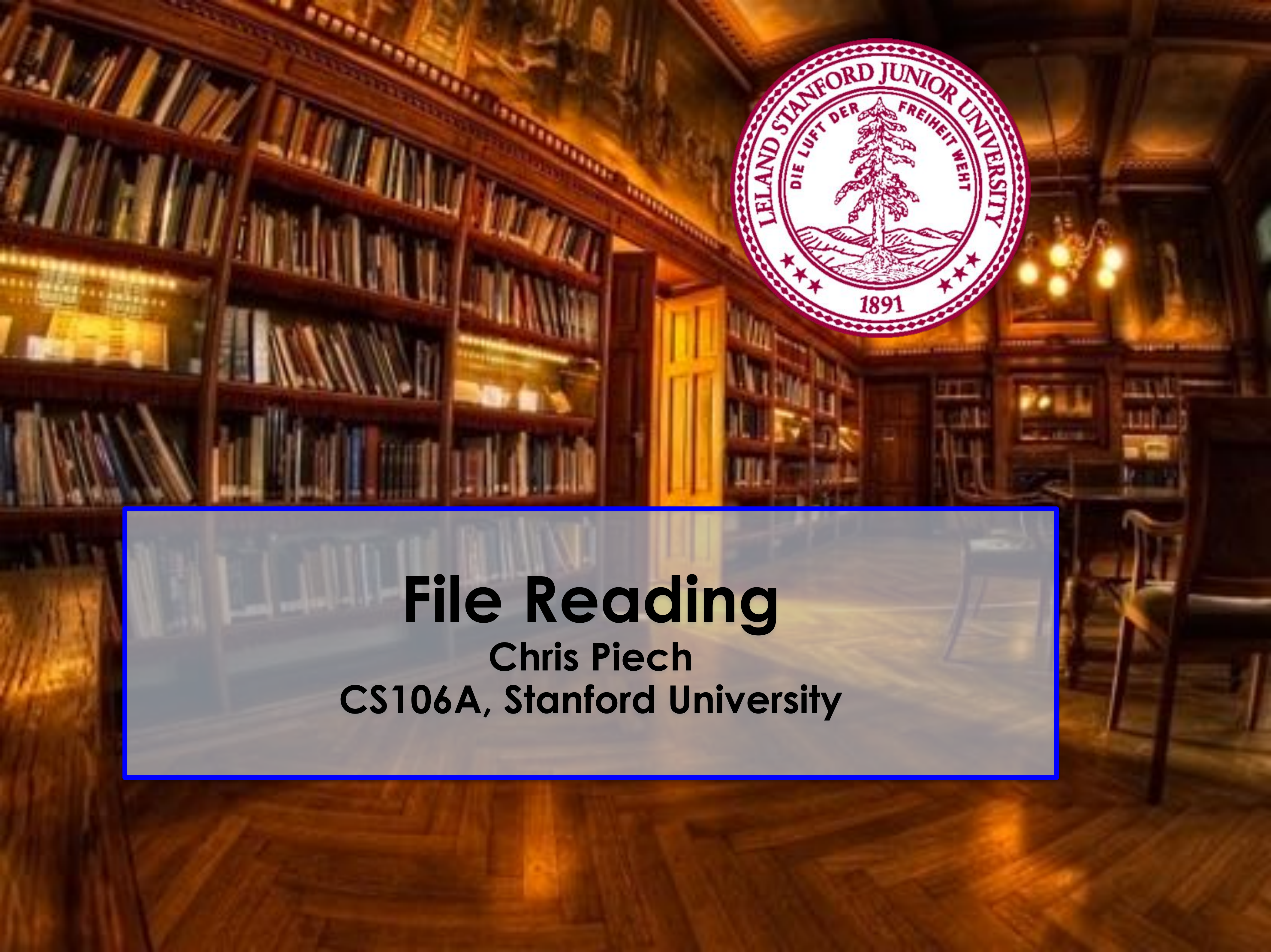


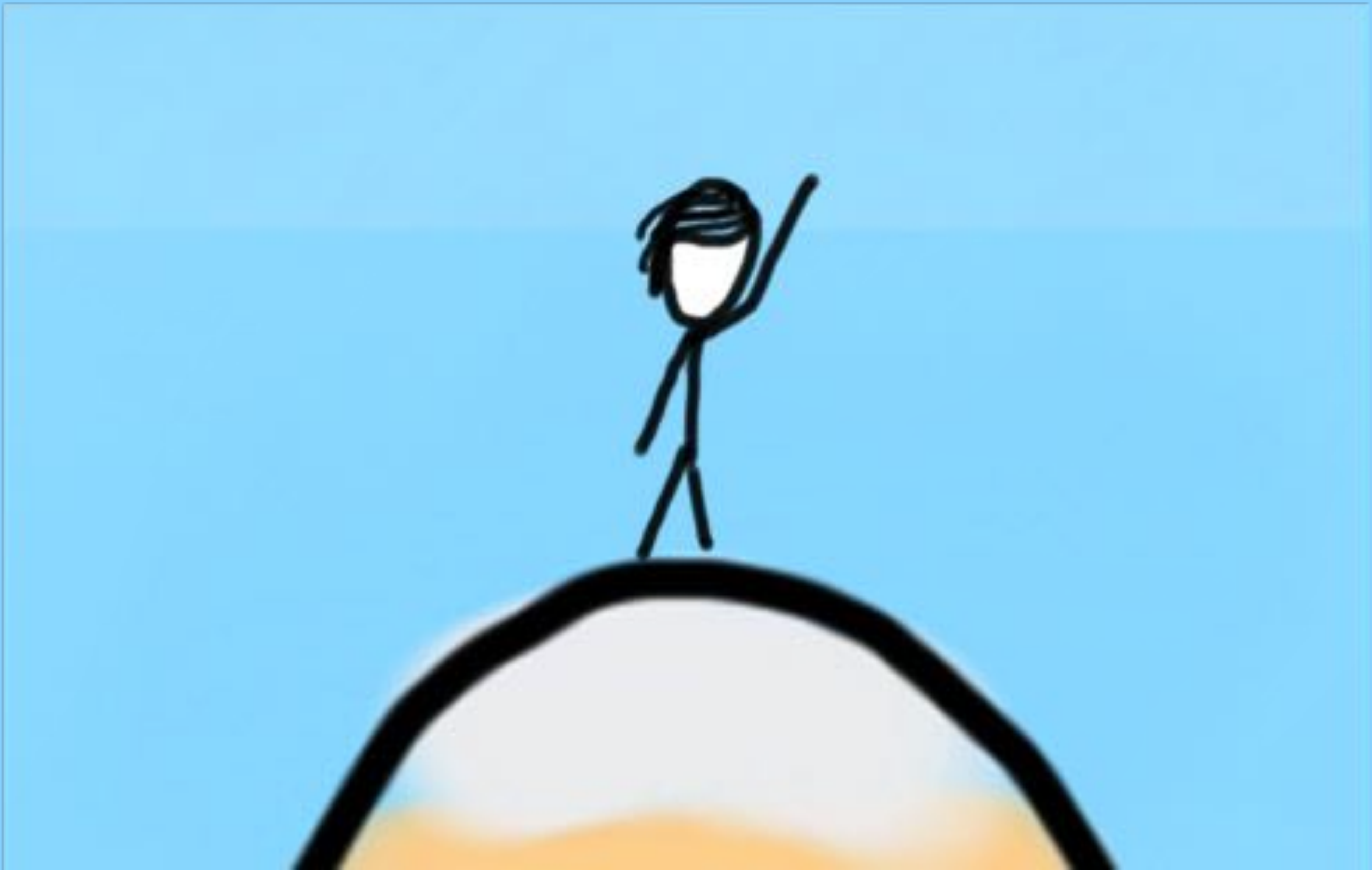
File Reading

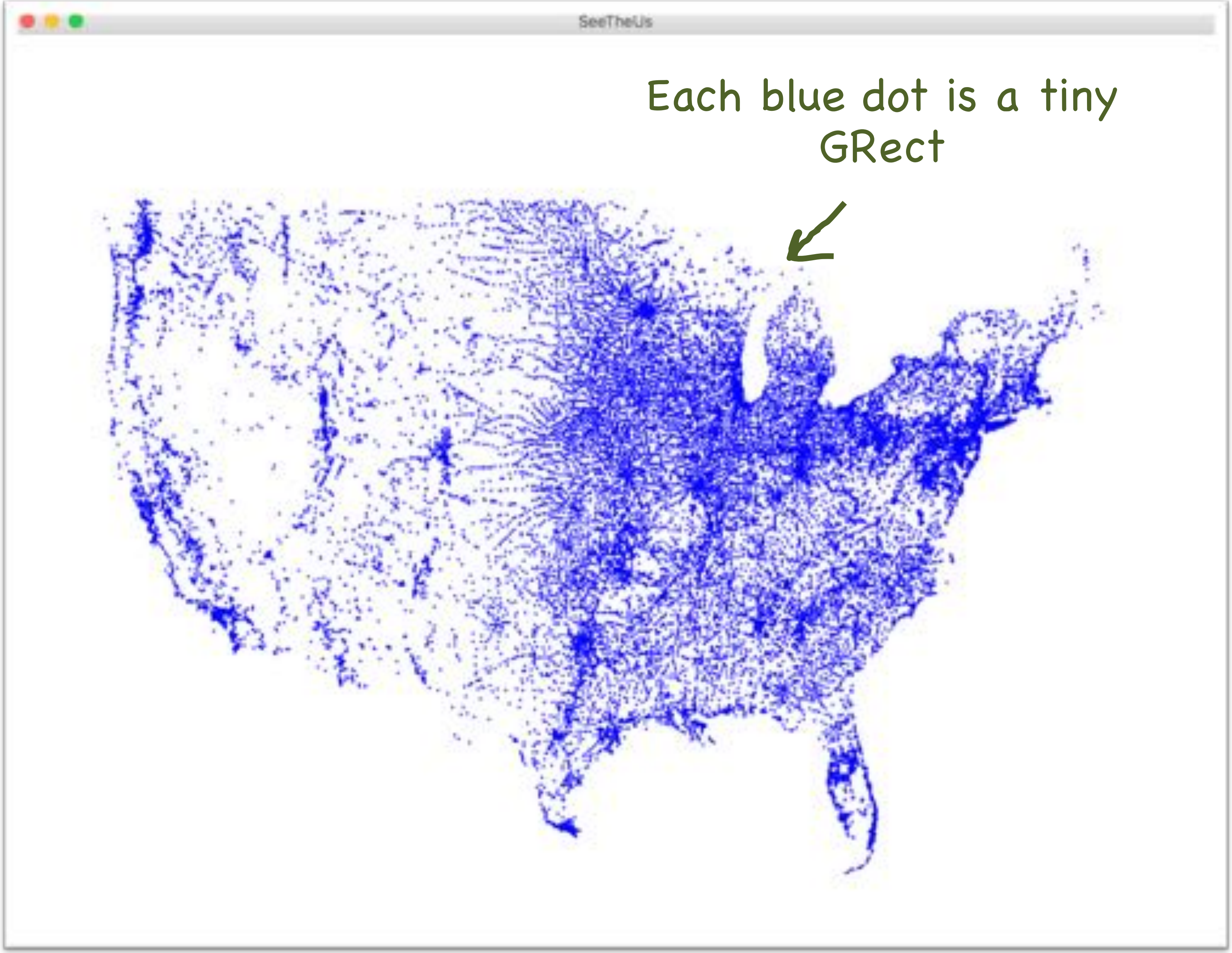
Chris Piech

CS106A, Stanford University

Learning Goals

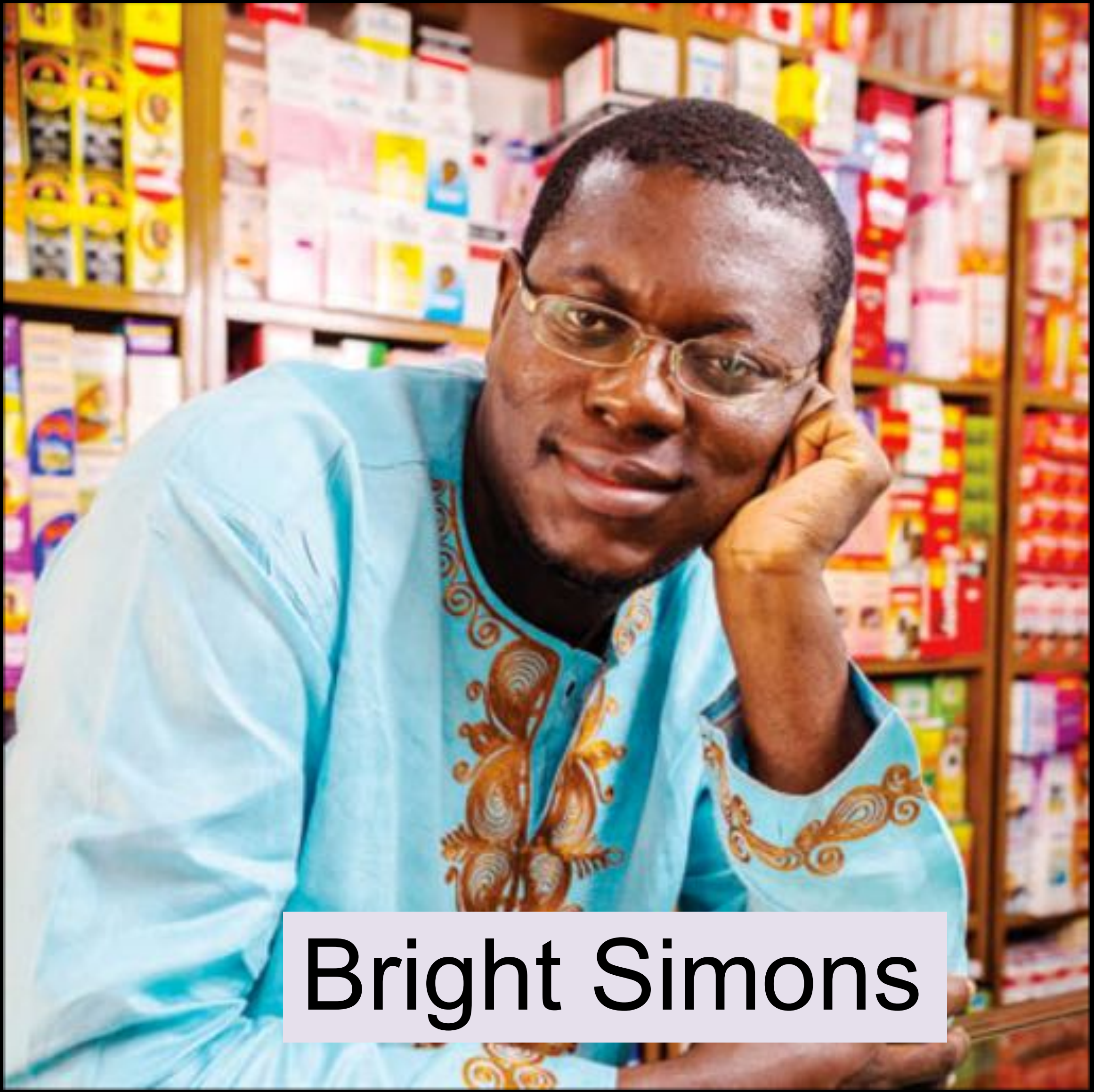
1. Know how to read a file line by line.





Each blue dot is a tiny GRect

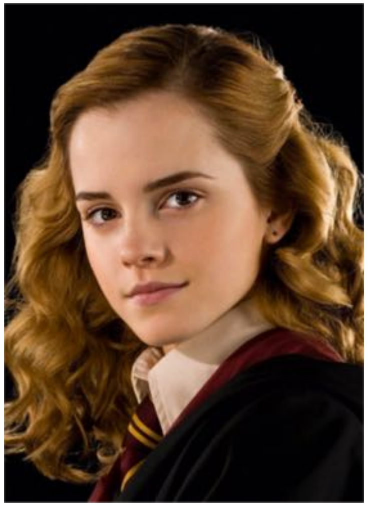
Chris' Favorite Program



Bright Simons

Underlying Puzzle

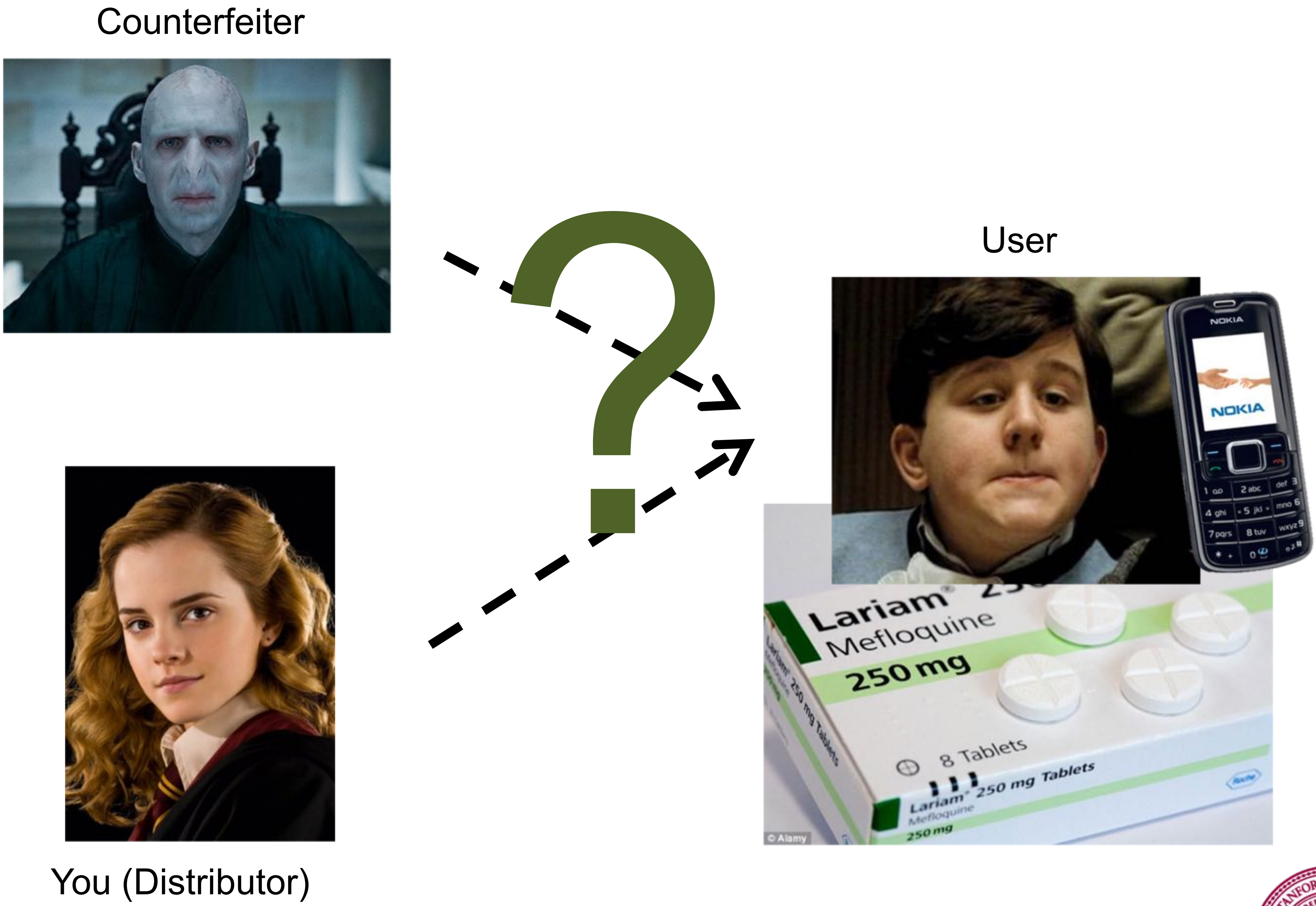
Counterfeiter



You (Distributor)

User

Underlying Puzzle



Counterfeiter

User

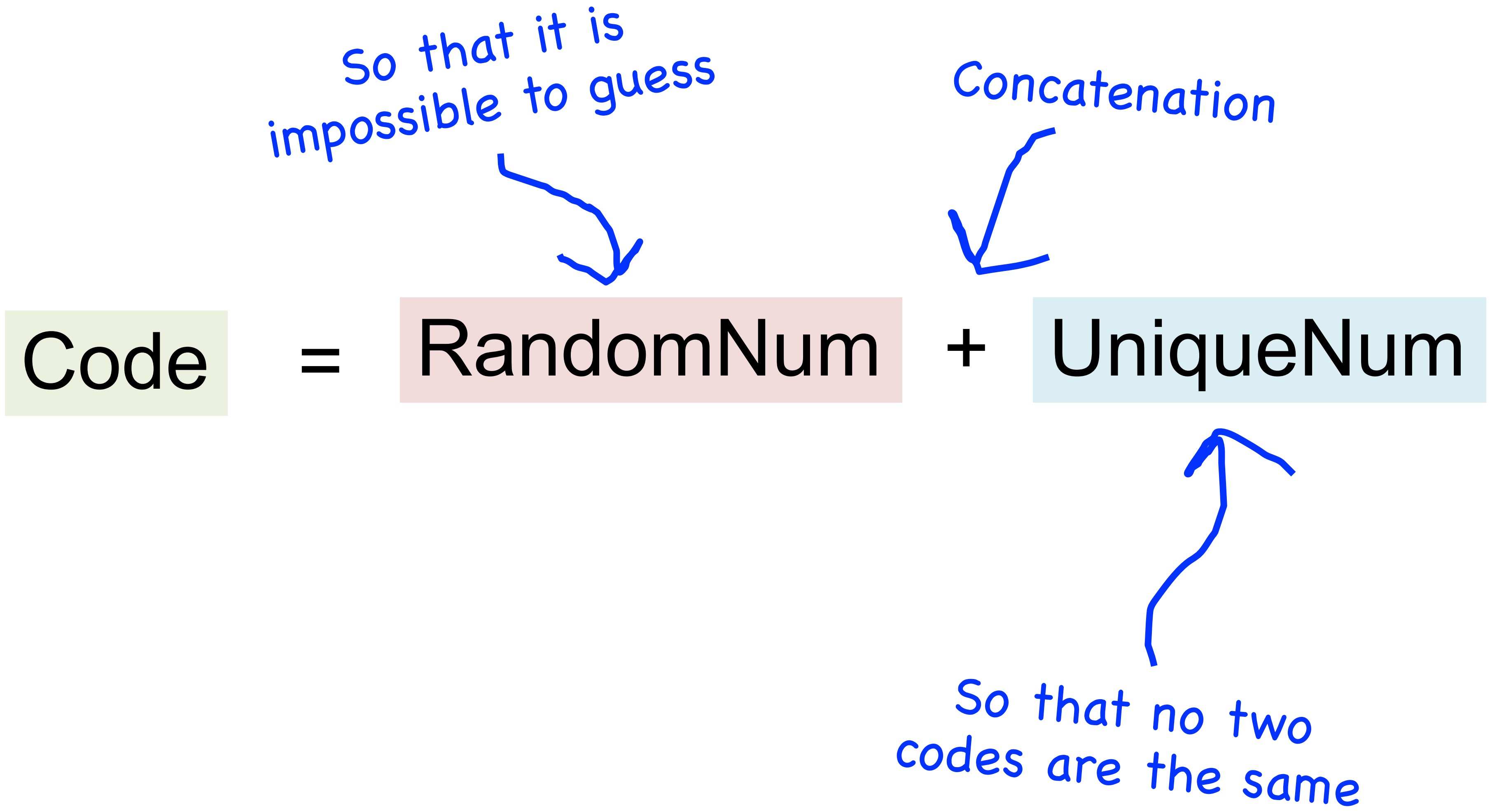
You (Distributor)

Make a code to
put on every box

Artelum
Artemether Lumefantrine
Anti-malarial agent
40 /240 mg
12 Tablets
342302033
BlackBerry

1. Unique
2. Impossible to guess

Insight



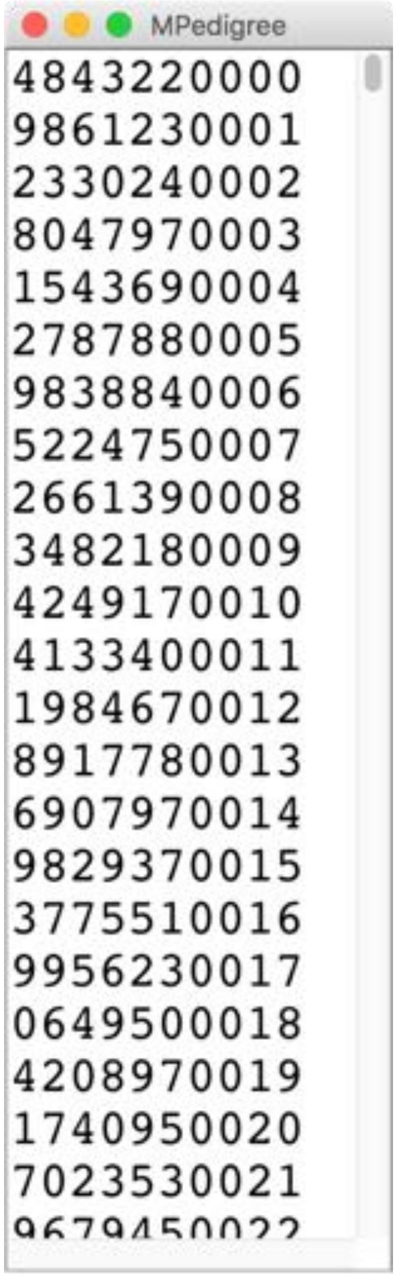
So that it is impossible to guess

Concatenation

Code = RandomNum + UniqueNum

So that no two codes are the same

M-Pedigree



```
4843220000
9861230001
2330240002
8047970003
1543690004
2787880005
9838840006
5224750007
2661390008
3482180009
4249170010
4133400011
1984670012
8917780013
6907970014
9829370015
3775510016
9956230017
0649500018
4208970019
1740950020
7023530021
9679450022
```

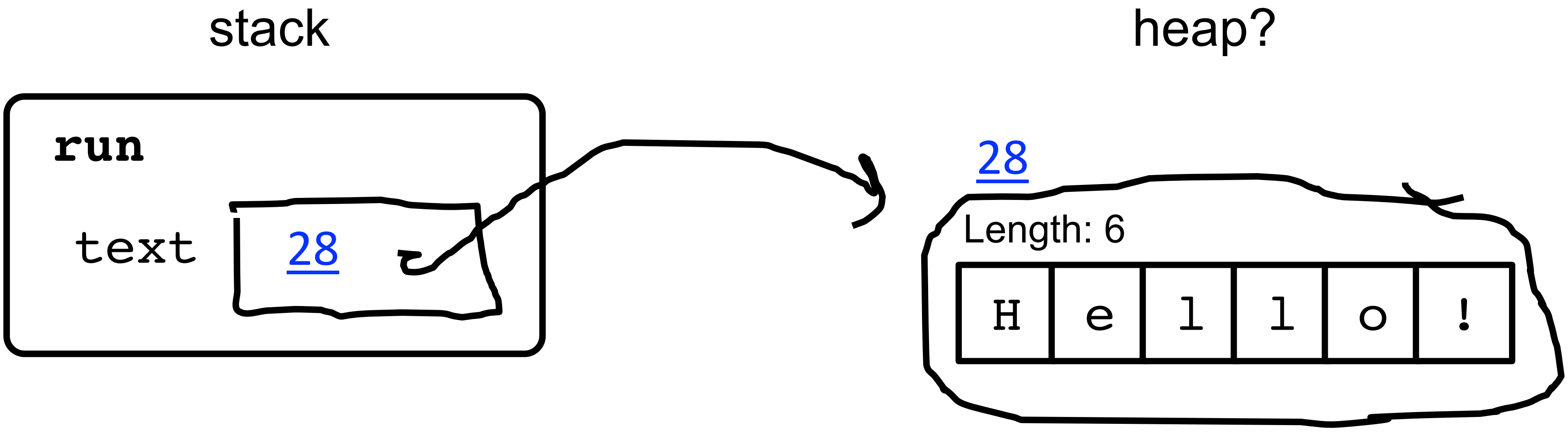
How strings are represented

```
public void run() {
    String text = “hello!”;
}
```

H	e	l	l	o	!
0	1	2	3	4	5

How it is actually stored

```
public void run() {
   String text = "hello!";
}
```



stack

heap?

run

text

28

28

Length: 6

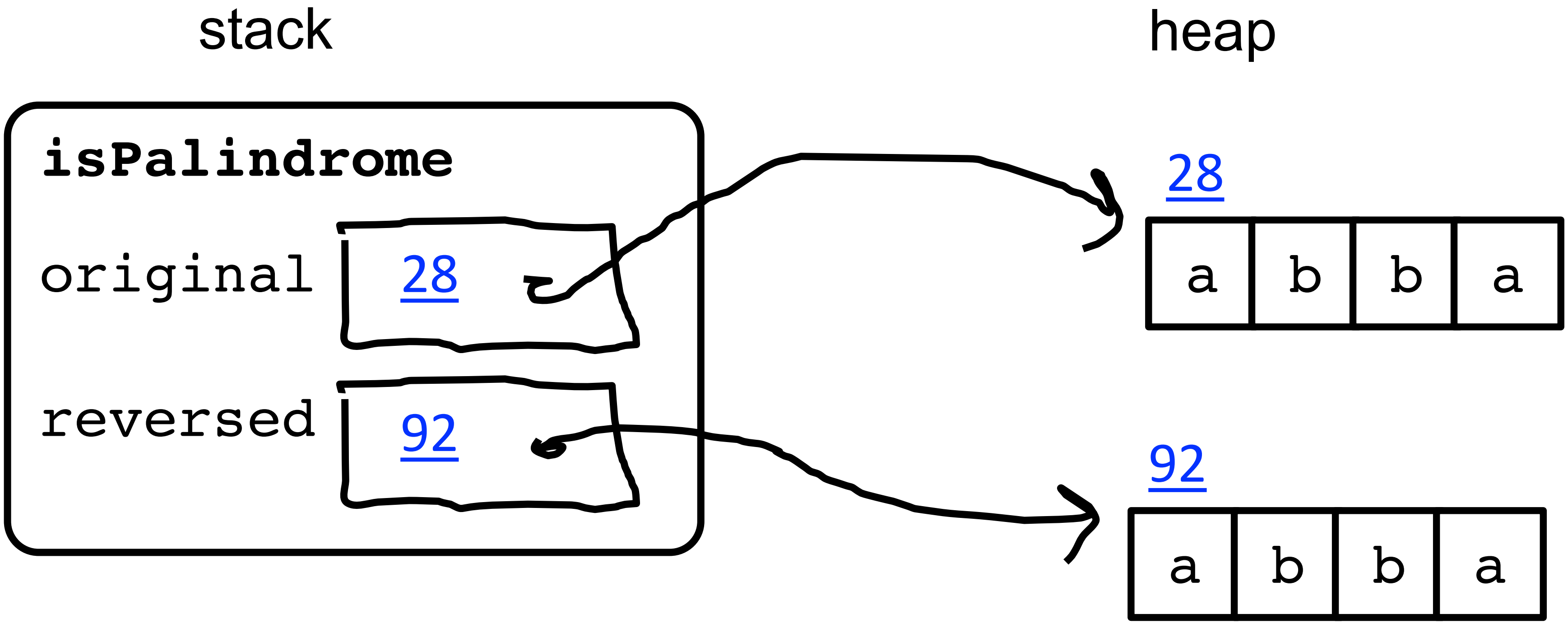
H	e	l	l	o	!

H	e	l	l	o	!
0	1	2	3	4	5

```
text.charAt(index)
```

First try
original == reverse
What went wrong?

```
private boolean isPalindrome(String original) {
   String reversed = reverse(original);
   return reversed == original;
}
```



Use .equals to compare strings, not ==

ATGCTTAAACC..

Human Genome Project

```
"ATGCCAGGAC"
```

```
"GGACTTACATTTTT"
```

```
"ATTTTTGGCCGGCC"
```

The human genome has 3 billion base pairs

Compose Problem

strand1 "GCATCAT"

strand2 "CATTAC"

---

result "GCATCATTAC"

The human genome has 3 billion base pairs

Ha. Gene was working on
The Genome project ☺

Did Gene Myers define all those little pieces as constants?

File Processing!

Thanks Keith Schwarz for some great slides to build off!

Getting Data into Programs

- Put it directly in the program:
  - Define constants holding your values.
- Get it from the user:
  - Mouse events, nextLine, etc.
- Generate it randomly:
  - Use a RandomGenerator.
- Get it from an external source.
  - Store it in a file and read it later.

Reading Fiels

- Virtually all programs that you've used at some point read files from disk:
  - Word processing (documents)
  - Web browser (cookies)
  - Games (saved progress)
  - Eclipse (Java files)
  - Music player (songs)

The structure of files

- A file is just a series of ***bits*** (ones and zeros).
- Those bits can have structure:
  - Plain-text: Bits represent characters.
  - JPEG: Bits encode information about the structure of an image.
  - MP3: Bits encode frequency information about music.
  - etc.

The structure of files

A file is just a series of ***bits*** (ones and zeros).

Those bits can have structure:

- Plain-text: Bits represent characters.
- JPEG: Bits encode information about the structure of an image.
- MP3: Bits encode frequency information about music.
- etc.

Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"

```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

Step one:

Open the file for reading.

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

```java
Scanner input = new Scanner(new File("mydata.txt"));
```

```java
import java.util.*;    // for Scanner
import java.io.*;      // for File
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));
```

Step Two:

Read the file, one line at a time.

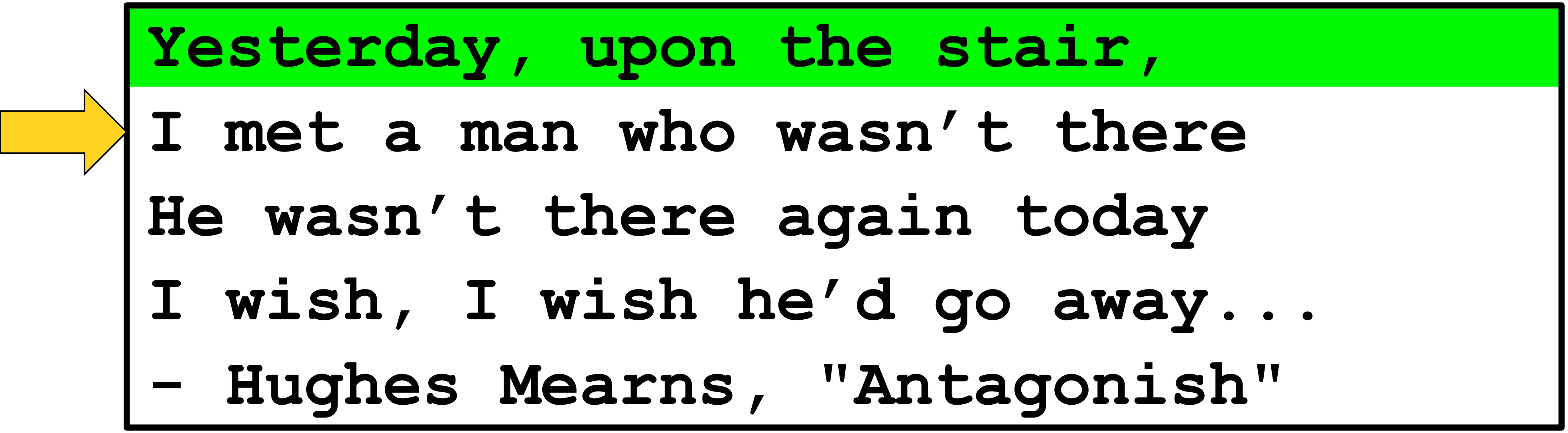
Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

// Yesterday, upon the stair
String line1 = input.nextLine();
```

Reading in a File

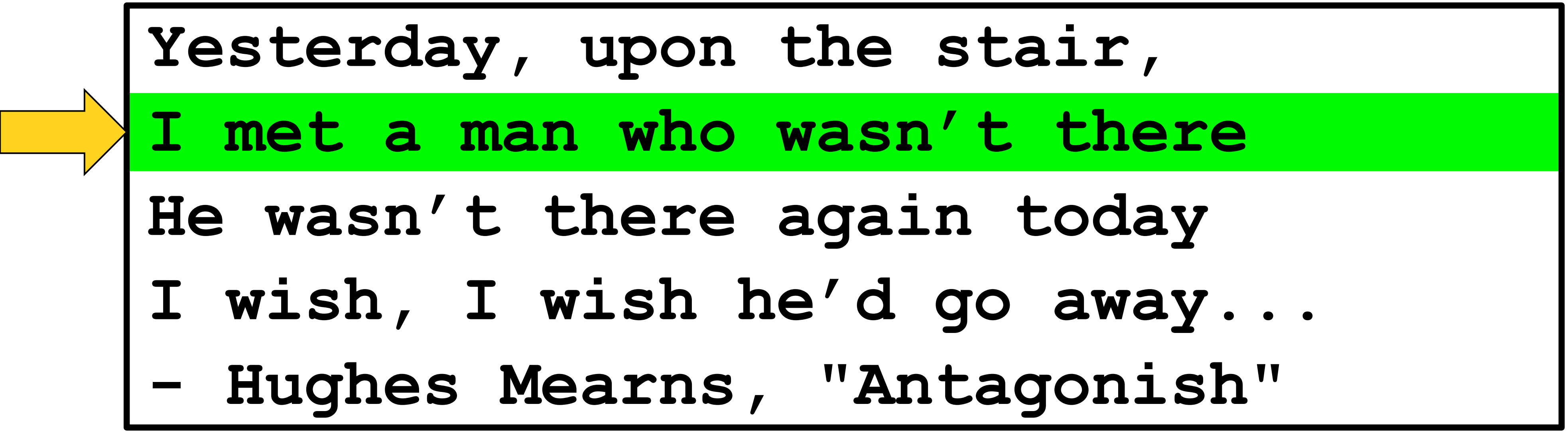


```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

// Yesterday, upon the stair
String line1 = input.nextLine();
```

Reading in a File



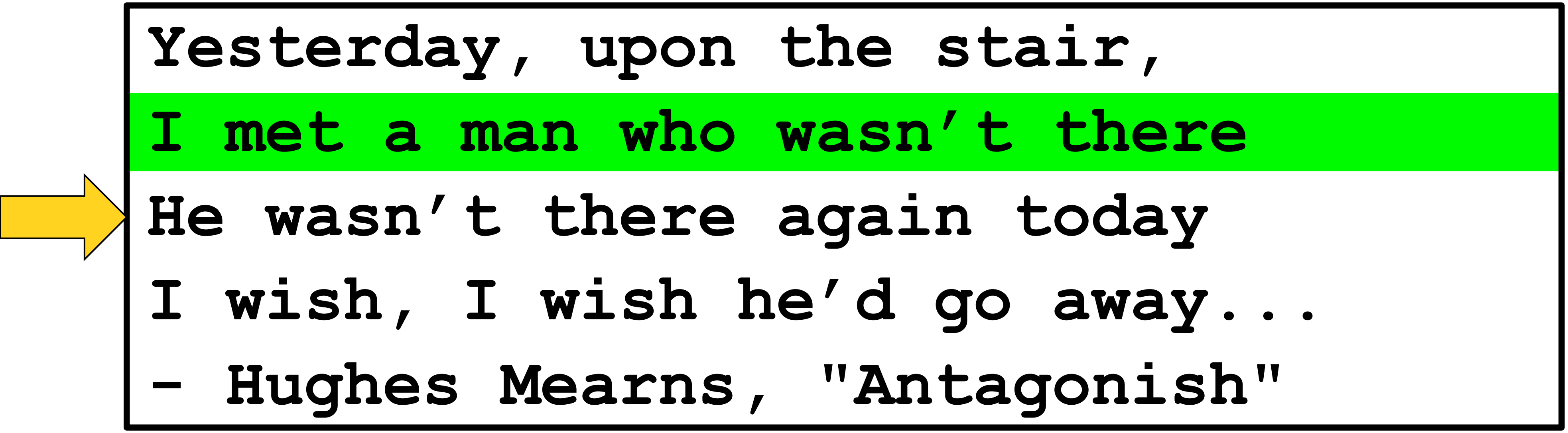
```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```java
Scanner input = new Scanner(new File("mydata.txt"));

// Yesterday, upon the stair
String line1 = input.nextLine();

// I met a man who wasn't there
String line2 = input.nextLine();
```

Reading in a File



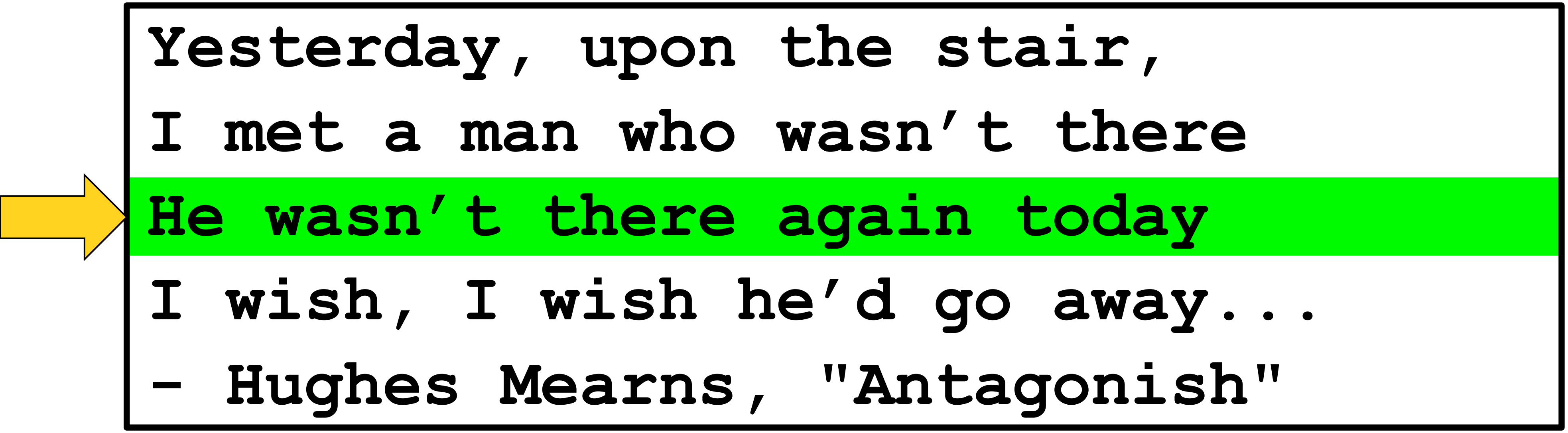
```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```java
Scanner input = new Scanner(new File("mydata.txt"));

// "Yesterday, upon the stair"
String line1 = input.nextLine();

// I met a man who wasn't there
String line2 = input.nextLine();
```

Reading in a File

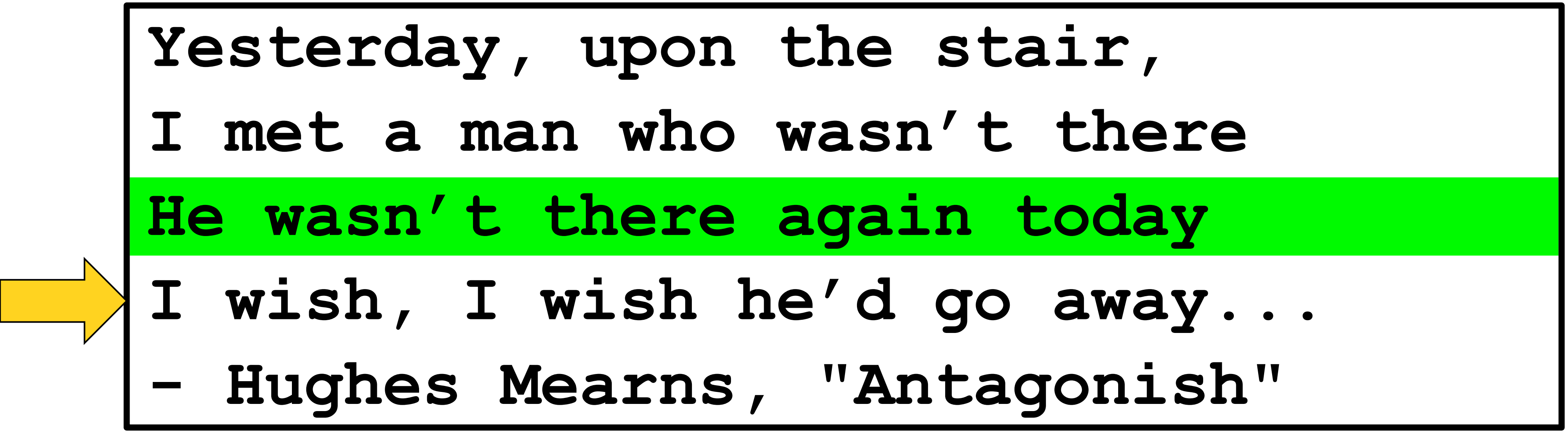


```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// He wasn't there again today
String line3 = input.nextLine();
```

Reading in a File

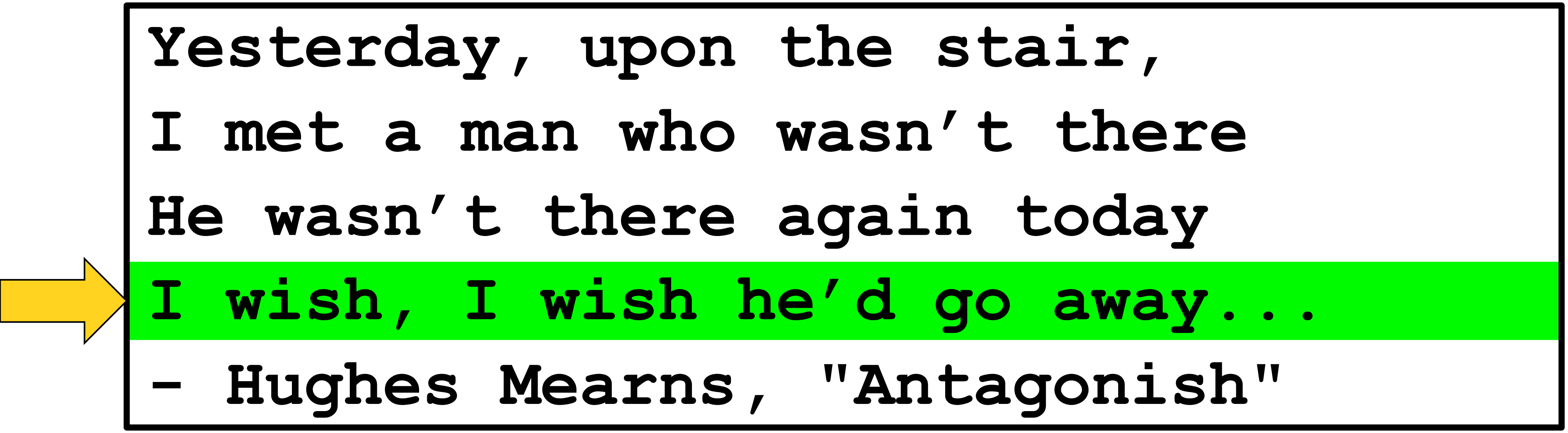


```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// He wasn't there again today
String line3 = input.nextLine();
```

Reading in a File



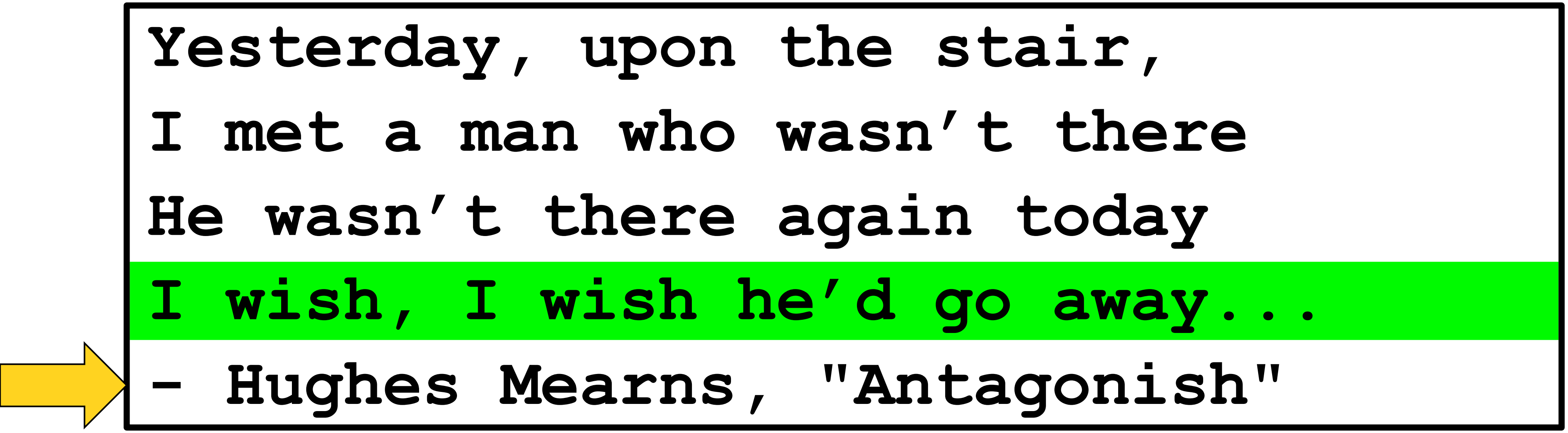
```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// He wasn't there again today
String line3 = input.nextLine();

// I wish, I wish he'd go away
String line4 = input.nextLine();
```

Reading in a File



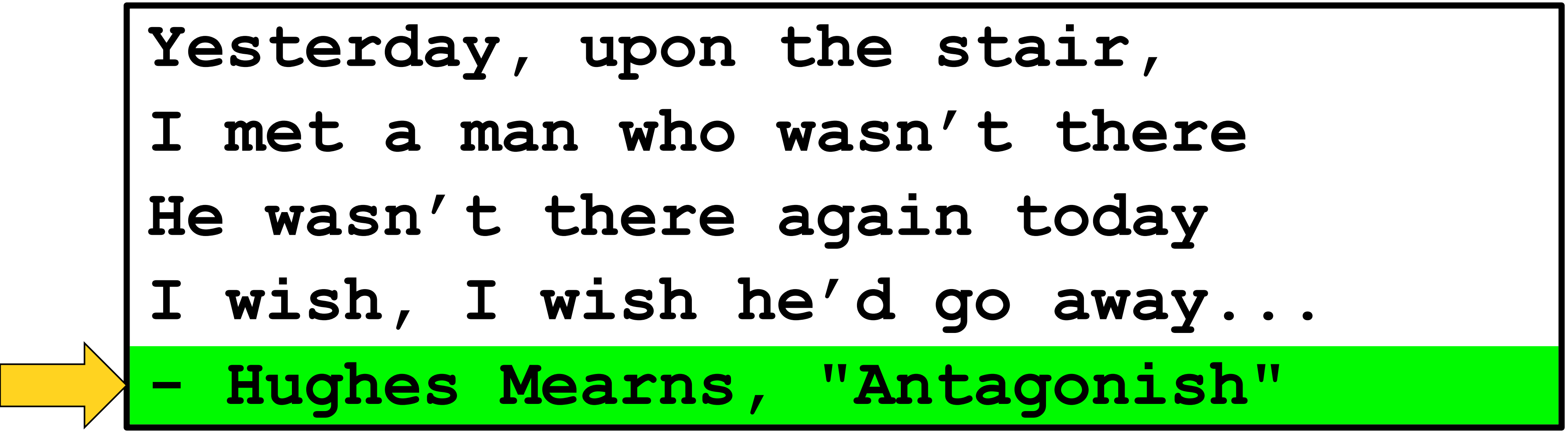
```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// He wasn't there again today
String line3 = input.nextLine();

// I wish, I wish he'd go away
String line4 = input.nextLine();
```

Reading in a File



```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// - Hughes Mearns, "Antagonish"
String line5 = input.nextLine();
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// - Hughes Mearns, "Antagonish"
String line5 = input.nextLine();
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// - Hughes Mearns, "Antagonish"
String line5 = input.nextLine();
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));

...
// prints all lines in the file
while (input.hasNextLine()) {
    String line = input.nextLine();
    println(line);
}
```

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn’t there
He wasn’t there again today
I wish, I wish he’d go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));
...
// prints all lines in the file
while (input.hasNextLine()) {
    String line = input.nextLine();
    println(line);
}
```

Step Three: close the file.

Reading in a File

```
Yesterday, upon the stair,
I met a man who wasn't there
He wasn't there again today
I wish, I wish he'd go away...
- Hughes Mearns, "Antagonish"
```

```
Scanner input = new Scanner(new File("mydata.txt"));
...
// prints all lines in the file
while (input.hasNextLine()) {
    String line = input.nextLine();
    println(line);
}

input.close();
```

Scanner Methods

Method	Description
`sc.nextLine()`	reads and returns a one-*line* `String` from the file
`sc.next()`	reads and returns a one-word `String` from the file
`sc.nextInt()`	reads and returns an `int` from the file
`sc.nextDouble()`	reads and returns a `double` from the file
`sc.hasNextLine()`	returns `true` if there are any more lines
`sc.hasNext()`	returns `true` if there are any more tokens
`sc.hasNextInt()`	returns `true` if there is a next token and it's an `int`
`sc.hasNextDouble()`	returns `true` if there is a next token and it's a `double`
`sc.close();`	should be called when done reading the file

Let “try” it out!

Thanks Keith Schwarz for some great slides to build off!

There’s a “catch”

Thanks Keith Schwarz for some great slides to build off!

Sometimes things break

- Programs sometimes encounter unexpected errors.
- Sometimes these are bugs:
  - Dividing by zero.
  - Sending a message to a **`null`** object.
- Sometimes these are due to external factors:
  - Network errors.
  - Missing files.

Exceptional cases

- If Java encounters a case where it can't proceed as normal, it will cause an ***exception***.
- Java requires that your program handle certain types of exceptions.
- Think of exceptions as rerouting control in an emergency:
  - If all goes well, program continues as usual.
  - If something goes wrong, handle the emergency.

Let “try” it out!

Thanks Keith Schwarz for some great slides to build off!

Let **try** it out!

Thanks Keith Schwarz for some great slides to build off!

try-ing your best

- To use a method or class that might cause an exception, you need to tell Java to **try** its best, knowing that it might fail.

try-ing your best

- To use a method or class that might cause an exception, you need to tell Java to **try** its best, knowing that it might fail.

```
Scanner input =
   new Scanner(new File("poem.txt"));

String line1 = input.nextLine(); // Yesterday, upon the stair,
String line2 = input.nextLine(); // I met a man who wasn't there
String line3 = input.nextLine(); // He wasn't there again today
String line4 = input.nextLine(); // I wish, I wish he'd go away
String line5 = input.nextLine(); // - Hughes Mearns, "Antagonish
String line6 = input.nextLine(); // *Returns null*

input.close();
```

try-ing your best

- To use a method or class that might cause an exception, you need to tell Java to **try** its best, knowing that it might fail.

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
    String line3 = input.nextLine(); // He wasn't there again today
    String line4 = input.nextLine(); // I wish, I wish he'd go away
    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonis
    String line6 = input.nextLine(); // *Returns null*

    input.close();
}
```

There’s a “catch”

Thanks Keith Schwarz for some great slides to build off!

There’s a **catch**

Thanks Keith Schwarz for some great slides to build off!

try and catch me

- If an exception occurs, you may need to tell Java to **catch** that exception.

try and catch me

- If an exception occurs, you may need to tell Java to **catch** that exception.

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
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    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonish
    String line6 = input.nextLine(); // *Returns null*

    input.close();
}
```

try and catch me

- If an exception occurs, you may need to tell Java to **catch** that exception.

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
    String line3 = input.nextLine(); // He wasn't there again today
    String line4 = input.nextLine(); // I wish, I wish he'd go away
    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonish
    String line6 = input.nextLine(); // *Returns null*

    input.close();
} catch (IOException e) {
    println("An error occurred: " + e);
}
```

try and catch me

- If an exception occurs, you may need that exception.

If something fails up here...

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
    String line3 = input.nextLine(); // He wasn't there again today
    String line4 = input.nextLine(); // I wish, I wish he'd go away
    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonish
    String line6 = input.nextLine(); // *Returns null*

    input.close();
} catch (IOException e) {
    println("An error occurred: " + e);
}
```

try and **catch** me

- If an exception occurs, you may need that exception.

If something fails up here…

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
    String line3 = input.nextLine(); // He wasn't there again today
    String line4 = input.nextLine(); // I wish, I wish he'd go away
    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonish
    String line6 = input.nextLine(); // *Returns null*

    input.close();
} catch (IOException e) {
    println("An error occurred: " + e);
}
```

… we immediately jump down here.

try and catch me

- If an exception occurs, you may need that exception.

If something fails up here…

```
try {
    Scanner input =
       new Scanner(new File("poem.txt"));

    String line1 = input.nextLine(); // Yesterday, upon the stair,
    String line2 = input.nextLine(); // I met a man who wasn't there
    String line3 = input.nextLine(); // He wasn't there again today
    String line4 = input.nextLine(); // I wish, I wish he'd go away
    String line5 = input.nextLine(); // - Hughes Mearns, "Antagonis
    String line6 = input.nextLine(); // *Returns null*

    input.close();
} catch (IOException e) {
    throw new RuntimeException(e);
}
```

… we immediately jump down here.

File concepts in one slide

1. Make a Scanner (lets call it input) to open a file for reading

```
Scanner input = new Scanner(new File("poem.txt"));
```

2. Use scanner.nextLine to get one line from the file

```
input.nextLine(); // returns the next line
```

3. Both the above operations are “dangerous” so we need to use a try/catch loop

```
try{
   // live dangerously
} catch (Exception e){
   // have heath insurance
}
```

4. You can either handle the problem or throw a runtime exception

```
throw new RuntimeException(“AHHHH!”);
```

lets **throw** it all together.

Thanks Keith Schwarz for some great slides to build off!

The classic file reading program.

- The idiomatic “read all the lines of a file” code is shown here:

```
try {
    Scanner input = /*…open the file… */
    while (input.hasNextLine()) {
        String line = input.nextLine();
        /* … process current line … */
    }
    input.close();
} catch (IOException e) {
    throw new RuntimeException(e);
}
```

Understanding this code is about 95% of what we want you to know for files in CS106A

US Census Data

Thanks Keith for the cool dataset