JAVA REVIEW

cs2420 | Introduction to Algorithms and Data Structures | Spring 2015

administrivia…

-Lab 0 posted

  -getting started with Eclipse

  -Java refresher

    *-this will **not** count towards your grade*

-TA office hours today, 12:15-5pm

-help sessions this Friday

  -9:40am | 10:45am | 11:50am

  -MEB 3225

last time…

N

-we refer to unspecified integer quantities as **N**

-**N** is the problem size

-*sorting an array of* **N** *numbers*

-*searching for an item in a set of* **N** *items*

-*inserting an item into a set of* **N** *items*

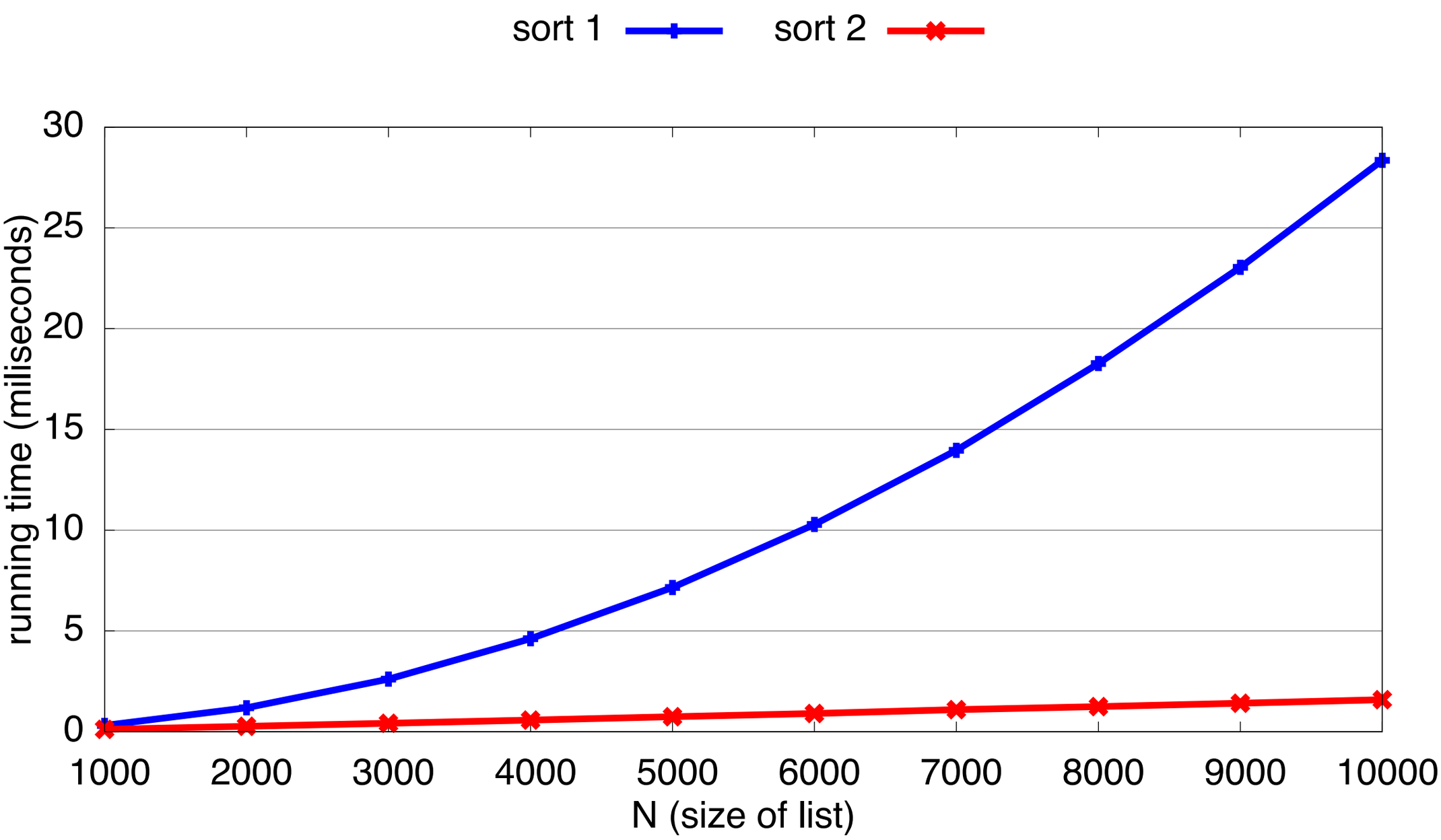
-amount of work done for these operations usually depends on **N**

-work required is a **function** of **N**

large N

TAKE AWAY:

AS **N** BECOMES LARGE
COMPLEXITY MATTERS!



phases of software development

-requirements gathering
    -read and understand assignment specs, ask questions

-planning l design l analysis
    -outline how to solve a problem, determine algorithms, write pseudocode

-construction
    -write code, debug **syntactic** errors

-testing
    -test thoroughly to find **semantic** errors and boundary cases

-maintance

testing

-white-box

-test with knowledge of the program's inner-workings
— from the programmer's perspective

-unit testing, boundary analysis

-black-box

-test only with knowledge of the program's interface
— from the user's perspective

-stress testing

-test-first model

-write acceptance tests before writing any code

good coding style

-benefits the programmer and all other readers of the program

-components:
  -descriptive names (variables, methods, classes)
  -clear expressions, straightforward control flow
  -consistency, conventions, and language idioms
  -comments!

-well-written code is often smaller, has fewer errors, and is easier to extend and modify

today…

disclaimer: this class is *not* about teaching you Java

-variables

-control flow

-reference types

-misc.

variables

-a **variable** is a piece of data in memory with:
  -an identifier (name)
  -a **type**

-what is a type?
  -a basic building block in a programming language
  -determines what kind of data a variable holds, and what operations can be performed on it

-Java defines eight primitive types
  -byte, short, int, long, float, double, char, boolean
  -each primitive type can hold a single value
    -`'r', 12, 2.64, true`

declaration & initialization

-**declaring** a variable is stating that it exists

-assigns the variable a type and name

```
boolean areWeThereYet;
```

-**initializing** a variable gives it an initial value, and is often combined with declaring

```
boolean areWeThereYet = false;
```

-variables declared as **final** are constant and cannot be changed after initialization

```
final int theMeaningOfLife = 42;
```

assignment

-after a variable has been declared we can assign it a new value with =

```
areWeThereYet = true;
```

-we can use arithmetic expressions with an assignment

```
age = currentYear - birthYear;
```

arithmetic operations

-explicitly supported on primitive types

  -binary operators

    `+, -, *, /, %`

  -unary operators

    `-` (negation), `++` (increment), `--` (decrement)

-Java follows common order-of-operation rules

`unary ops`	:	highest
`*, /, %`	:	high
`+, -`	:	low
`=`	:	lowest

type conversion

- **widening conversions** convert data to another type that has the same or more bits of storage

```
short -> int
int   -> long
int   -> float
```

- **narrowing conversions** convert data to another type that has fewer bits of storage, possibly losing information

```
double -> float
float  -> int
```

type conversion

- java uses widening conversion when an operator is applied to operands of different types (called **promotion**)

```
2.2 * 2          evaluates to 4.4
1.0 / 2          evaluates to 0.5
double x = 2;    assigns 2.0 to x
"count = " + 4   evaluates to "count = 4"
```

mixing types

-conversions are done on one operator at a time in the order the operators are evaluated

```
3 / 2 * 3.0  + 8 / 3      5.0

2.0 * 4 / 5 + 6 / 4.0     3.1
```

mixing types

-String concatenation has the same precedence as +– and is evaluated left to right

```
1 + "x" + 4          "1x4"

"2+3=" + 2 + 3       "2+3=23"

   1 + 2 + "3"       "33"

"2*3=" + 2 * 3       "2*3=6"

   4 - 1 + "x"       "3x"

   "x" + 4 - 1       error
```

type casting

- **type casting** tells Java to convert one type to another
  - uses:
    - *convert an* `int` *to a* `double` *to force floating-point division*

```
double average = (double) 12 / 5;
```

    - *truncate a* `double` *to an* `int`

```
int feet = (int) (28.3 / 12.0);
```

assignment operators

-basic assignment operator

```
=
```

-combined assignment/arithmetic operators

```
+=, -=, *=, /=
```

-increment/decrement operators can be stand-alone statements

```
i++;
i--;
++i;
--i;
```

```
int i = 3;
int j = i++;
System.out.println(i+" "+j);

int i = 3;
int j = ++i;
System.out.println(i+" "+j);
```

relational and logical ops

-results are always `boolean`

-relational ops supported for number and character types (and equality for `boolean`)

`>, <, >=, <=, ==, !=`

-logical ops supported for `boolean`

`&&, ||, !`

-precedence (all lower than arithmetic):

`>, <, >=, <=`	: highest
`==, !=`	: high
`&&`	: low
`||`	: lowest

control flow

- **control flow** determines how programs make decisions about what to do, and how many times to do it
  - decision making : `if-else, switch-case`
  - looping : `for, while, do-while`
  - jumping : `break, continue, return`
  - exceptions : `try-catch, throw`

switch statements

-similar to an `if-else-if` statement

```
switch(integer expression)
{
  case <integer literal>:
    list of statements…

  case <integer literal>:
    …
}
```

switch statements

-execution begins on the ___ `case` that matches the value of the switch variable

-execution continues until _____ is reached

-even continues through other cases!

-usually want a `break` after every case

-switches can use the `default` keyword

-if no cases were hit, execute the `default` case

-similar to an `else` at the end of a long line of `if-else-if`

exceptions

-an `exception` is a special event that interrupts the control of the program

-exceptions are “thrown” explicitly by the code

-use a `try` block to wrap any code that might `throw` an exception

-a `catch` block immediately follows a `try` block

-execution of the program jumps inside the `catch` block if an exception occurred within the `try` block

```
try
{
  FileReader in = new FileReader(“fakefile.txt”);
}
catch(FileNotFoundException e)
{
  System.out.println(“file does not exist”);
}
catch(Exception e) // a less specific error occured
{
  System.err.println(e.getMessage());
}
```

throwing exceptions

```
if(arraySize < 0)
  throw new NegativeArraySizeException();
arr = new int[arraySize];
```

-why don't we need an `else`?

-there are many many subclasses of exceptions…

-you can even define your own!

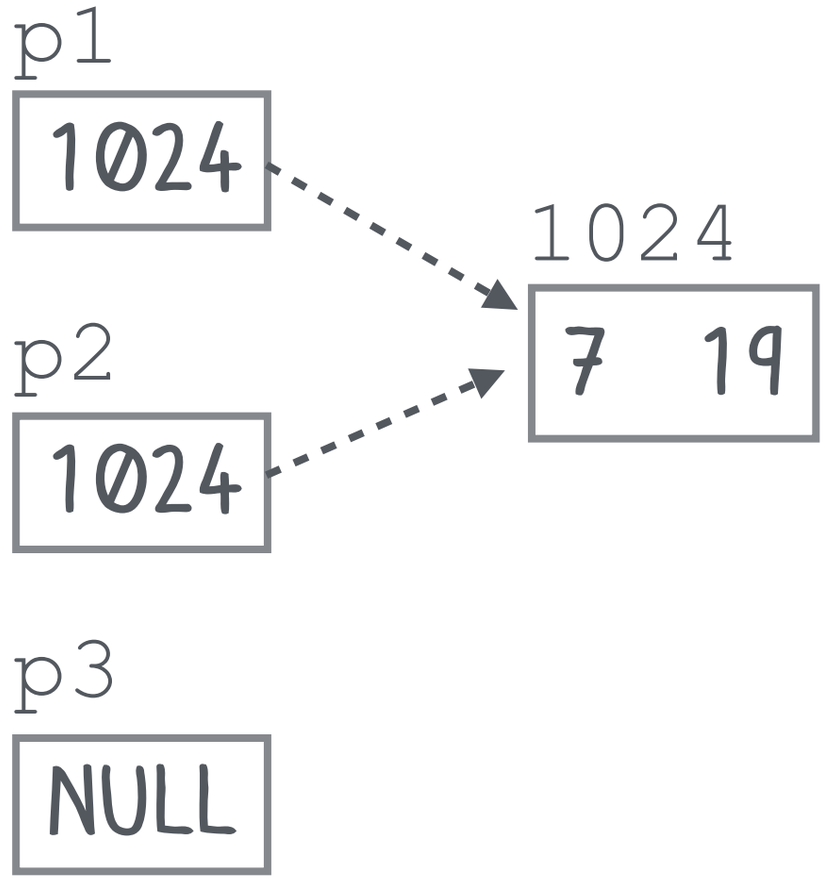
```
public class BadnessOccurred extends Exception
{ … }
```

reference types

-all non-primitive types are **reference types**

-a **reference** is a variable that stores the memory address where an object (a group of values) resides

```
Point p1, p2, p3;
p1 = new Point(7,19);
p2 = p1;
```



reference declaration

-declaration of a reference variable only provides a name to reference an object — *it does not create an object*

-after `Point p1;` the value stored in `p1` is _____

-the `new` keyword is used to construct an object

```
Point p1 = new Point();
Point p2;
p2 = new Point();
```

-why are `()` needed?

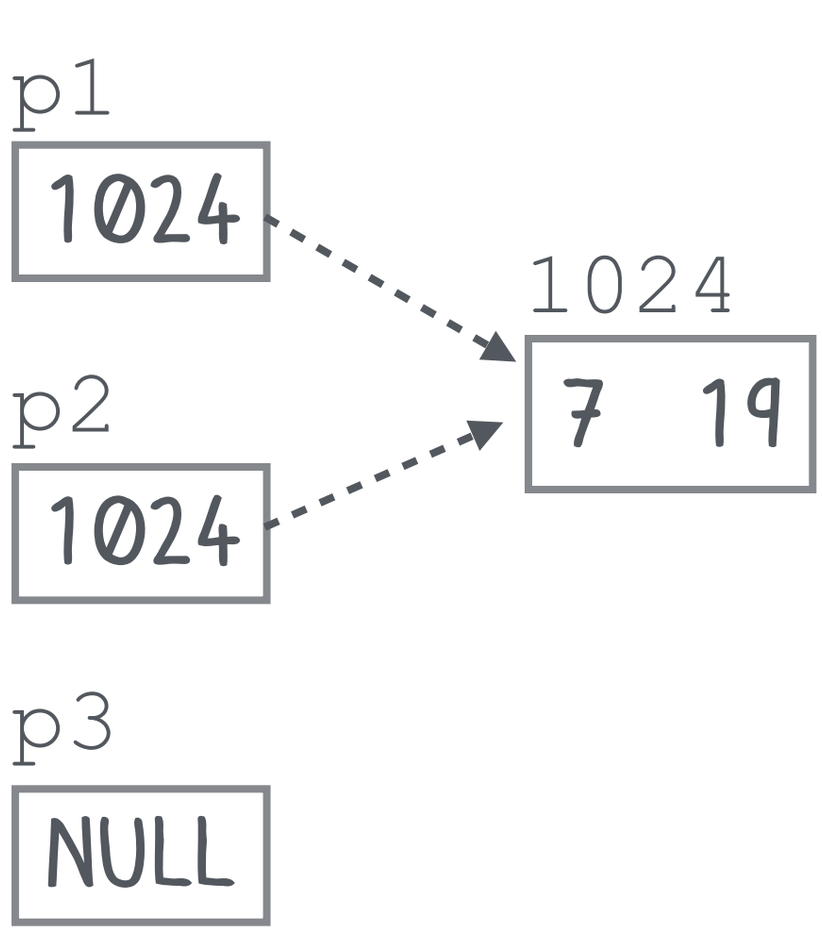
operations on reference types

-operations on references: `=, ==, !=`

-equality operators compare addresses

-what does `p2 == p1` return?

```
Point p1, p2, p3;
p1 = new Point(7,19);
p2 = p1;
```

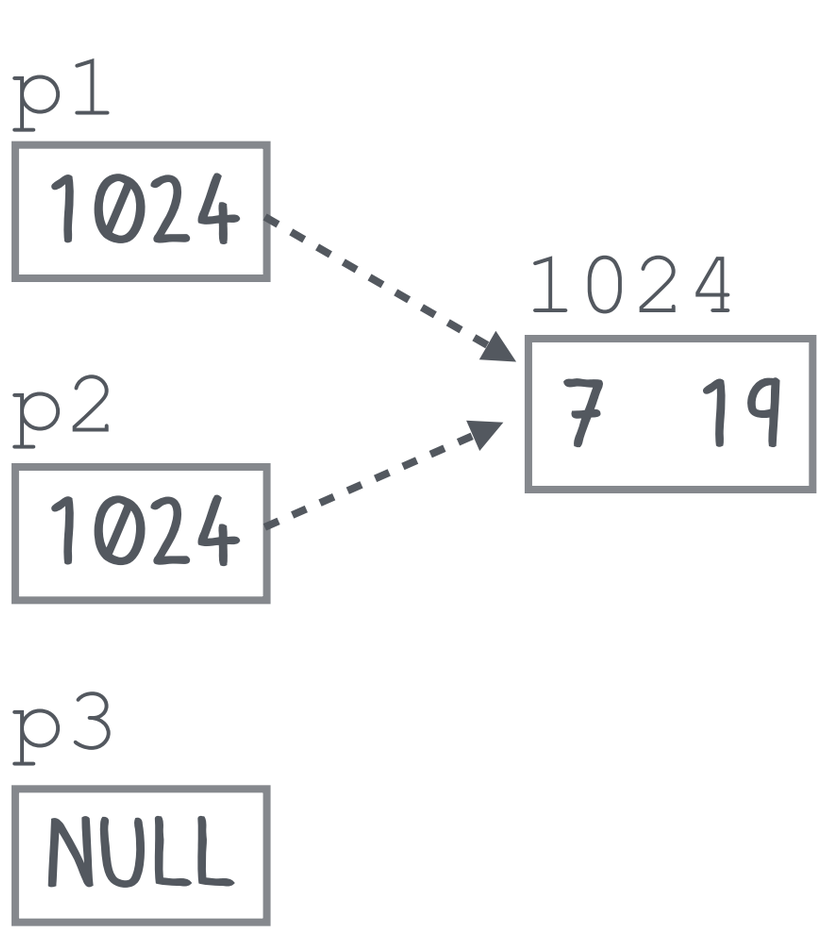


operations on reference types

-operations on objects: `.`, `instanceof`

-the . operator is used to select a method that is applied to an object, or an individual component of an object

```
Point p1, p2, p3;
p1 = new Point(7,19);
p2 = p1;
```



what does `p3.firstValue()` return?

what does `p1 instanceof Point` return?

`String`

-`String` is the only reference type for which operator overloading is allowed (`+` and `+=`)

-`String` objects are **immutable**

-to compare `String` objects use `equals` and `compareTo` methods — not `==`, `!=`, `<`, or `>`

  -why?

-other useful `String` methods:

  -`length`, `charAt`, `substring`

arrays

-an array is a mechanism for storing a collection of identically typed entities

-in Java, arrays behave like objects

-the `[]` operator indexes an array, accessing an individual entity — bounds checking is performed automatically

-by default, array elements are initialized `0` (primitive types) and `null` (reference types)

```
Point[] refArray = new Point[10];
double[] primArray = {3.14, 2.2, -9.8};
```

ArrayList

-the `ArrayList` class (from the Collections library) mimics an array and allows for dynamic expansion

-the `get, set` methods are used in place of `[]` for indexing

-the `add` method increases the size by one and adds a new item

-`ArrayList` may only be used with reference types

```
ArrayList<String> a = new ArrayList<String>(1);
a.set(0, “hi”);
a.add(“there”);
```

misc.

parameter passing

-Java uses **call-by-value** parameter passing

-ie. a copy is created

-what does this mean for reference types?

```
int i = 4;
modifyInt(i);
System.out.println(i);    // prints 4
```

```
Point p = new Point(1, 2);
modifyPoint(p);
System.out.println(p.x);  // prints ????
```

`main`

-when a program is run, the `main` method is invoked

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

-the parameters of `main` can be set using **command-line arguments**

-more on this later!

classes & constructors

-a **class** consists of **fields** (aka. variables) that store data and **methods** that operate on that data

-fields and methods may be **public** or **private**

-the **constructor** controls how an object is created and initialized

-multiple constructors may be defined, taking different parameters

-if none is defined, a default constructor is generated

-initializes primitive fields to `0`*, and reference fields to* `null`

THE DIFFERENCE BETWEEN **FIELD** AND **VARIABLE**:
HTTP://DOCS.ORACLE.COM/JAVASE/TUTORIAL/JAVA/NUTSANDBOLTS/VARIABLES.HTML

this

- this is a reference to the current object
  - useful in avoiding self-assignment

```
Account account1;
Account account2;
…
account2 = account1;
account1.finalTransfer( account2 );

// transfer all money from rhs to current account
public void finalTransfer( Account rhs )
{
  dollars += rhs.dollars;
  rhs.dollars = 0;
}
```

this

- `this` is a reference to the current object
  - useful in avoiding self-assignment

```
Account account1;
Account account2;
…
account2 = account1;
account1.finalTransfer( account2 );

// transfer all money from rhs to current account
public void finalTransfer( Account rhs )
{
  if ( this == rhs )
    return;
  dollars += rhs.dollars;
  rhs.dollars = 0;
}
```

next time…

-reading

  -chapters 3 & 4

-homework

  -assignment 1 up by 5pm

  -due next Thursday at 5pm

  -must complete on your own!

-no lab

  -happy MLK day!

-clicker questions start next Thursday