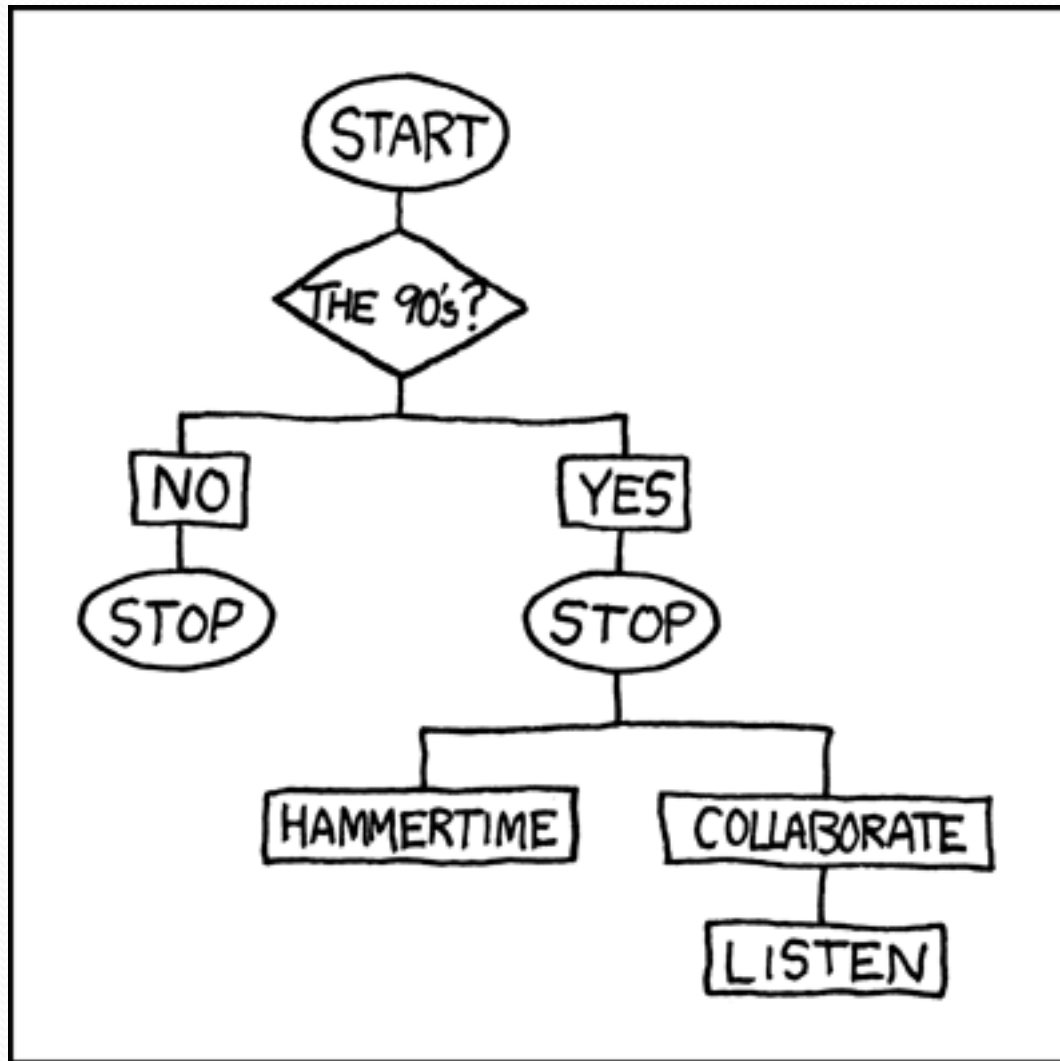# Building Java Programs

Chapter 4
Lecture 4-1: `Scanner`; `if/else`

reading: 3.3 – 3.4, 4.1, 4.5

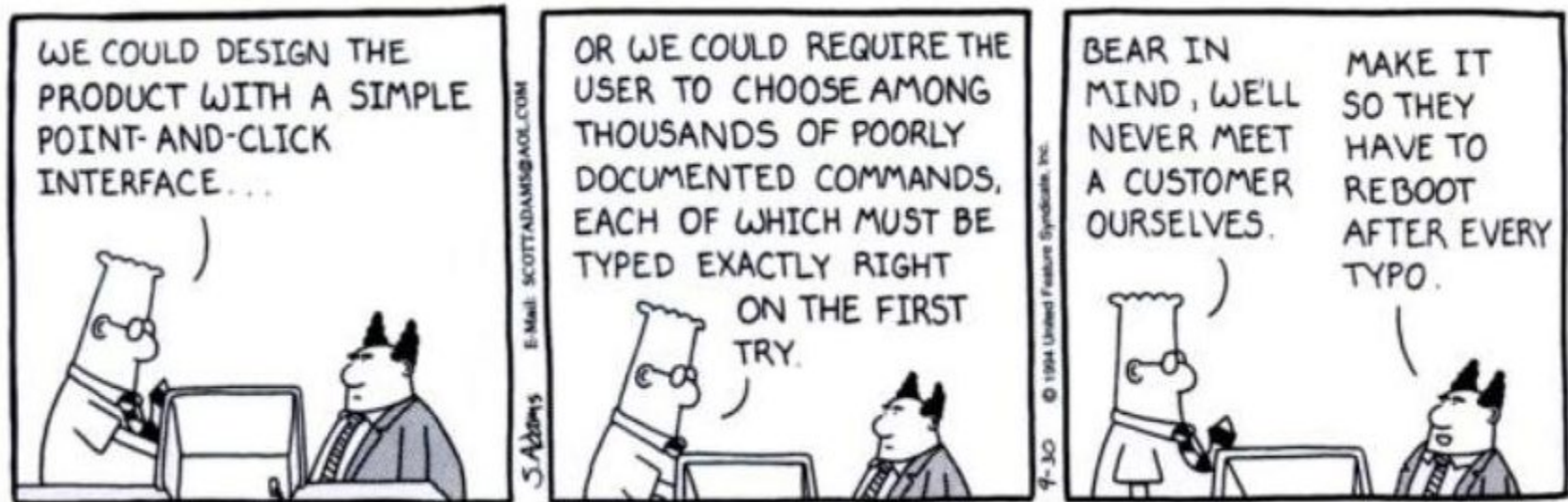# Interactive Programs with `Scanner`

reading: 3.3 - 3.4

Interactive programs

- We have written programs that print console output.

- It is also possible to read *input* from the console.
  - The user types the input into the console.
  - The program uses the input to do something.
  - Such a program is called an *interactive program*.

Interactive programs

- Interactive programs can be challenging.
  - Computers and users think in very different ways.
  - Users tend to "misbehave".

Scanner

- **`Scanner`**: An object that can read input from many sources.
  - Communicates with `System.in`
  - Can also read from files (Ch. 6), web sites, databases, etc…

- The `Scanner` class is found in the `java.util` package.

  ```
  import java.util.*;   // so you can use Scanner
  ```

- Constructing a `Scanner` object to read console input:

  ```
  Scanner name = new Scanner(System.in);
  ```

  - Example:
  ```
  Scanner console = new Scanner(System.in);
  ```

Scanner methods

Method	Description
`nextInt()`	reads an `int` from the user and returns it
`nextDouble()`	reads a `double` from the user
`next()`	reads a one-word `String` from the user
`nextLine()`	reads a one-*line* `String` from the user

- Each method waits until the user presses Enter.
  - The value typed by the user is returned.

```
System.out.print("How old are you? ");  // prompt
int age = console.nextInt();
System.out.println("You typed " + age);
```

- **prompt**: A message telling the user what input to type.

Scanner example

```java
import java.util.*;    // so that I can use Scanner

public class UserInputExample {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("How old are you? ");
        int age = console.nextInt();

        int years = 65 - age;
        System.out.println(years + " years until retirement!");
    }
}
```

age 12

years 53

- Console (user input underlined):

```
How old are you? 12
53 years until retirement!
```

Scanner example 2

```java
import java.util.*;    // so that I can use Scanner

public class ScannerMultiply {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("Please type two numbers: ");
        int num1 = console.nextInt();
        int num2 = console.nextInt();

        int product = num1 * num2;
        System.out.println("The product is " + product);
    }
}
```

- Output (user input underlined):

```
Please type two numbers: 8 6
The product is 48
```

- The Scanner can read multiple values from one line.

Input tokens

- **token**: A unit of user input, as read by the `Scanner`.
  - Tokens are separated by *whitespace* (spaces, tabs, new lines).
  - How many tokens appear on the following line of input?
    ```
    23  John Smith   42.0  "Hello world"  $2.50  "  19"
    ```

- When a token is not the type you ask for, it crashes.

    ```
    System.out.print("What is your age? ");
    int age = console.nextInt();
    ```

    Output:

    ```
    What is your age? Timmy
    java.util.InputMismatchException
            at java.util.Scanner.next(Unknown Source)
            at java.util.Scanner.nextInt(Unknown Source)
            ...
    ```

Scanners as parameters

- If many methods need to read input, declare a `Scanner` in `main` and pass it to the other methods as a parameter.

```java
public static void main(String[] args) {
    Scanner console = new Scanner(System.in);
    int sum = readSum3(console);
    System.out.println("The sum is " + sum);
}

// Prompts for 3 numbers and returns their sum.
public static int readSum3(Scanner console) {
    System.out.print("Type 3 numbers: ");
    int num1 = console.nextInt();
    int num2 = console.nextInt();
    int num3 = console.nextInt();
    return num1 + num2 + num3;
}
```

Program puzzle

- Consider changing the output to include the minimum value:

```
Type 3 numbers: 8 6 13
The average is 9.0
The minimum value is 6
```

- How would we change the previous program?

```java
public static void main(String[] args) {
    Scanner console = new Scanner(System.in);
    int sum = readSum3(console);
    double average = sum / 3.0
    System.out.println("The average is " + average);
    // What goes here?
}

public static int readSum3(Scanner console) {
    System.out.print("Type 3 numbers: ");
    int num1 = console.nextInt();
    int num2 = console.nextInt();
    int num3 = console.nextInt();
    return num1 + num2 + num3;
}
```

Can't return multiple values!

```java
import java.util.*;    // so that I can use Scanner

public class Average {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("Type 3 numbers: ");
        int num1 = console.nextInt();
        int num2 = console.nextInt();
        int num3 = console.nextInt();

        double average = (num1 + num2 + num3) / 3.0;
        System.out.println("The average is " + average);
        System.out.println("The minimum value is " +
                        Math.min(num1, Math.min(num2, num3)));
    }
}
```