Objectives

- Using the Java Library
  - `java.lang` classes: `String` class
  - Getting user input with `java.util.Scanner`
  - Constructing objects
  - Using the Java API
  - Importing classes

Review

- What are the primitive data types of Java?
- What is the syntax for declaring a variable in Java?
  - What is the difference between *declaring* a variable and *defining* a variable?
- What are the arithmetic and relational operators that Java supports?
  - What does ++ after a variable mean?
- 111/112 review
  - What is an **API**?
  - What are operations you can do on strings in Python?
- How did assignment 0 go?

Review: Data Types

- Java is ***strongly*** and ***statically typed***
  - Every variable must have a ***declared*** **type**
- All data in Java is an ***object*** – except for the ***primitive data types***:

`int`	4 bytes (-2,147,483,648 -> 2,147,483,647)
`short`	2 bytes (-32,768 -> 32,767)
`long`	8 bytes (really big integers)
`byte`	1 byte (-128 -> 127)
`float`	4 bytes (floating point)
`double`	8 bytes (floating point)
`char`	2 bytes (Unicode representation), **single** quotes
`boolean`	`true` or `false`

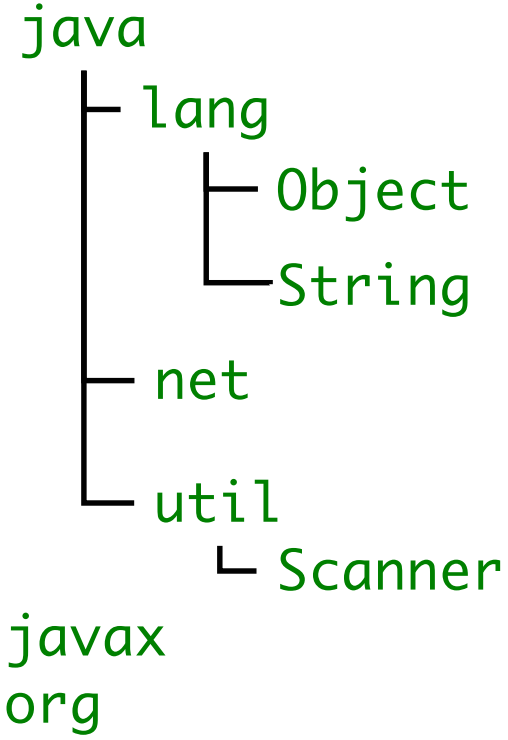
Assign 0

- Problems?
- Tips or tricks for others?
  - Read: what mistakes will you vow never to do again but probably will?
- Debugging part – shows that you shouldn't write a lot of code before compiling!

INTRODUCTION TO JAVA LIBRARIES

Java Libraries

- Organized into a *hierarchy* of ***packages***
- Similar to Python's ***packages*** (`__init__.py`)



Fully qualified name: `java.lang.String`

`java.lang.*` classes included *by default* in all Java programs

Many, many more classes and packages

java.lang.String class

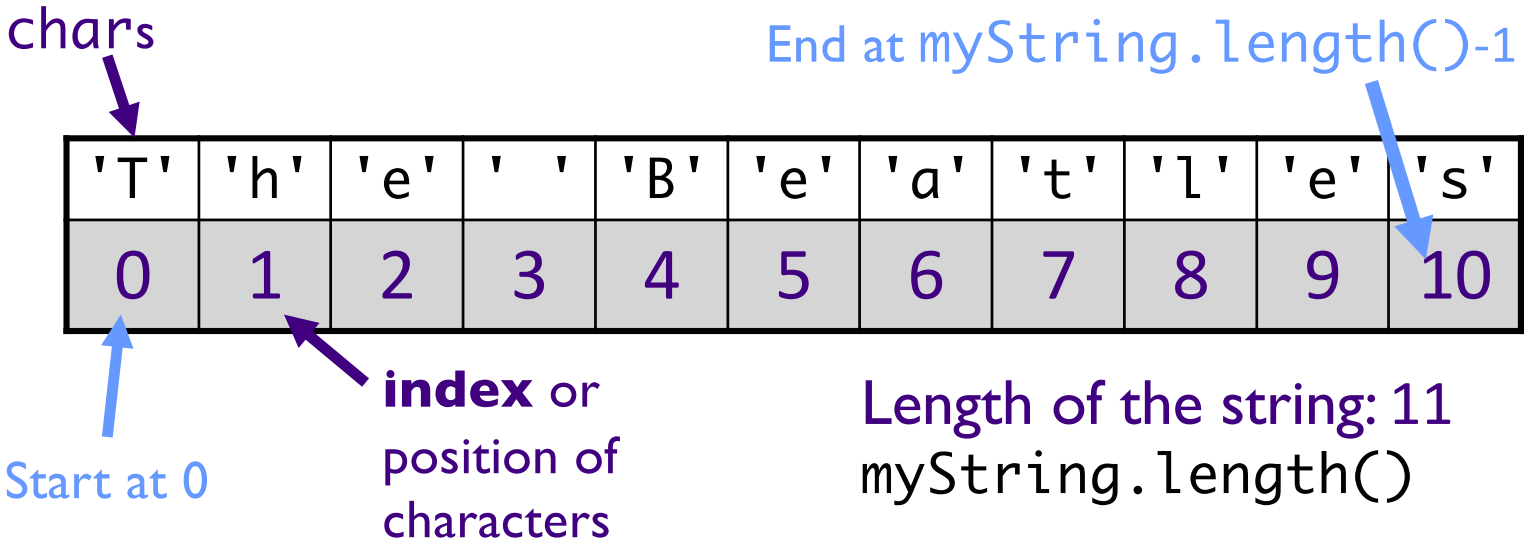
- Similar functionality to Python's but accessed differently
  - Mostly through *methods*!
- **Included by default** in every Java program
- Strings are represented by **double** quotes: **""**
  - Single quotes represent **chars** only
- Examples:

```
String emptyString = "";
String niceGreeting = "Hello there.";
String badGreeting = "What do you want?";
```

Strings

- A `char` at each position of `String`

```
String myString = "The Beatles";
```



Calling a method is the same syntax as Python: `object.method()`

Java API Documentation

https://docs.oracle.com/en/java/javase/21/docs/api/index.html

- API: Application Programming Interface
  - What a class can do for YOU!
  - The contract: if you call this method with these parameters, then the method will do this
- Complete documentation of every class included with the JDK
  - Every method and variable contained in class
- Bookmark it!
  - Too many classes, methods to remember them all
  - Refer to it often

Reading JavaDocs: String Overview

Data type of what method returns

Modifier and Type	Method	Description
char	**charAt**(int index)	Returns the char value at the specified index.
IntStream	**chars**()	Returns a stream of int zero-extending the char values from this sequence.
	ePointAt(int index)	Returns the character (Unicode code point) at the specified index.
int	**codePointBefore**(int index)	Returns the character (Unicode code point) before the specified index.
int	**codePointCount**(int beginIndex, int endIndex)	Returns the number of Unicode code points in the specified text range of this String.
IntStream	**codePoints**()	Returns a stream of code point values from this sequence.

Reading JavaDocs: Detail

charAt

`public char charAt(int index)`

Returns the `char` value at the specified index. An index ranges from `0` to `length() - 1`. The first `char` value of the sequence is at index `0`, the next at index `1`, and so on, as for array indexing.

If the `char` value specified by the index is a surrogate, the surrogate value is returned.

Specified by:

`charAt` in interface `CharSequence`

Parameters:

`index` - the index of the `char` value.

Returns:

the `char` value at the specified index of this string. The first `char` value is at index `0`.

Throws:

`IndexOutOfBoundsException` - if the `index` argument is negative or not less than the length of this string.

Python equivalent?

String method: charAt

```
String testString1 = "Demonstrate Strings";

char character1;
char character2 = testString1.charAt(3);
character1 = testString1.charAt(testString1.length()-2);

System.out.println(character1 + " " + character2);
```

Aside: I try to show different ways to code to show different implementations are possible, e.g., declaring variables with and without initializing it.

- Python equivalent: indexing with [<pos>]

String method: charAt

```
String testString1 = "Demonstrate Strings";

char character1;
char character2 = testString1.charAt(3);
character1 = testString1.charAt(testString1.length()-2);

System.out.println(character1 + " " + character2);
```

Displays:

```
g o
```

Python Transition Gotcha: Can't use negative numbers for indices as in Python

- Python equivalent: indexing with [<pos>]

String methods: `substring`

- Python equivalent: *slicing*
- `String substring(int beginIndex)`
  - Returns a new String that is a substring of this string, from `beginIndex` to end of this string
- `String substring(int beginIndex, int endIndex)`
  - Returns a new String that is a substring of this string, from `beginIndex` to `endIndex-1`

```
String language = "Java!";
String subStr = language.substring(1);
String subStr2 = language.substring(2, 4);
```

subStr is "ava!"
subStr2 is "va"

String Concatenation

- Use + operator to concatenate Strings

```
String niceGreeting = "Hello";
String firstName = "Clark";
String lastName = "Kent";
String blankSpace = " ";

String greeting = niceGreeting + "," +
       blankSpace + firstName +
       blankSpace + lastName;

System.out.println(greeting);
```

Note: statement doesn't end until ;

Displays `Hello, Clark Kent`

String methods: and many more!

- `boolean endsWith(String suffix)`
- `boolean startsWith(String prefix)`
- `boolean equalsIgnoreCase(String other)`
- `int length()`
- `String toLowerCase()`
- `String trim()` : remove trailing and leading white space
- …

See `java.lang.String` API for all available methods:
https://docs.oracle.com/en/java/javase/21/docs/api/java.base/java/lang/String.html

Multiple Methods with Same Name

- We saw it with `substrir`
- Another example:

Different from Python!
How/why is it possible with Java?

int	**indexOf**(int ch)	Returns the index within this string of the first occurrence of the specified character.
int	**indexOf**(int ch, int fromIndex)	Returns the index within this string of the first occurrence of the specified character, starting the search at the specified index.
int	**indexOf**(**String** str)	Returns the index within this string of the first occurrence of the specified substring.
int	**indexOf**(**String** str, int fromIndex)	Returns the index within this string of the first occurrence of the specified substring, starting at the specified index.

Multiple Methods with Same Name

- We saw it with su
- Another example:

Different from Python!
Java is *statically typed.*
Compiler determines which method gets called based on the parameters passed in

int	**indexOf**(int ch)	character.
int	**indexOf**(int ch, int fromIndex)	Returns the index within this string of the first occurrence of the specified character, starting the search at the specified index.
int	**indexOf**(**String** str)	Returns the index within this string of the first occurrence of the specified substring.
int	**indexOf**(**String** str, int fromIndex)	Returns the index within this string of the first occurrence of the specified substring, starting at the specified index.

Leveraging an API

- Consider:
  - What do I want to do?
  - What data/information do I have?
  - What information do I want back?
- Process:
  - Find a method that does what you want
    - Check if there is more than one method of the same name.
    - Don't necessarily stop when you find one that could work; may be a better fit if you keep looking
  - If you can't find a method, can you break the problem down into multiple steps? Repeat process of finding method(s)
  - Look at the method's parameters and their types
    - Do you have the data in that form/data type? If not, can you convert it to that type?

Getting user input

JAVA.UTIL.SCANNER

Getting User Input

- To get user input, use the `java.util.Scanner` class
- Create a Scanner object by calling the ***constructor***
  - new keyword means you're *allocating memory* for an *object*

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

What is this?

- Need to ***import*** the class because it's ***not*** part of the `java.lang` package
  - Imports go at the top of the program, before class definition

```
import java.util.Scanner;
```

Generalizing

- Constructing a new object:

```
DataType object = new DataType(arguments,…);
```

- Importing classes
  - If the class does not belong to `java.lang` package, need to import it

Scanner

- Makes reading/parsing input easier
- Breaks its input into *tokens* using a *delimiter pattern*, which matches *whitespace*

What is a "delimiter pattern"?
What is "whitespace"?

- Converts resulting tokens into values of different types using `nextXXX()`

Example Code Using Scanner

```
long tempLong;

// create the scanner for the console
Scanner scanner = new Scanner(System.in);

// read in an integer and a String
int i = scanner.nextInt();
String restOfLine = scanner.nextLine();

// read in a long
tempLong = scanner.nextLong();

scanner.close();
```

java.util.Scanner

- Many constructors
  - Read from file, input stream, string …
- Many methods
  - `nextXXXX` (int, long, line)
  - Skipping patterns, matching patterns, etc.
  - Can change token delimiter from default of whitespace
- Close the Scanner when you're done with it

Using Scanner

```
public static void main(String[] args) {

   // open the Scanner on the console input, System.in
   Scanner scan = new Scanner(System.in);

   scan.useDelimiter("\n"); // breaks up by lines, useful for console I/O

   System.out.print("Please enter the width of a rectangle: ");
   int width = scan.nextInt();

   System.out.print("Please enter the height of a rectangle: ");
   double length = scan.nextDouble();
   scan.close();

   System.out.println("The area of your square is " + length * width + ".");
}
```

ScannerDemoRectangle.java

Using Scanner

- What does the `useDelimeter` method in last slide do?
- Try running the program with and without that line, entering `5 4` as input

Comparing Delimiter

User enters: 4 5

White Space:

- Sees input as two tokens, “4” and “5”
- ”4” gets read in and converted to an int
- “5” is left on the input stream, for the next call to scanner (`nextDouble`)

“\n” (only):

- “Sees” input as one token: “4 5”
- “4 and 5” gets read in and attempted to turn into an int but throws exception

Effective Java: Code Inefficiency

- I showed this:

```
String s = "text";
```

- Instead of this

```
String s = new String("text"); // DON'T DO THIS
```

Why didn't we talk about ***constructing*** a String?

Effective Java: Code Inefficiency

- I showed this:

```
String s = "text";
```

- Instead of this

```
String s = new String("text"); // DON'T DO THIS
```

Why didn't we talk about ***constructing*** a String?

Would create *two* strings

StringBuilders and Strings

- Strings are read-only or immutable
  - Same as Python
- More efficient to use `StringBuilder` to manipulate a `String`
- Instead of creating a new String using
  - ~~`String str = prevStr + " more!";`~~
- Use

```
StringBuilder str = new StringBuilder( prevStr );
str.append(" more!");
```

- Many `StringBuilder` methods
  - `toString()` to get the resultant string back

Looking Ahead

- Assignment 1 due Wednesday before class
  - Part 3 can't be completed until after Monday's class
- Read textbook (see web site)