CS 1 Half-Homework 2
Method Madness

1 Overview

Your objective in this homework is to make code self-contained and repeatable using methods. You will do this in the context of solving several disconnected problems that have no overarching story. Sorry.

Breaking code up into methods has several benefits: it enables large problems to be decomposed into smaller, mind-sized bytes; methods with a distinct purpose are easier to test than gangly spans of code; and because of the scope boundaries of methods, data becomes more insulated and less likely to get accidentally overwritten or inappropriately referenced. Additionally, methods jive with a basic human desire to make things that have lasting value. Like a family recipe, methods stand the test of time and get passed around.

2 Warning

When one is first learning about methods, there's a great temptation to acquire the parameters from the user and print out the method's return value *inside* the method:

```
public void triple(int n) {
  Scanner in = new Scanner(System.in);
  System.out.println("What is n? ");
  n = in.nextInt();

  System.out.println(n + n + n);
}
```

Don't do this. Methods generally should be independent of input from and output to the user. Where the input comes from and where the output goes to should be decided by the caller of the method—not the method itself. Our method `triple` is most reusable and testable when we write it like this:

```
public int triple(int n) {
  return n + n + n;
}
```

Written properly, we can feed it data from many different sources:

```
triple(in.nextInt());
triple(generator.nextInt());
triple(17);
```

Additionally, we can embed the return value in many different contexts:

```
int thrice = triple(17);
System.out.println(triple(2));
int b = a + triple(5);
```

3 Requirements

Complete the four classes described below. Place all classes in package `hw2`. Make all methods `static`.

3.1 Main

Write a class `Main` with a `main` method, which you are encouraged to use to test your code. Nothing in particular is required of it, but it must exist.

3.2 NumberUtilities

Write class `NumberUtilities` with the following:

1. Method `round10`, which accepts one parameter: a number to round, of type `double`. It returns the number rounded to the nearest multiple of 10 and converted to an `int`.
   - `NumberUtilities.round10(17.6)` → `20`
   - `NumberUtilities.round10(-103.3)` → `-100`
2. Method `getGameCount`, which accepts one parameter: a number of rounds in a tournament, of type `int`. It returns as an `int` the number of games that must be played to determine the tournament's winner. For example, a tournament with only 1 round of play is decided with just 1 game between teams A and B. A tournament with 2 rounds is decided with 3 games: A vs. B, C vs. D, and the championship game. For example:
   - `NumberUtilities.getGameCount(1)` → `1`
   - `NumberUtilities.getGameCount(2)` → `3`
   - `NumberUtilities.getGameCount(3)` → `7`
3. Method `getFraction`, which accepts one parameter: a number of type `double`. It returns as a `double` the fractional portion of the number, the value of the digits after the decimal point. For example:
   - `NumberUtilities.getFraction(3.14159)` → `0.14159`
   - `NumberUtilities.getFraction(-100.01)` → `0.01`

3.3 WebUtilities

Write class `WebUtilities` with the following:

1. Method `getImageLink`, which accepts three parameters in this order:
   (a) a path to an image file, of type `String`
   (b) a width of type `int`
   (c) a height of type `int`

It returns as a `String` the HTML that presents the image at the given width and height and also as a clickable link. For example, `getImageLink("alpaca.png", 1024, 768)` → `<a href="alpaca.png"><img src="alpaca.png" width="1024" height="768"></a>`.

2. Method `getHost`, which accepts one parameter: a URL of type `String`. For this problem, we will define the parts of a URL in the following way: `protocol://host/path`. This method returns the host portion of the URL, which lies between the 2 and 3 forward slashes. Assume at least three slashes will always be present. Do not assume that the host always begins at the same index. The protocols of different URLs may vary in length.

3. Method `getTitle`, which accepts one parameter: some HTML source of type `String`. It returns as a `String` the text between the opening and closing `title` tags. For example, `getTitle("<html><head><title>Trees I Have Hugged</title></head><body>...</html>")` → `Trees I Have Hugged`. Assume that only one title tag appears in the HTML and it is formatted as in the example.

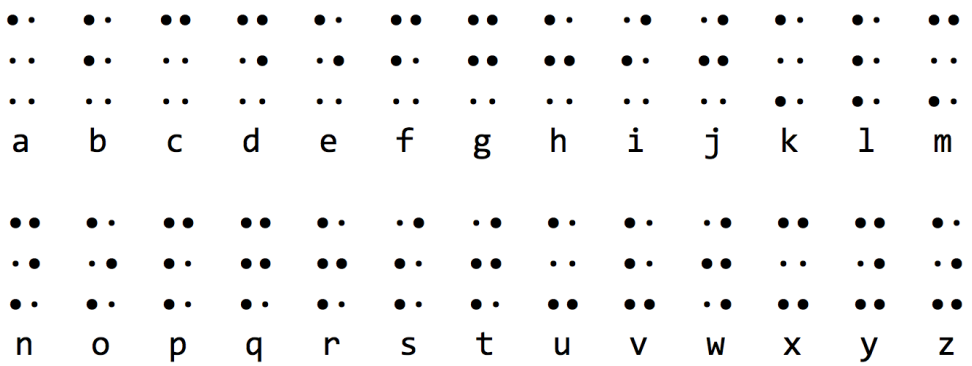
4. Method `invertHexColor`, which accepts one parameter: an HTML color of type `String`. Assume the color is a hexadecimal triplet of the form `#rrggbb`, where `rr`, `gg`, and `bb` are respectively the red, green, and blue intensities of a color. Each is represented as a two-digit hexadecimal number in [0, 255]. This method returns as a `String` the inverse (or complement) of that color, also as a hexadecimal HTML color. If the red intensity is 50, its inverse is $255 - 50 = 205$. For example:

   - `WebUtilities.invertHexColor("#000000")` → `#ffffff`
   - `WebUtilities.invertHexColor("#ff99cc")` → `#006633`
   - `WebUtilities.invertHexColor("#147acf")` → `#eb8530`

   You won't be able to perform arithmetic on the color as long as it's locked up in a `String`. Use `Integer.parseInt` with a base of 16 to convert hexadecimal characters to a decimal `int`. To convert an `int` intensity back to hexadecimal, use `String.format`—which behaves like `printf` but returns rather than outputs—with format specifier `%02x`. This will convert the corresponding `int` parameter to its lowercase hexadecimal equivalent, with leading zeroes as necessary to pad it out to two digits. For example: `String.format("%02x", 15)` → `0f`.

3.4 BrailleUtilities

Write class `BrailleUtilities` that converts text into a "seeable" Braille representation using the following alphabet:



In the real Braille alphabet, the small dots are not actually present. We include them to make their absence more visible to seeing people. The larger dots appear as raised bumps on the display surface. The class has the following:

1. `String` constant `RAISED` defined to be `\u2022`, which represents the raised bump present in the real Braille alphabet. It is `public`, `static`, and `final`.

2. `String` constant `UNRAISED` defined to be `\u00b7`, which represents the artificial unraised bump that we have introduced in our Braille representation. It is `public`, `static`, and `final`.

3. `String` constant `LETTER_SPACER` defined to be two spaces. This padding will appear between letters to make the Braille letters easier to separate visually. It is `public`, `static`, and `final`.

4. `String` constant `WORD_SPACER` defined to be four spaces. This padding will appear between words and is therefore intentionally larger than `LETTER_SPACER`. It is `public`, `static`, and `final`.

5. Method `translateTopLine`, which accepts one parameter: the text to translate to Braille, of type `String`. It returns just the top line of the Braille translation. Process the text using the following procedure:

   (a) Replace each existing space character (which likely separates words) in the text with `WORD_SPACER`.

   (b) Lowercase all letters in the text. We will not distinguish cases in our representation.

   (c) Replace all lowercase case letters with the top lines of their Braille representation, with a `LETTER_SPACER` appearing after each letter. For example, each 'a' is replaced by a raised dot, an unraised dot, and a letter spacer. Each 'b' is replaced with with the same thing. Each 'c' is replaced with two raised dots and a letter spacer.

   (d) Remove any leading or trailing space in the `String`. The `trim` method in the `String` is one way to accomplish this.

   Hold on! Before writing 26 separate replace commands, observe that the top row can only be one of three sequences: raised-unraised, unraised-raised, or raised-raised. Save yourself considerable work by clustering the letters according to their Braille sequence. Then use `String.replaceAll` and some magic called a *regular expression* to process each of the three clusters very succinctly. Regular expressions let one describe patterns of text in a non-literal

way. To describe a character that is one of a fixed set, we use a regular expression with a *character class*. For example, the expression `[aeiou]` matches any vowel. To replace each 'a' and 'b' *en masse* in `text`, we write `text.replaceAll("[ab]", ...)`.

6. Method `translateMiddleLine`, which accepts one parameter: the text to translate to Braille, of type `String`. It returns just the middle line of the Braille translation. Process the text using a procedure similar to `translateTopLine`.

7. Method `translateBottomLine`, which accepts one parameter: the text to translate to Braille, of type `String`. It returns just the bottom line of the Braille translation. Process the text using a procedure similar to `translateTopLine`.

8. Method `translate`, which accepts one parameter: the text to translate to Braille, of type `String`. It returns the Braille translation of the text, with a newline after each. Do not use the linefeed character `\n` to separate lines, as this isn't the correct way to separate lines on every operating system. Instead, use `%n` with `String.format` to get the correct newline for the operating system running your code. For example, `String.format("a%nb")`.

4 Implementation Hints

Don't read this section—at least not right away. It will rob you of the chance to think hard, which is the main ingredient of learning.

1. For `NumberUtilities.round10`, method `Math.round` will round to the nearest whole number, which isn't exactly what you want. But try dividing the number by 10 first...

2. For `NumberUtilities.getGameCount`, draw increasingly larger tournament brackets and count the games. What do you notice to always be true about the number of games? How is the number of games linked to the number of rounds?

3. For `NumberUtilities.getFraction`, the fractional portion of a positive number is the difference between the number and the nearest whole number less than or equal to it. There is a method in the `Math` class that computes this nearest whole number and another that turns a negative number positive.

4. For `WebUtilities.getHost`, use your standard `String` surgery methods `indexOf` and `substring`. Finding the location of the second and third slashes may require a version of `indexOf` that accepts multiple parameters.

5. For `WebUtilities.getTitle`, this one's not that different than `WebUtilities.getHost`.

5 Submission

To submit your work for grading:

1. Put the SpecChecker for this homework in your Build Path. Run the SpecChecker as a Java Application and fix problems until all tests pass.

2. Commit and push your work to your repository. Verify that your solution is on Bitbucket.

A passing SpecChecker does not guarantee you credit. Your grade is conditioned on a few things:

- You must meet the requirements described above. The SpecChecker checks some of them, but not all.
- You must not plagiarize. Write your own code. Talk about code with your classmates. Ask questions of your instructor or TA. Do not look at others' code. Do not ask questions specific to your homework anywhere online but Piazza. Your instructor employs a vast repertoire of tools to sniff out academic dishonesty, including: drones, CS 145 moles, and a piece of software called MOSS that rigorously compares your code to every other submission. You don't want to live in a world serviced by those who squeaked by through questionable means. For your future self, career, and family, do your own work.
- Your code must be submitted correctly and on time. Most excuses devolve into, "I started too late." The fix for this problem is not an extension.