CIS 110: Introduction to Computer Programming

Lecture 15

Our Scanner eats files

(§ 6.1-6.2)

Outline

- Programming assertion recap
- The Scanner object and files
- Token-based file processing

Exam announcements

- Attempting to reschedule midterm #2 to 11/21 (Monday of Thanksgiving break)
  - Let me know asap if you will be out of town.
- Final time has been *confirmed* for 12/19, 6-8 PM
  - Let me know asap if you need to reschedule.

Programming assertions revisited

An extended example: mystery

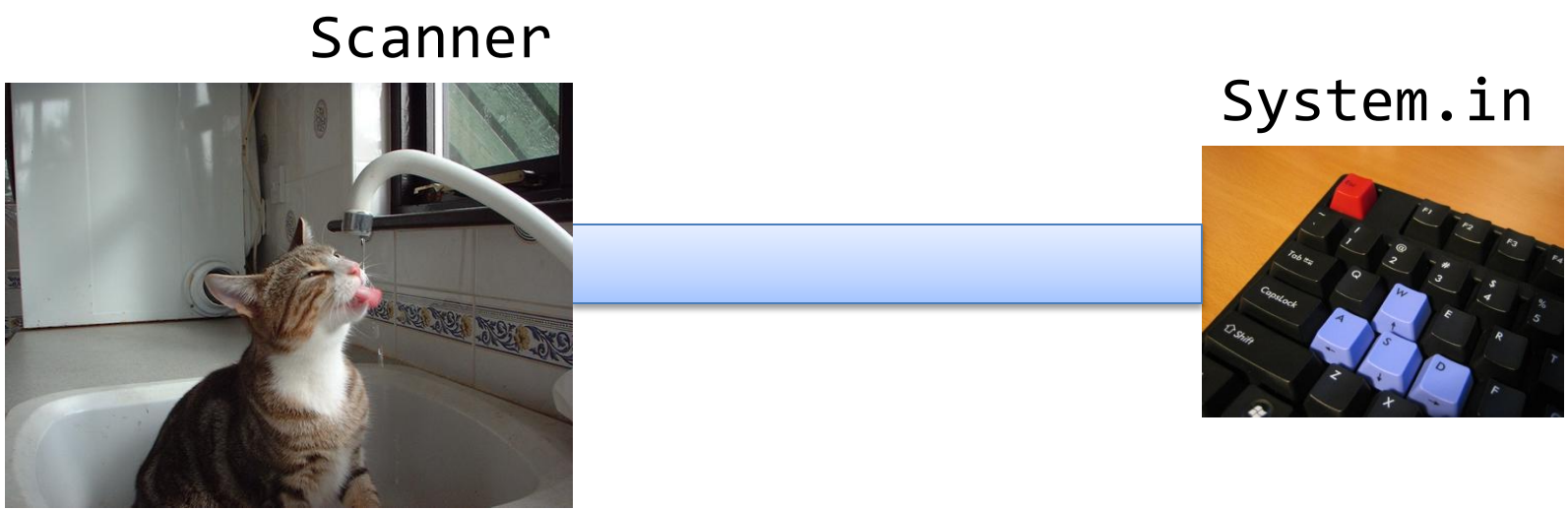
```java
public static int mystery(int n) {
  int x = 0;
  // Point A
  if (n < 0) { return -1; }
  while (n != 0) {
    // Point B
    int d = n % 10;
    if (d % 2 == 1) {
      x += d;
    }
    // Point C
    n /= 10;
  }
  // Point D
  return x;
}
```

```
For each point, are the
following
always/sometimes/never true?
1) n < 0
2) x >= 0
3) d < 10
4) x < n
(See AssertionProblem.java.)
```

The Scanner object and files

Scanners revisited

- A Scanner is a *faucet* over some pipe of data.



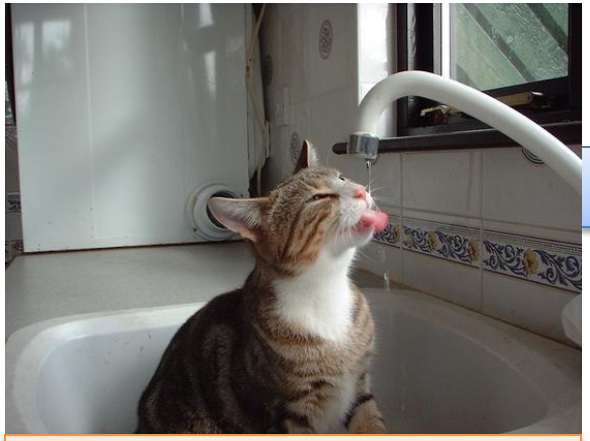
Empty pipes

- If the pipe is empty, the scanner first gets a line of input from the user, e.g., one call to `next()`.

Consuming input from the pipe

- The call to `next()` then consumes the first *token* of input.

Scanner



Hello

world! 42\n

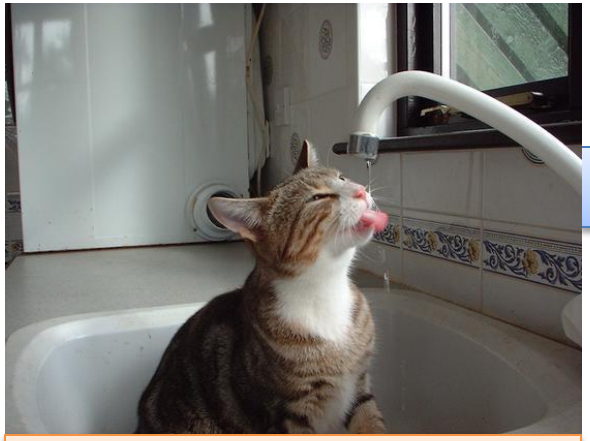
System.in

(*Token* = chunk of text separated by whitespace)

Consuming tokens

- When we consume a token, there's no way to "go back", only forward!

Scanner



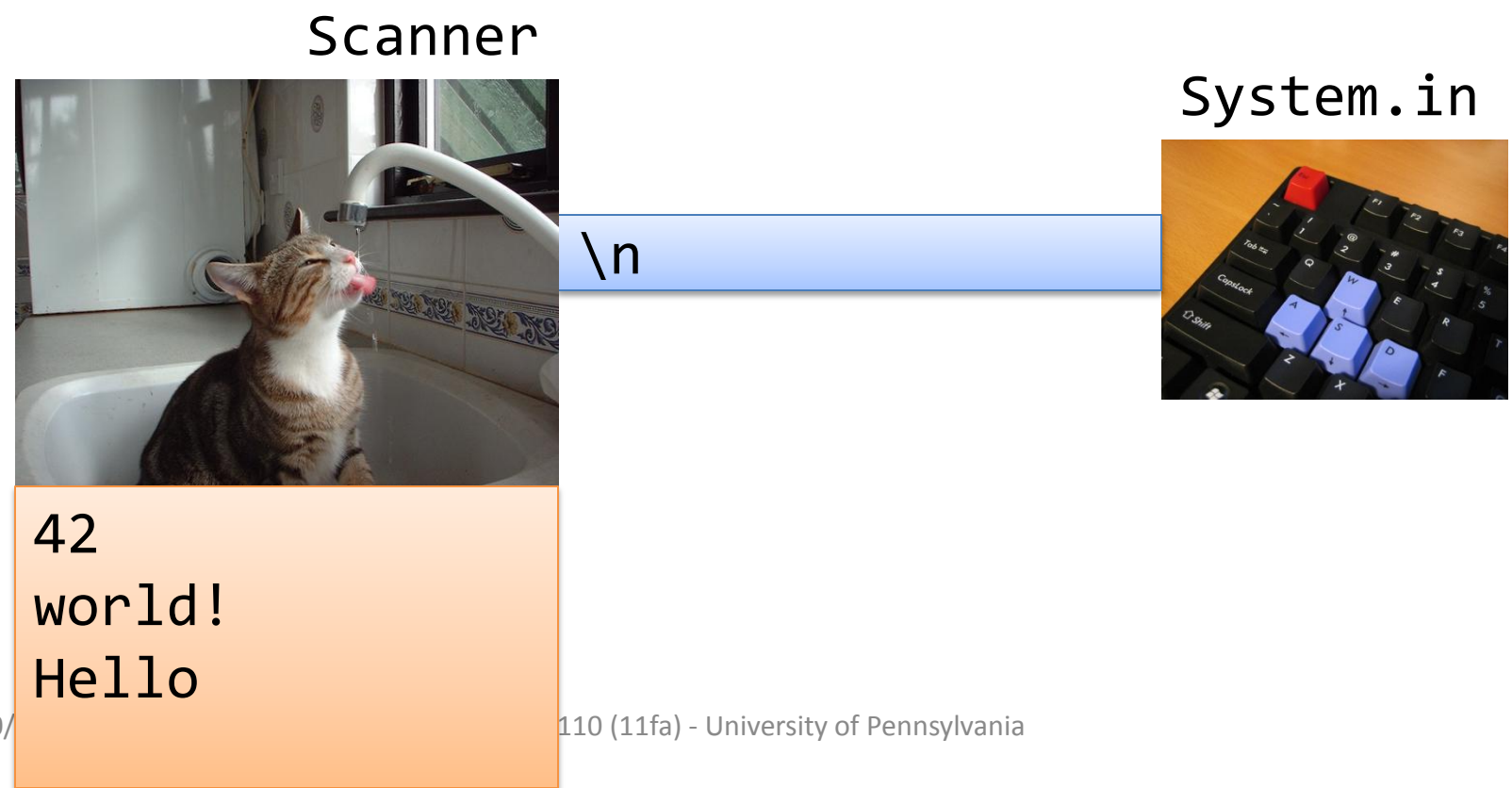
```
world!
Hello
```

```
42\n
```

System.in

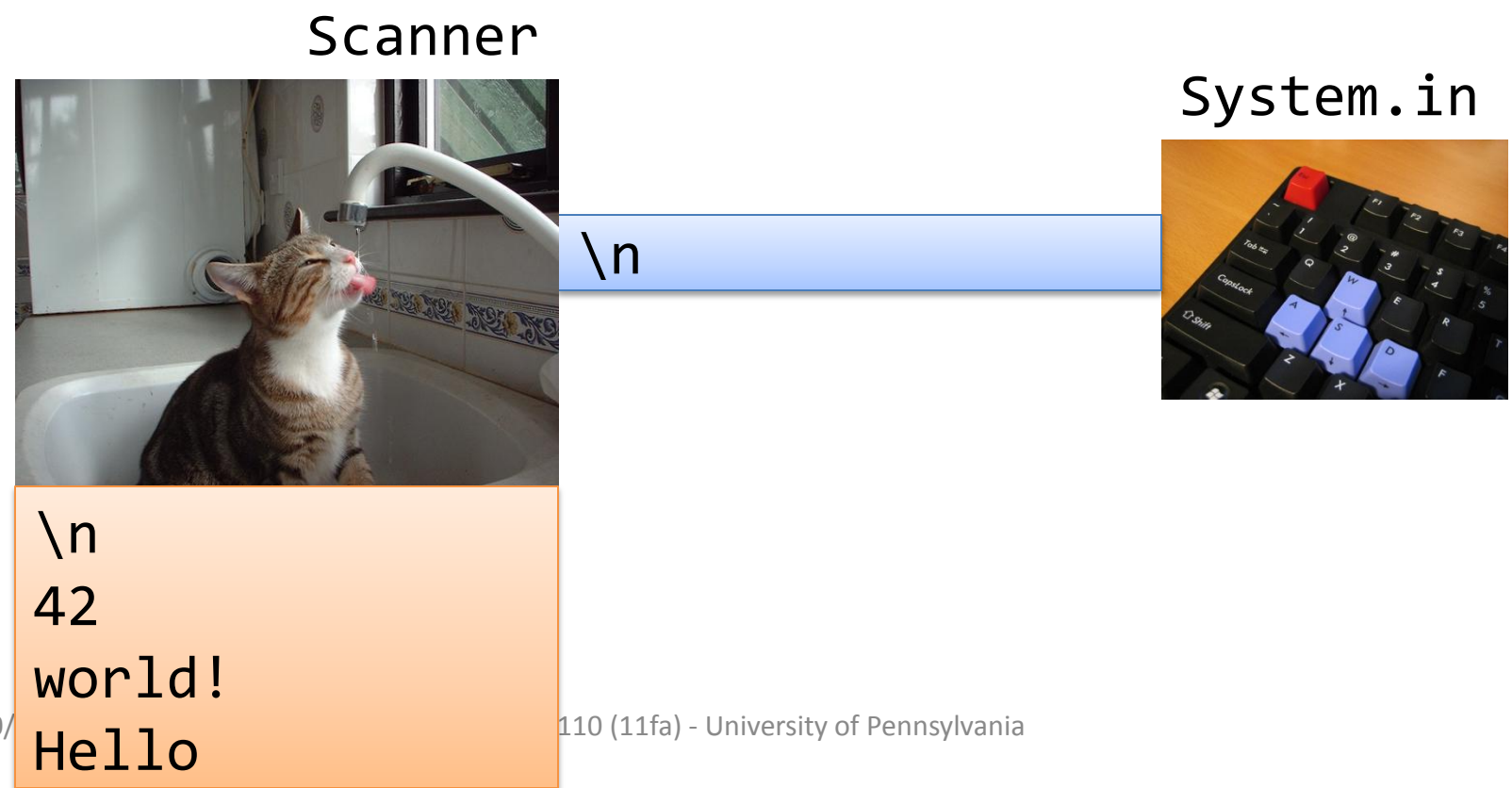
Consuming tokens as different types

- We can consume a token *and* translate it to a particular type, e.g., `nextInt()`.



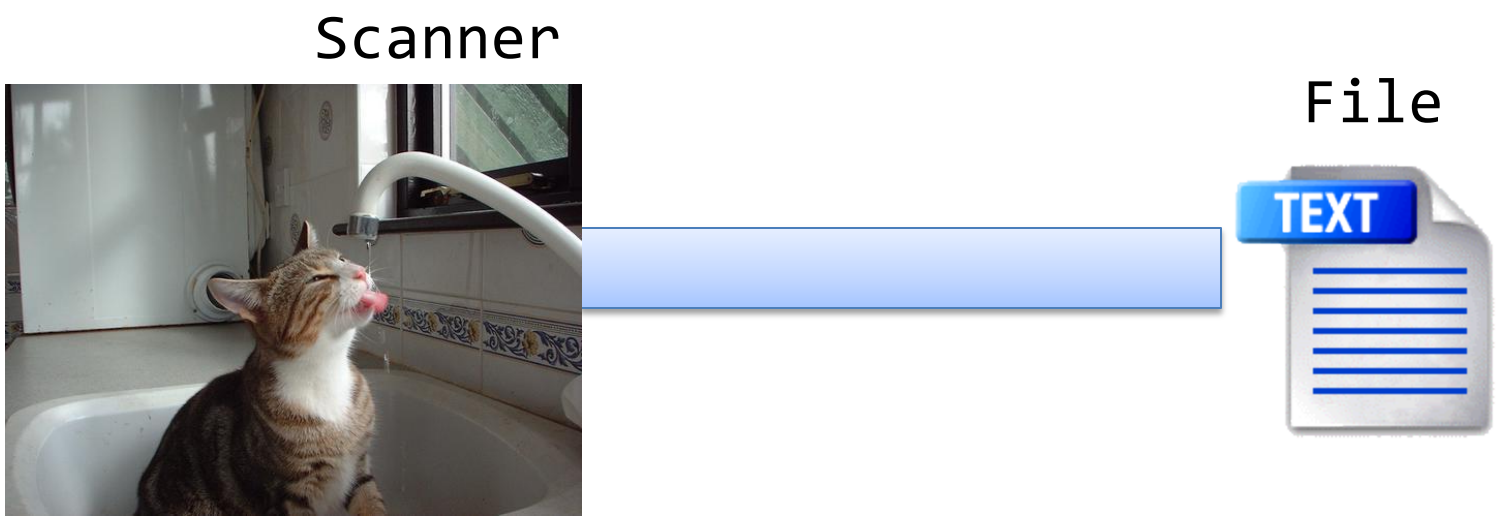
Consuming the rest of a line

- We can consume the rest of a line with `nextLine()`.



Plugging in different data sources

- A Scanner can accept many kinds of data sources such as Files instead!




```
Scanner file =
  new Scanner(new File("data.txt"));
```

The File object

- A File object represents a *file or directory on disk*.
  - Exists in the `java.io` package.

```
File file = new File("data.txt");
System.out.println("canRead? " + file.canRead());
System.out.println("exists? " + file.exists());
// Renames the file to the given file's name.
file.renameTo(new File("foo.txt"));
// Deletes the file from disk if it exists.
file.delete();
```

File

An exceptional problem

```
public static void main(String[] args) {
  Scanner file = new Scanner(new File("data.txt"));
}
```

- The following code fails to compile. Why?
  - "unreported exception java.io.FileNotFoundException; must be caught or declared to be thrown"
- Example of a *checked exception* in Java.

Checked and unchecked exceptions

- Java distinguishes between two sorts of exceptions.
  - *Unchecked exceptions* represent program bugs
  - *Checked exceptions* represent badness outside of the program's control.

Unchecked exceptions	**Checked exceptions**
IndexOutOfBoundsException IllegalArgumentException StackOverflowError	FileNotFoundException

Dealing with checked exceptions

- Two solutions:
  - *Annotate the enclosing method with a throws clause.*
  - *Use a try-catch block.*

```
public static void main(String[] args)
        throws FileNotFoundException {
Scanner file =
  new Scanner(new File("data.txt"));
}
```

```
try {
  Scanner file = new Scanner(
    new File("data.txt"));
} catch (FileNotFoundException ex) {
  ex.printStackTrace();
}
```

Which do we use!?

Checked exceptions: a holy war

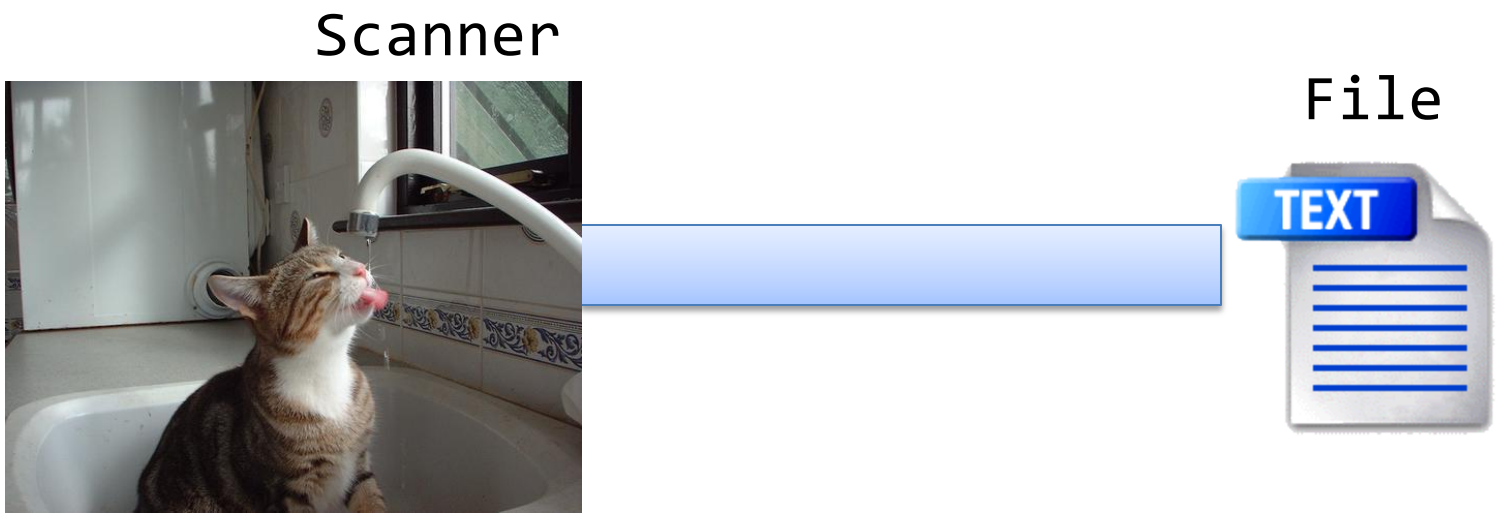
- Big debate if checked exceptions are "worth it".
- General advice: use try-catch when you can do something meaningful with the exception.
  - Give a good error message, re-throw, etc.
- For this class: we'll use *throws clauses*.

```
public static void main(String[] args)
        throws FileNotFoundException {
Scanner file =
  new Scanner(new File("data.txt"));
}
```

Token-based processing

Abstraction at its finest

- The methods of the Scanner we've learned so far apply when we use a File instead!




```
Scanner file =
  new Scanner(new File("data.txt"));
```

File processing example: FileSum

```
import java.util.*;
// Necessary since FileNotFoundException is also in java.io.
import java.io.*;

public class FileSum {
  public static void main(String[] args)
      throws FileNotFoundException {
    Scanner file = new Scanner(new File("data.txt"));
    double sum = 0.0;
    while(file.hasNextDouble()) {
      double d = file.nextDouble();
      System.out.println("Adding up " + d + "...");
      sum += d;
    }
    System.out.println("Total = " + sum);
  }
}
```

A file is just a long-ass string

data.txt


```
3.4  7.1 4.3
 5.9 1.1 2.5


3.6        -1.2
```

We can think of a file as a sequence of characters by replacing newlines with '\n'

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6       -1.2\n
```

```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

Input cursor

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6      -1.2\n
```

Input cursor

The input cursor is our *current position* in the file, initially at the beginning.

data.txt


```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

Input cursor and input consumption

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6      -1.2\n
```

Input cursor

On each call to nextDouble, we consume the next double and advance the input just past the token.

data.txt


```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

Jumping that whitespace

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6      -1.2\n
```

Input cursor

Calls to next*X*() skip whitespace to the next token.

data.txt


```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

Newlines are whitespace

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6      -1.2\n
```

Input cursor

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6      -1.2\n
```

Input cursor

data.txt


```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

hasNext*X* looks ahead

```
3.4  7.1 4.3\n 5.9 1.1 2.5\n\n\n3.6        -1.2\n
```

Input cursor

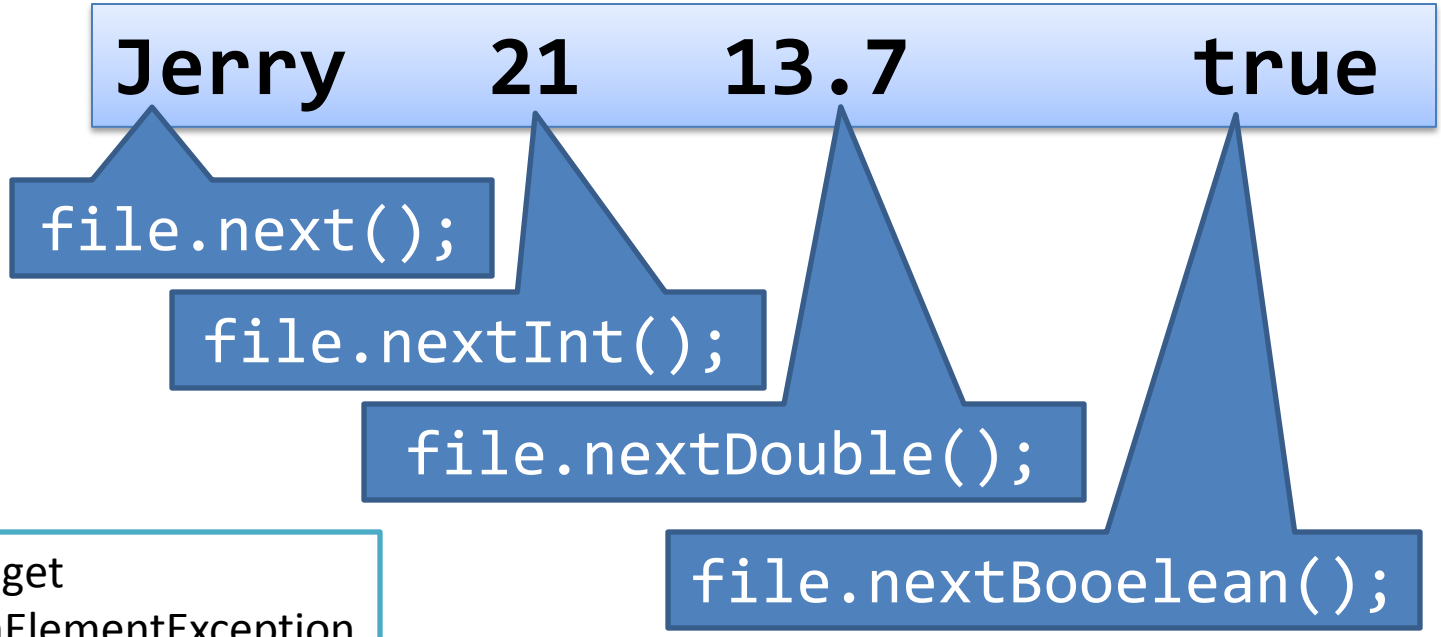
hasNextDouble() now returns false!

data.txt


```
while(file.hasNextDouble()) {
  double d = file.nextDouble();
}
```

Mixing up types

- We can mix different next*X* functions as necessary.



But we get NoSuchElementException if we're wrong!