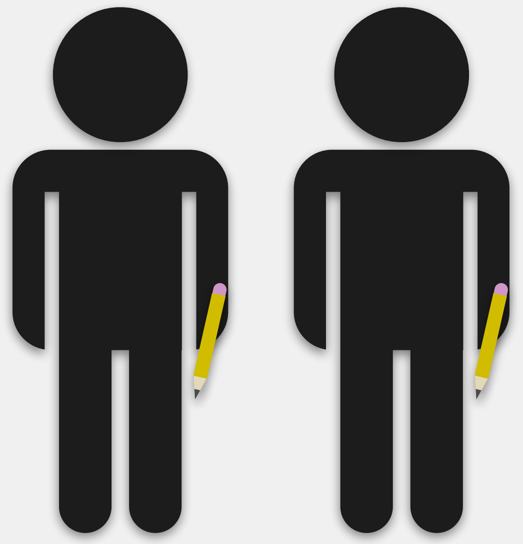
Programming: Data and Interaction

UWL as Data



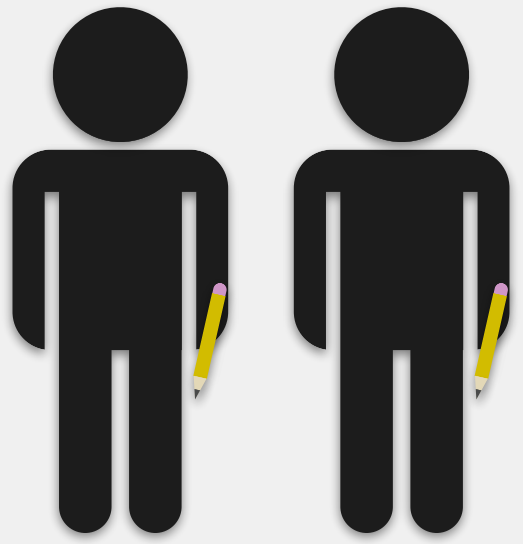
students

- birthday: **Feb. 23, 1994**
    - year: **1994**
    - month: **2**
    - day: **23**

Calculating a student's age: Write out instructions to calculate a student's age, given their birthday (i.e., year, month, day) and a value for today's date. Avoid using words like "before" or "after"; instead, use words for numerical comparison (e.g., "greater than", "less than or equal to"). Test your instructions with the following possibilities for today's date:

March 26, 2016
January 26, 2016
February 22, 2016
February 24, 2016
February 23, 2016

UWL as Data



students

- birthday: **Feb. 23, 1994**
  - year: **1994**
  - month: **2**
  - day: **23**

1. Subtract the birthday year from today's year.

2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

UWL as Data

1. Subtract the birthday year from today's year.

2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

UWL as Data

1. Subtract the birthday year from today's year.

2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

1. 2016 - 1994 = 22

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

---

1. 2016 - 1994 = 22

2. a. 2 > 3? **no**

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

---

1. 2016 - 1994 = 22
2. a. 2 > 3? **no**

   b. 2 = 3 and 23 > 26? **no**

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

---

1. 2016 - 1994 = 22
2. a. 2 > 3? **no**
   b. 2 = 3 and 23 > 26? **no**
   c. neither steps 2.a. or 2.b. performed? **yes**

UWL as Data

1. Subtract the birthday year from today's year.

2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **3** day: **26**

---

1. 2016 - 1994 = 22

2. a. 2 > 3? **no**

b. 2 = 3 and 23 > 26? **no**

c. neither steps 2.a. or 2.b. performed? **yes**

answer = 22

UWL as Data

1. Subtract the birthday year from today's year.
2. **a.** If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

UWL as Data

1. Subtract the birthday year from today's year.

2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.

b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.

c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

1. 2016 - 1994 = 22

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

1. 2016 - 1994 = 22
2. a. 2 > 2? **no**

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

---

1. 2016 - 1994 = 22
2. a. 2 > 2? **no**
   b. 2 = 2 and 23 > 22? **yes**

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

---

1. 2016 - 1994 = 22
2. a. 2 > 2? **no**
   b. 2 = 2 and 23 > 22? **yes**
   answer = 22 - 1 = 21

UWL as Data

1. Subtract the birthday year from today's year.
2. a. If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

birthday:

year: **1994** month: **2** day: **23**

today's date:

year: **2016** month: **2** day: **22**

---

1. 2016 - 1994 = 22

2. a. 2 > 2? **no**

   b. 2 = 2 and 23 > 22? **yes**

   answer = 22 - 1 = 21

   c. neither steps 2.a. or 2.b. performed? **no**

UWL as Data

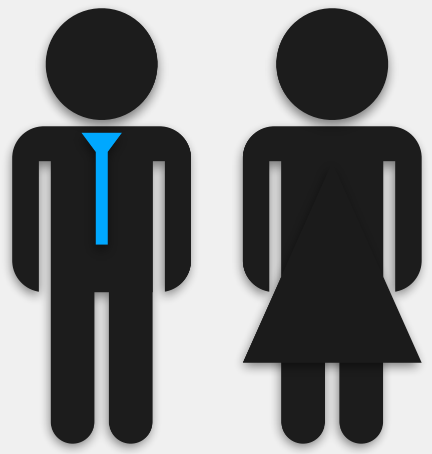
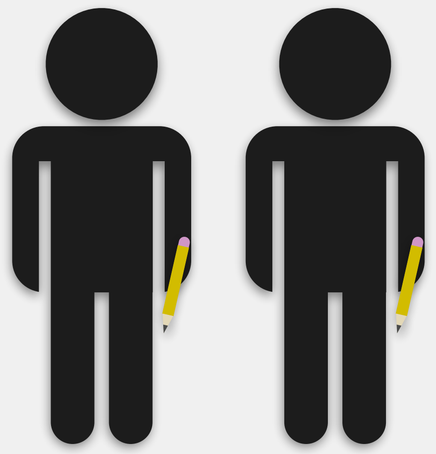
1. Subtract the birthday year from today's year.
2. **a.** If the birthday month is greater than today's month, then subtract one from the result of step 1 to obtain the final answer.
   b. If the birthday month is the same as today's month, and the birthday day is greater than today's day, then subtract one from the result of step 1 to obtain the final answer.
   c. If you do not perform steps 2.a. or 2.b., then the result of step 1 is the final answer.

when the birthday month has not yet occurred

when the birthday month is today's month, but the birthday day has not yet occurred

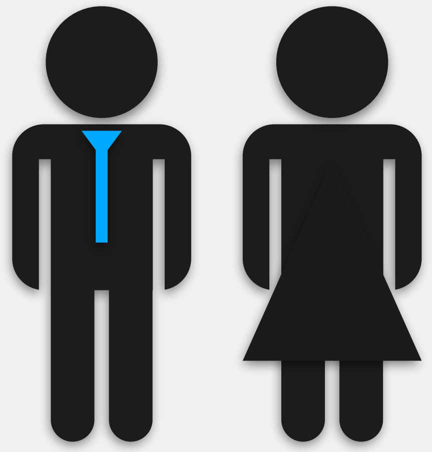
when the birthday has already passed

UWL as Object-Oriented Data

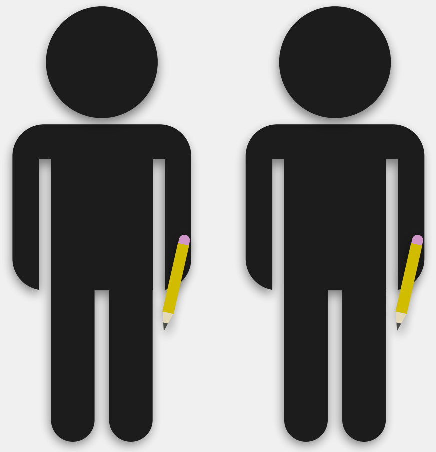
Objects	Attributes	Methods
 professors	- first name - last name - department - list of **classes** this semester	- display schedule of classes
 students	- first name - last name - major - list of **classes** this semester	- calculate age - display schedule of classes - calculate classes left
 classes	- department (e.g., CS) - number (e.g., 120) - section (e.g., 1) - **professor** of record - list of **students** enrolled	- calculate number of seats left - order students by grade

UWL as Object-Oriented Data

Objects



professors



students

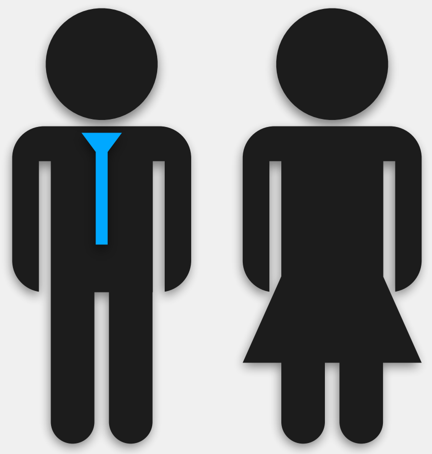
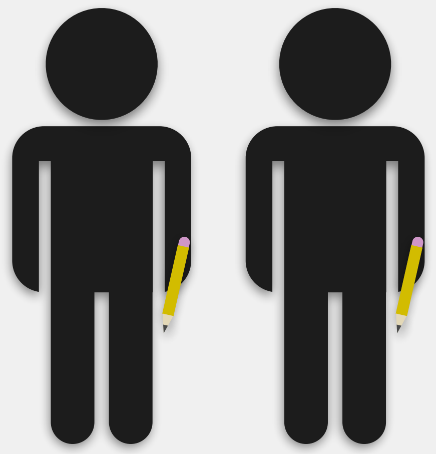
classes

objects/classes: allows us to organize data and actions to be performed on that data based on real-world phenomena

Comprised of two parts:

1. *attributes/data members*: data that describes the object
2. *methods/functions*: instructions for calculations that can be performed on the object's attributes

UWL as Object-Oriented Data

Objects		Attributes	Methods
	professors	- first name - last name - department - list of **classes** this semester	- display schedule of classes
	students	- first name - last name - major - list of **classes** this semester	**- calculate age** - display schedule of classes - calculate classes left
	classes	- department (e.g., CS) - number (e.g., 120) - section (e.g., 1) - **professor** of record - list of **students** enrolled	- calculate number of seats left - order students by grade

Methods

Methods are a **named set of instructions**

Method: calculating a person's age (given their birthday and today's date)

- instruction 1: subtract the person's birth year from the current year
- instruction 2: determine which part of instruction 2 (a, b, or c) to execute and perform it

Statements

statement: the unit of instruction in programming

- enables us to give commands to the computer

Crux of all programming languages

Programming is about the use of statements to solve problems

In Java, statements **always** end with a semicolon

```
<instruction 1>;
<instruction 2>;
<instruction 3>;
```

Program Structure

```java
/**
 * Our first program
 */
public class ExampleClass {

   public static void main(String[] args) {

      // Your code goes here!

   }

}
```

Program Structure: Class

```
/**
 * Our first program
 */
public class ExampleClass {

   public static void

      // Your code goes here!

   }

}
```

Provides a name for the program

One program per class

For now, always created with
`public class <className>`

- replace `<className>` with the program name
- `<className>` must match the name of the file!

Program Structure: `main` Method

```java
/**
 * Our first program
 */
public class ExampleClass {

    public static void main(String[] args) {

        // Your code goes here!

    }

}
```

Denotes where the program will start executing

Only one `main` method per program

Always created with `public static void main(String[] args)`

Program Structure: Comments

```
/**
 * Our first program
 */
public class ExampleClass {

    public static void main(String[] args) {

        // Your code goes here!

    }

}
```

Allows us to annotate our program

- not interpreted as code/instructions
- completely ignored by the computer

Comments are often inserted on their own line(s)

Definition: Comments

inline comment

```
// Begins with two slashes; this comment lasts until the end of the line
```

block comment

```
/**
 * This is a block comment.
 * Typically used at the top of a class file or before methods,
 * and can span multiple lines.
 * Starts with a single slash followed by an asterisk,
 * and ends with an asterisk followed by a slash.
 */
```

Program Structure: Code Blocks

```
/**
 * Our first program
 */
public class ExampleClass {

    public static void main(String[] args) {

        // Your code goes here!

    }

}
```

Defined by matching opening and closing curly bracket (e.g., { & })

Can be nested

- innermost opening curly bracket matches innermost closing curly bracket on to

data and **interaction**

How can I take the **data I have** and transform it into the **data I need**?

Data

“Carpe Diem”	42 3.14159	`true` `false`
text	numbers	logical values

Data

“Carpe Diem”	42 3.14159	`true` `false`
text	numbers	logical values

Textual Data

Good for data not easily represented by numbers

- e.g., names, majors, descriptions

string literal: a sequence of characters that should be interpreted as data, not instructions

- colloquially, we call these *strings*

Strings

notice the
quotes

```
"This is a string."
```

Quotes define the beginning and end of a string

- are not part of the string itself

Can include any standard characters

- e.g., numbers, spaces, punctuation

Called a *string literal* since the data is exactly what is stored between quotes

Console

Allows us to communicate textually with a Java program

- Java produces output with `System.out` (sometimes referred to as *standard output*)
- Java reads in input with `System.in` (sometimes referred to as *standard input*)

```java
public class ExampleClass {
    public static void main(String[] args) {
        // Your code goes here!

    }
}
```

```
^
```

Definition: String Output

print statement: prints <string> to the console

```
System.out.print(<string>);
```

println statement: prints <string> to the console, then moves to the next line

```
System.out.println(<string>);
```

N.B.: the rest of the statement needs to be exactly as shown re: capitalization, spelling

Nota Bene (N.B.): anything with angle brackets should be **replaced** by something

Printing Strings

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

      > System.out.print("Allie Sauppe");
      >


    }
}
```

```
Allie Sauppe
```

Printing Strings

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

        System.out.print("Allie Sauppe, CS");


    }
}
```

```
Allie Sauppe, CS
```

Printing Strings

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

      > System.out.println("Allie Sauppe");
      >


    }
}
```

```
Allie Sauppe
^
^
```

Sequential Execution

Instructions start executing in `main` method

Execute one at a time, in order, starting at top of `main`

Order matters!

- changing the order of instructions will often change the functionality of the program
- particularly important when printing to console — cannot go backwards

Printing Strings

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

      > System.out.print("Allie Sauppe");
      > System.out.print(", CS");
      >

    }
}
```

```
Allie Sauppe, CS
```

Printing Strings

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

      > System.out.print(", CS");
      > System.out.print("Allie Sauppe");
      >

    }
}
```

```
, CSAllie Sauppe
^    ^          ^
```

Printing Strings

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

        System.out.print("Allie Sauppe");
        System.out.println(", CS");
        System.out.print("UW-La Crosse");

    }
}
```

```
Allie Sauppe, CS
UW-La Crosse
```

Exercise: Adding Quotation Marks

Use `print` and `println` statements to display the following:

```
"I'll be back."
- The Terminator
```

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

        System.out.println(""I'll be back."");
        System.out.print("- The Terminator");


    }
}
```

this will **not** work!

Escape Character

Allows us to *escape* the string with a backslash (the *escape character*)

Escape character + next character are interpreted together, non-literally

- form an *escape sequence*

Common escape sequences:

```
\"      //prints a double quotation mark
\'      //prints a single quotation mark
\n      //prints a newline
\t      //prints a tab
```

Escape Character

Allows us to *escape* the string with a backslash (the *escape character*)

Escape character + next character are interpreted together, non-literally

form an *escape sequence*

Common escape sequences:

```
\"      //prints a double quotation mark
\'      //prints a single quotation mark
\n      //prints a newline
\t      //prints a tab
\\      //prints a backslash
```

Example: Using Escape Sequences

Use `print` and `println` statements to display the following:

```
"I'll be back."
- The Terminator
```

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

        System.out.println("\"I'll be back.\"");
        System.out.print("- The Terminator");


    }
}
```

Variables

variable: a piece of computer memory that holds data

Two parts to every variable:

1. *identifier*: the name by which we refer to the variable
2. *data type*: the type of data the variable holds (e.g., string, number, boolean)

Identifiers

identifier: name we use to refer to parts of code

- e.g., variables, classes, methods

Must follow a few rules:

- start with an alphabetic character (a-z, A-Z), underscore (_), or dollar sign ($)
- contain only alphanumeric characters (a-z, A-Z, 0-9), underscore (_), or dollar sign ($)

Should be descriptive

No spaces!

- use *camelcase* to name variables

Camelcase

Might want to give identifiers containing multiple words

```
mybirthday
yourbirthday
```

camelcase: only first letter of each word is uppercase

```
MyBirthday  //capitalize first letter for classes
myBirthday  //lowercase first letter for variables, methods
```

Identifiers

Case matters

`mybirthday`, `myBirthday`, `MyBirthday` and `MYBIRTHDAY` are all unique variable names

Identifiers cannot be reserved keywords

`public`	`int`
`protected`	`double`
`private`	`boolean`
`static`	`new`
`void`	`return`
`final`	`...`

Data Type

data type: the type of data the variable holds; defines what actions can be performed on it

- e.g., we can divide one number by another, we can't divide one string by another

Cannot be changed once variable is created

Types of Data Type

Two categories: *primitive type* and *class type*

Primitives

represents basic data types

examples:

```
char      //holds a single character
int       //holds integer values
double    //holds decimal values
boolean   //holds true/false values
```

Classes

represents more complex data

examples:

```
String  //** holds textual data
Scanner //reads input
Date    //represents day/month/year
Math    //complex mathematical ops
```

Using Variables

Two parts to variable use:

1. ***declaring* the variable:** defines the variable's data type and identifier
2. ***initializing* the variable:** sets the variable to some value; sets it up to be used

Variables must be…

- declared before they can be initialized
- initialized before they can be used

Can be done separately or together

Declaration must happen exactly once for each variable

Definition: Variable Declaration

declare a single variable

```
<dataType> <identifier>;
```

declare multiple variables **of the same type**

```
<dataType> <identifier>, <identifier>, <identifier>;
```

N.B.: remember, anything in angle brackets should be completely replaced! (including the brackets)

Example: Variable Declaration

declare a single variable

```
int age;
double height;
String name;
```

declare multiple variables **of the same type**

```
int day, favoriteNumber;
double temp, weight;
String firstName, lastName, middleName;
```

Example: Variable Declaration

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

      > int age;
      > double height;
      > String firstName;
      >
    }
}
```

memory

age (int)

height (double)

firstName (String)

Definition: Primitive Variable Initialization

initialize a primitive variable

```
<identifier> = <value>;
```

N.B.: the data type associated with the identifier **must** match the data type of the value

Example: Primitive Variable Initialization

initialize a primitive variable

```
firstName = "James";
```

this works because we are initializing a `String` variable with a `String` value

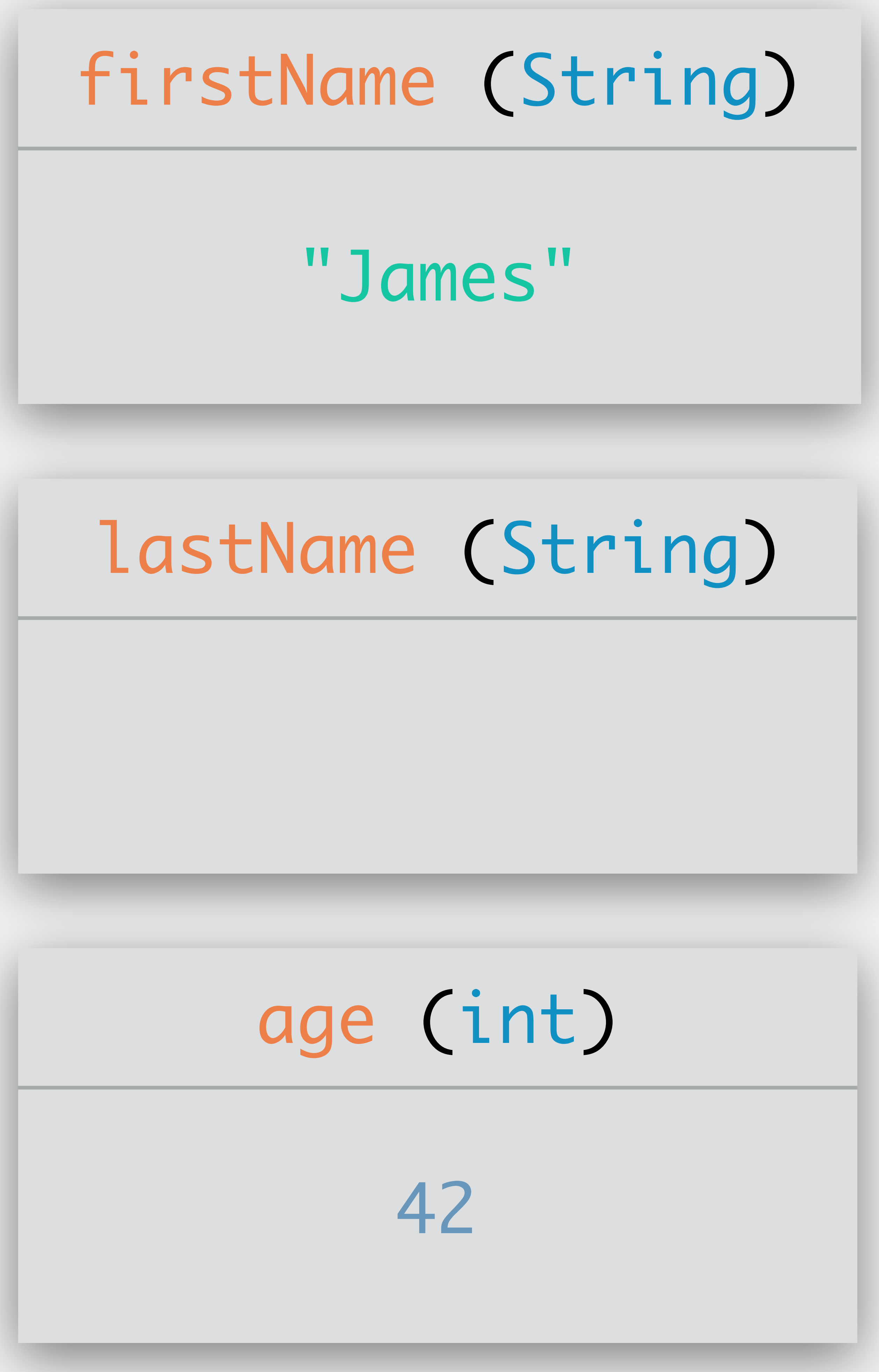
Example: Primitive Variable Initialization

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

      > String firstName, lastName;
      > int age;

      > firstName = "James";
      > age = 42;
      >
    }
}
```

memory



Definition: Combining Declaration & Initialization

declare & initialize a single primitive variable

```
<dataType> <identifier> = <value>;
```

declare & initialize multiple primitive variables **of the same type**

```
<dataType> <identifier> = <value>, <identifier> = <value>, <identifier>;
```

Example: Combining Declaration & Initialization

declare & initialize a single primitive variable

```
String firstName = "James";
```

declare & initialize multiple primitive variables **of the same type**

```
String firstName = "James", lastName = "Kirk", middleName;
```

Example: Combining Declaration & Initialization

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

        String firstName = "James", middleName, lastName = "Kirk";

        middleName = "Tiberius";

    }
}
```

Definition: String Output

`print` statement: prints <String> to the console

```
System.out.print(<String>);
```

`println` statement: prints <String> to the console, then moves to the next line

```
System.out.println(<String>);
```

Printing Strings

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

        String firstName = "James", lastName = "Kirk";
        int age = 42;

        System.out.println(firstName);
        System.out.println("James");
        System.out.println(lastName);
        System.out.println("Kirk");
        System.out.println(age);
        System.out.println("42");

    }
}
```

```
James
James
Kirk
Kirk
42
42
```

Definition: Primitive Variable Assignment

assign a new value to a variable

```
<identifier> = <value>;
```

N.B.: the data type associated with the identifier **must** match the data type of the value

Variable initialization versus assignment

- *initialization* is the first time a value is assigned to a variable
- *assignment* is overwriting the current value with a new value

In practice, look the same

Primitive Variable Assignment

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

          > String firstName = "James", lastName = "Kirk", middleName;

          > System.out.println(firstName);
          > System.out.println(lastName);

          > firstName = "Jim";

          > System.out.println(firstName);
          >
     }
}
```

```
James
Kirk
Jim
```

memory

firstName (String)
"James" / "Jim"

lastName (String)
"Kirk"

middleName (String)

Primitive Variable Assignment

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

        > String firstName = "James", lastName = "Kirk", middleName;

        > System.out.println(firstName);
        > System.out.println(lastName);

        > firstName = lastName;

        > System.out.println(firstName);
        >
     }
}
```

```
James
Kirk
Kirk
```

memory

firstName (String)
"Kirk"

lastName (String)
"Kirk"

middleName (String)

`String` Methods

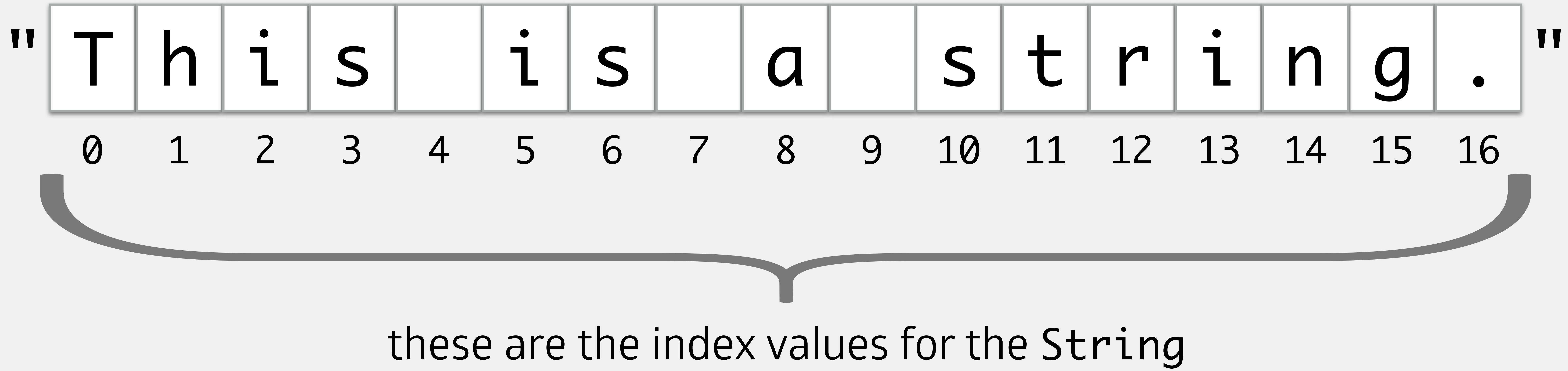
Text is one of our fundamental units of data

Several ways we might want to manipulate our text

Examples:

- change letters to all upper or lowercase
- isolate a small part of the text
- find a particular letter or number in a text
- replace some part of the text

Strings


"This is a string."
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
these are the index values for the String

Methods

Methods have four main characteristics we should know

For any given method:

- what is it called?
- what does it do?
- what type of input does it need? (called *parameters*)
- what type does it give back? (i.e., what does it *return*?)

Definition: `String` Methods

`+`: *concatenates* two `String` values together

```
<String> + <String>;
```

`length`: returns the length of <`String`> (i.e., how many characters)

```
<String>.length();
```

`substring`: returns part of <`String`> from index <`int1`> to index <`int2`>

```
<String>.substring(<int1>, <int2>);
```

Concatenation (+)

concatenate: to join two Strings together into one String

arguments: the two Strings to join together

returns: a single String

```
<String> + <String>;
```

```
String str1 = "Hello", str2 = "World";

String exampleConcat = str1 + str2;
System.out.print(exampleConcat);
```

```
HelloWorld
```

Definition: `String` Methods

`+`: *concatenates* two `String` values together

```
<String> + <String>;
```

`length`: returns the length of `<String>` (i.e., how many characters)

```
<String>.length();
```

`substring`: returns part of `<String>` from index `<int1>` to index `<int2>`

```
<String>.substring(<int1>, <int2>);
```

Concatenation (+)

concatenate: to join two `String`s together into one `String`

arguments: the two `String`s to join together

returns: a single `String`

```
<String> + <String>;
```

```
> String str1 = "Hello", str2 = "World";

> String exampleConcat = str1 + str2;
> System.out.print(exampleConcat);
>
```

```
HelloWorld
```

memory

exampleConcat (String)

"HelloWorld"

str1 (String)

"Hello"

str2 (String)

"World"

Concatenation (+)

concatenate: to join two `String`s together into one `String`

arguments: the two `String`s to join together

returns: a single `String`

```
<String> + <String>;
```

```
> String str1 = "Hello", str2 = "World";

> String exampleConcat = str1 + " " + str2;
> System.out.print(exampleConcat);
>
```

```
Hello World
```

memory

exampleConcat (String)

"Hello World"

str1 (String)

"Hello"

str2 (String)

"World"

length

arguments: none

returns: the length (<int>) of the String (i.e., the number of characters)

```
<String>.length();
```

```
> String exampleStr = "Hello, world!";

> int len = exampleStr.length();
> System.out.print(len);
>
```

```
13
```

memory

len (int)	exampleStr (String)
13	"Hello, world!"

substring

arguments: the beginning index <int1> (inclusive), the ending index <int2> (exclusive)

returns: the String specified by the beginning and end index

```
<String>.substring(<int1>, <int2>);
```

```
> String exStr = "All the king's men.";

> String exSubStr = exStr.substring(4, 14);
> System.out.print(exSubStr);
>
```

```
the king's
```

memory

exStr (String)
"All the king's men."

exSubStr (String)
"the king's"

Definition: String Methods

`indexOf`: returns the index (`<int>`) of the first occurrence of `<char>`

```
<String>.indexOf(<char>);
```

`charAt`: returns the `<char>` present at index `<int>`

```
<String>.charAt(<int>);
```

`replaceAll`: replace every occurrence of `<String1>` with `<String2>`

```
<String>.replaceAll(<String1>, <String2>);
```

indexOf

arguments: the char to look for <char> (case sensitive!)

returns: the index (<int>) of the first occurrence of char

```
<String>.indexOf(<char>);
```

```
> String exampleStr = "Hello, home!";

> int index = exampleStr.indexOf('h');
  System.out.print(index);
```

memory

exampleStr (String)

“Hello, home!”

index (int)

indexOf

arguments: the char to look for <char> (case sensitive!)

returns: the index (<int>) of the first occurrence of char

```
<String>.indexOf(<char>);
```

```
String exampleStr = "Hello, home!";

int index = exampleStr.indexOf('h');
> System.out.print(index);
>
```

```
7
```

memory

exampleStr (String)
“Hello, home!”

index (int)
7

indexOf

arguments: the char to look for <char> (case sensitive!)

returns: the index (<int>) of the first occurrence of char

```
<String>.indexOf(<char>);
```

```
String exampleStr = "Hello, home!";

int index = exampleStr.indexOf('H');
System.out.print(index);
```

memory

exampleStr (String)

“Hello, home!”

index (int)

indexOf

arguments: the char to look for <char> (case sensitive!)

returns: the index (<int>) of the first occurrence of char

```
<String>.indexOf(<char>);
```

```
String exampleStr = "Hello, home!";

int index = exampleStr.indexOf('H');
System.out.print(index);
```

```
0
```

memory

exampleStr (String)
“Hello, home!”

index (int)
0

charAt

arguments: a specific index in the String <int>

returns: the char at that index

```
<String>.charAt(<int>);
```

```
> String exampleStr = "Hello, home!";

> char charPos = exampleStr.charAt(5);
  System.out.print(charPos);
```

memory

exampleStr (String)

“Hello, home!”

charPos (char)

charAt

arguments: a specific index in the String <int>

returns: the char at that index

```
<String>.charAt(<int>);
```

```
String exampleStr = "Hello, home!";

char charPos = exampleStr.charAt(5);
> System.out.print(charPos);
>
```

```
,
```

memory

exampleStr (String)
“Hello, home!”

charPos (char)
‘,’

replaceAll

arguments: the String to replace is <String1>, the replacement String is <String2>

returns: a String with every occurrence of <String1> replaced by <String2>

memory

```
<String>.replaceAll(<String1>, <String2>);
```

```
String exampleStr = "She sells seashells";

> String newStr = "She se_!!_s seashe_!!_s";
> System.out.print(newStr);
>
```

```
She se_!!_s seashe_!!_s
```

exampleStr (String)

"She sells seashells"

newStr (String)

"She se_!!_s seashe_!!_s"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

- moves left to right
- evaluates inner parentheses before outer parentheses

```
String exampleStr = "She sells seashells";

System.out.print(exampleStr.replaceAll("ll", “_!!_"));
```

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

- moves left to right
- evaluates inner parentheses before outer parentheses

```
String exampleStr = "She sells seashells";

System.out.print(exampleStr.replaceAll("ll", “_!!_"));
```

N.B.: we know print methods must have some string argument

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

- moves left to right
- evaluates inner parentheses before outer parentheses

```java
String exampleStr = "She sells seashells";

System.out.print("She se_!!_s seashe_!!_s");
```

this statement evaluates to a string, so we can use it here

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = exampleStr.replaceAll("ll", "_!!_") + exampleStr2;
```

memory

exampleStr (String)	exampleStr2 (String)
"She sells seashells"	"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = exampleStr.replaceAll("ll", "_!!_") + exampleStr2;
```

memory

exampleStr (String)	exampleStr2 (String)
"She sells seashells"	"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = exampleStr.replaceAll("ll", "_!!_") + exampleStr2;
```

memory

exampleStr (String)
"She sells seashells"

exampleStr2 (String)
"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```java
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = "She se_!!_s seashe_!!_s" + exampleStr2;
```

memory

exampleStr (String)	exampleStr2 (String)
"She sells seashells"	"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = "She se_!!_s seashe_!!_s" + exampleStr2;
```

memory

exampleStr (String)	exampleStr2 (String)
"She sells seashells"	"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = "She se_!!_s seashe_!!_s" + "and other things"
```

memory

exampleStr (String)	exampleStr2 (String)
"She sells seashells"	"and other things"

Order of Evaluation

In order to set/change the value of a variable, = must be used!

Java will evaluate right of equal sign first

```
String exampleStr = "She sells seashells";
String exampleStr2 = "and other things";

exampleStr = "She se_!!_s seashe_!!_s" + "and other things"
```

memory

exampleStr (String)
"She se_!!_s seashe_!!_sand other things"

exampleStr2 (String)
"and other things"

Putting It All Together

The Scanner Class

Multiple ways to read input from a user

In this course, we'll use the Java-provided `Scanner` class

- our first class data type!

Provides input from the console

Using the Scanner Class

memory

```java
import java.util.Scanner;

public class Person {
    public static void main(String[] args) {

        Scanner scan = new Scanner(System.in);
        String firstName;

        System.out.print("What is your first name? ");
        firstName = scan.nextLine();
        System.out.print("Your name is ");
        System.out.print(firstName);

    }
}
```

```
What is your first name? Jim
Your name is Jim
```

firstName (String)

"Jim"

import Statements

```
import java.util.Scanner;

public class
    public static void

        Scanner
        String

        System
        firstName
        System
        System

    }
}
```

```
What is your first name? Jim
Your name is Jim
```

Enables your program to leverage additional functionality

- either from within Java, or from a third-party source

Eclipse will help you find what imports you need

Definition: Variable Declaration

declare a single variable

```
<dataType> <identifier>;
```

declare multiple variables **of the same type**

```
<dataType> <identifier>, <identifier>, <identifier>;
```

Definition: Object Variable Instantiation

instantiate an object variable

```
<identifier> = new <dataType>(<arguments>);
```

N.B.: the data type associated with the identifier **must** match this data type

N.B.: *arguments* provide details necessary to create/use the object; will be specific to each type of object

We *initialize* primitive variables

We *instantiate* object variables

Same basic idea — setting the variable up for use

Definition: Combining Declaration & Instantiation

declare & instantiate a single object variable

```
<dataType> <identifier> = new <dataType>(<arguments>);
```

declare & instantiate multiple object variables **of the same type**

```
<dataType> <identifier> = new <dataType>(<arguments>), <identifier>;
```

Definition: Scanner Creation

declare & instantiate a single object variable

```
<dataType> <identifier> = new <dataType>(<arguments>);
```

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

N.B.: this works because the data type associated with the identifier matches this data type

N.B.: for `Scanner` objects, we need to define where we are receiving input from; `System.in` specifies the console

Definition: Calling an Object’s Methods

calls `<methodName>`, specifying `<arguments>` if necessary

```
<identifier>.<methodName>(<arguments>);
```

dot notation says “we want to perform the set of instructions associated with `<methodName>`, and that this method is available for `<identifier>`’s data type”

we refer to this process as *calling a method*

Definition: Scanner Methods

`nextLine`: reads in a `String` until a linebreak

```
scan.nextLine();
```

`nextInt`: reads in a single `int` until whitespace (i.e., one number)

```
scan.nextInt();
```

`next`: reads in a `String` until whitespace (i.e., one word)

```
scan.next();
```

Definition: Method Returns

Once a method finishes it's calculation, it will *return* the result of the calculation to your program

- the value returned will have a specific data type
- not all methods will return a value

```
scanner.nextLine();    //returns a String

scanner.nextInt();     //returns an int

scanner.next();        //returns a String
```

Using the Scanner Class

```java
import java.util.Scanner;

public class Person {
    public static void main(String[] args) {

        Scanner scan = new Scanner(System.in);
        String firstName;

        System.out.print("What is your first name? ");
      > firstName = "Jim"
      > System.out.print("Your name is ");
      > System.out.print(firstName);
      >
    }
}
```

```
What is your first name? Jim
Your name is Jim
```

memory

firstName (String)
"Jim"