3.10 Case Study: Checking an ISBN Number

- An ISBN (International Standard Book Number) is a unique number assigned to a book when it’s published, such as 0–393–96945–2.
- The number at the end is a check digit that’s calculated from the other digits in the ISBN.
- Our goal is to write a program named CheckISBN that calculates the check digit for an ISBN entered by the user:
  Enter ISBN: 0–393–96945–2
  Check digit entered: 2
  Check digit computed: 2
Design of the CheckISBN Program

• The CheckISBN program will have four steps:
  1. Prompt the user to enter an ISBN.
  2. Compute the check digit for the ISBN.
  3. Display the check digit entered by the user.
  4. Display the computed check digit.

• The ISBN will be stored as a string, and the other variables will be integers.
Computing the Check Digit

• The check digit is calculated by multiplying the first nine digits in the number by 10, 9, 8, …, 2, respectively, and summing these products to get a value we’ll call \( \text{total} \).

• The check digit is now determined by the expression

\[
10 - ((\text{total} - 1) \mod 11)
\]

• The value of this expression is a number between 0 and 10. If the value is 10, the check digit is X.
Computing the Check Digit

- Computation of the check digit for the ISBN 0–393–96945–2:

\[
\text{total} = 0 \times 10 + 3 \times 9 + 9 \times 8 + 3 \times 7 + 9 \times 6 + 6 \times 5 + 9 \times 4 + 4 \times 3 + 5 \times 2 \\
= 0 + 27 + 72 + 21 + 54 + 30 + 36 + 12 + 10 \\
= 262 \\
\text{Check digit: } 10 - ((262 - 1) \mod 11) = 10 - (261 \mod 11) = 10 - 8 = 2
Extracting Digits from the ISBN

- In order to compute the check digit, the first nine digits in the ISBN must be extracted and converted to numeric form.
- Since the position of the first two dashes may vary, the program will need to search for them.
- Once the dashes have been found, the program can extract the language code, publisher, and book number and join these into a single string, the “reduced ISBN.”
- If the original ISBN is "0–393–96945–2", the reduced ISBN will be "039396945".
Extracting Digits from the ISBN

- Searching for the dashes can be done by calling the `indexOf` method.
- The `substring` method can extract a portion of the original ISBN.
- The `+` operator can put the pieces together to form the reduced ISBN.
- The following expression extracts a digit and converts it to a number:

\[
\text{Integer.parseInt(reducedISBN.substring(i, i + 1))}
\]

\(i\) is the position of the digit in the reduced ISBN.
Displaying the Check Digit

• If the check digit is 10, the program will need to display the letter X instead of a normal digit.

• This problem can be solved by creating a string containing the digits from 0 to 9, plus the letter X:
  
  ```java
  final String DIGITS = "0123456789X";
  ```

• The value of the check digit can be used to select one of the characters in DIGITS. If the check digit is stored in the variable `checkDigit`, the expression will be
  
  ```java
  DIGITS.charAt(checkDigit)
  ```
// Program name: CheckISBN
// Author: K. N. King
// Written: 1998-04-17
// Modified: 1999-02-11

// Prompts the user to enter an ISBN number. Computes the
// check digit for the ISBN. Displays both the check digit
// entered by the user and the check digit computed by the
// program.

import java.util.Scanner;
public class CheckISBN {
    public static void main(String[] args) {
        // Prompt the user to enter an ISBN
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter ISBN: ");
        String originalISBN = sc.nextLine();

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// Determine location of dashes
int dashPos1 = originalISBN.indexOf("-");
int dashPos2 = originalISBN.indexOf("-", dashPos1 + 1);

// Remove dashes from ISBN
String reducedISBN =
originalISBN.substring(0, dashPos1) +
originalISBN.substring(dashPos1 + 1, dashPos2) +
originalISBN.substring(dashPos2 + 1, 11);

// Compute the check digit for the ISBN
int total =
10 * Integer.parseInt(reducedISBN.substring(0, 1)) +
9 * Integer.parseInt(reducedISBN.substring(1, 2)) +
8 * Integer.parseInt(reducedISBN.substring(2, 3)) +
7 * Integer.parseInt(reducedISBN.substring(3, 4)) +
6 * Integer.parseInt(reducedISBN.substring(4, 5)) +
5 * Integer.parseInt(reducedISBN.substring(5, 6)) +
4 * Integer.parseInt(reducedISBN.substring(6, 7)) +
3 * Integer.parseInt(reducedISBN.substring(7, 8)) +
2 * Integer.parseInt(reducedISBN.substring(8, 9));
int checkDigit = 10 - ((total - 1) % 11);
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// Display the check digit entered by the user
System.out.println("Check digit entered: " +
                      originalISBN.charAt(12));

// Display the computed check digit
final String DIGITS = "0123456789X";
System.out.println("Check digit computed: " +
                   DIGITS.charAt(checkDigit));