInt();
    double rating = lineScan.nextDouble();
    int votes = lineScan.nextInt();
    String title = "";
    while (lineScan.hasNext()) {
        title += lineScan.next() + " ";    // the rest of the line
    }
    System.out.println(rank + "\t" + votes + "\t" + rating + "\t" + title);
}
}
```

Better IMDb answer 1

```
// Displays IMDB's Top 250 movies that match a search string.
import java.io.*;     // for File
import java.util.*;   // for Scanner

public class Movies {
    public static void main(String[] args) throws FileNotFoundException {
        String searchWord = getWord();
        Scanner input = new Scanner(new File("imdb.txt"));
        String line = search(input, searchWord);

        if (line.length() > 0) {
            System.out.println("Rank\tVotes\tRating\tTitle");
            while (line.length() > 0) {
                display(line);
                line = search(input, searchWord);
            }
        }

        System.out.println(matches + " matches.");
    }

    // Asks the user for their search word and returns it.
    public static String getWord() {
        System.out.print("Search word: ");
        Scanner console = new Scanner(System.in);
        String searchWord = console.next();
        searchWord = searchWord.toLowerCase();
        System.out.println();
        return searchWord;
    }
    ...
```

Better IMDb answer 2

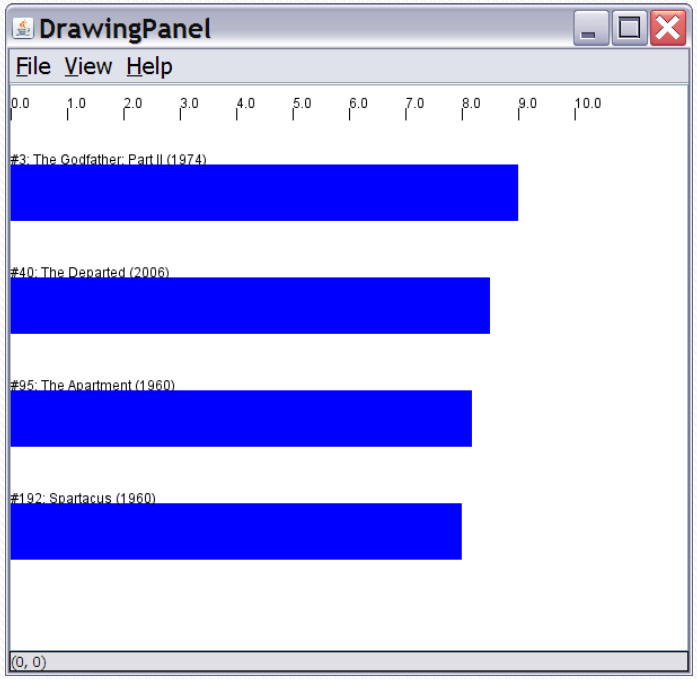
```
...

// Breaks apart each line, looking for lines that match the search word.
public static String search(Scanner input, String searchWord) {
    while (input.hasNextLine()) {
        String line = input.nextLine();
        String lineLC = line.toLowerCase();     // case-insensitive match
        if (lineLC.indexOf(searchWord) >= 0) {
            return line;
        }
    }
    return "";   // not found
}

// Displays the line in the proper format on the screen.
public static void display(String line) {
    Scanner lineScan = new Scanner(line);
    int rank = lineScan.nextInt();
    double rating = lineScan.nextDouble();
    int votes = lineScan.nextInt();
    String title = "";
    while (lineScan.hasNext()) {
        title += lineScan.next() + " ";    // the rest of the line
    }
    System.out.println(rank + "\t" + votes + "\t" + rating + "\t" + title);
}
}
```

Graphical IMDB problem

- Turn our IMDb code into a graphical program.
  - top-left 0.0 tick mark at (0, 20)
  - ticks 10px tall, 50px apart
  - first blue bar top/left corner at (0, 70)
  - bars 50px tall
  - bars 50px wide per rating point
  - bars 100px apart vertically



Mixing graphics and text

- When mixing text/graphics, solve the problem in pieces.

  Do the text and file I/O first:

  - Display any welcome message and initial console input.
  - Open the input file and print some file data.
    (Perhaps print every line, the first token of each line, etc.)
  - Search the input file for the proper line record(s).

  Lastly, add the graphical output:

  - Draw any fixed graphics that do not depend on the file data.
  - Draw the graphics that do depend on the search result.

Graphical IMDb answer 1

```
// Displays IMDB's Top 250 movies that match a search string.
import java.awt.*;     // for Graphics
import java.io.*;      // for File
import java.util.*;    // for Scanner

public class Movies2 {
    public static void main(String[] args) throws FileNotFoundException {
        String searchWord = getWord();
        Scanner input = new Scanner(new File("imdb.txt"));
        String line = search(input, searchWord);

        int matches = 0;
        if (line.length() > 0) {
            System.out.println("Rank\tVotes\tRating\tTitle");
            Graphics g = createWindow();
            while (line.length() > 0) {
                matches++;
                display(g, line, matches);
                line = search(input, searchWord);
            }
        }

        System.out.println(matches + " matches.");
    }

    // Asks the user for their search word and returns it.
    public static String getWord() {
        System.out.print("Search word: ");
        Scanner console = new Scanner(System.in);
        String searchWord = console.next();
        searchWord = searchWord.toLowerCase();
        System.out.println();
        return searchWord;
    }
    ...
```

Graphical IMDb answer 2

```
...
// Breaks apart each line, looking for lines that match the search word.
public static String search(Scanner input, String searchWord) {
    while (input.hasNextLine()) {
        String line = input.nextLine();
        String lineLC = line.toLowerCase();    // case-insensitive match
        if (lineLC.indexOf(searchWord) >= 0) {
            return line;
        }
    }
    return "";   // not found
}

// Displays the line in the proper format on the screen.
public static void display(Graphics g, String line, int matches) {
    Scanner lineScan = new Scanner(line);
    int rank = lineScan.nextInt();
    double rating = lineScan.nextDouble();
    int votes = lineScan.nextInt();
    String title = "";
    while (lineScan.hasNext()) {
        title += lineScan.next() + " ";    // the rest of the line
    }
    System.out.println(rank + "\t" + votes + "\t" + rating + "\t" + title);
    drawBar(g, matches, title, rank, rating);
}

...
```

Graphical IMDb answer 3

```
...

// Creates a drawing panel and draws all fixed graphics.
public static Graphics createWindow() {
    DrawingPanel panel = new DrawingPanel(600, 500);
    Graphics g = panel.getGraphics();

    for (int i = 0; i <= 10; i++) {      // draw tick marks
        int x = i * 50;
        g.drawLine(x, 20, x, 30);
        g.drawString(i + ".0", x, 20);
    }

    return g;
}

// Draws one red bar representing a movie's votes and ranking.
public static void drawBar(Graphics g, int matches, String title,
                           int rank, double rating) {
    int y = 70 + 100 * (matches - 1);
    int w = (int) (rating * 50);
    int h = 50;

    g.setColor(Color.BLUE);   // draw the blue bar for that movie
    g.fillRect(0, y, w, h);
    g.setColor(Color.BLACK);
    g.drawString("#" + rank + ": " + title, 0, y);
}
}
```

Mixing tokens and lines

- Using `nextLine` in conjunction with the token-based methods on the same `Scanner` can cause bad results.

```
23   3.14
Joe   "Hello world"
          45.2   19
```

  - You'd think you could read `23` and `3.14` with `nextInt` and `nextDouble`, then read `Joe "Hello world"` with `nextLine` .

```
System.out.println(input.nextInt());        // 23
System.out.println(input.nextDouble());     // 3.14
System.out.println(input.nextLine());       //
```

  - But the `nextLine` call produces no output! Why?

Mixing lines and tokens

- Don't read both tokens and lines from the same `Scanner`:

```
23   3.14
Joe   "Hello world"
              45.2   19

input.nextInt()                                  // 23
23\t3.14\nJoe\t"Hello world"\n\t\t45.2  19\n
  ^

input.nextDouble()                               // 3.14
23\t3.14\nJoe\t"Hello world"\n\t\t45.2  19\n
       ^

input.nextLine()                                 // "" (empty!)
23\t3.14\nJoe\t"Hello world"\n\t\t45.2  19\n
         ^

input.nextLine()                          // "Joe\t\"Hello world\""
23\t3.14\nJoe\t"Hello world"\n\t\t45.2  19\n
                          ^
```

Line-and-token example

```
Scanner console = new Scanner(System.in);
System.out.print("Enter your age: ");
int age = console.nextInt();

System.out.print("Now enter your name: ");
String name = console.nextLine();
System.out.println(name + " is " + age + " years old.");
```

Log of execution (user input underlined):

```
Enter your age: 12
Now enter your name: Sideshow Bob
 is 12 years old.
```

- Why?
  - Overall input: `12\nSideshow Bob`
  - After `nextInt()`: `12\nSideshow Bob`
    ^
  - After `nextLine()`: `12\nSideshow Bob`
    ^