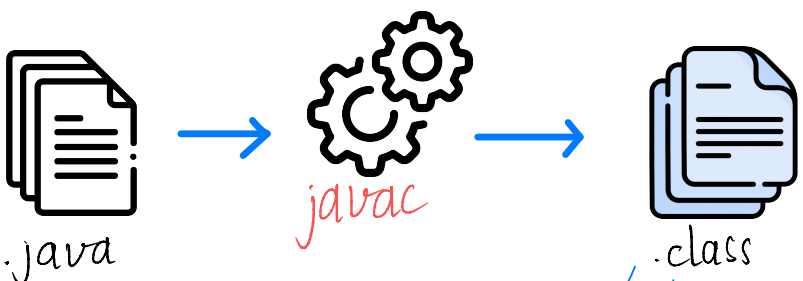
Chapter 1

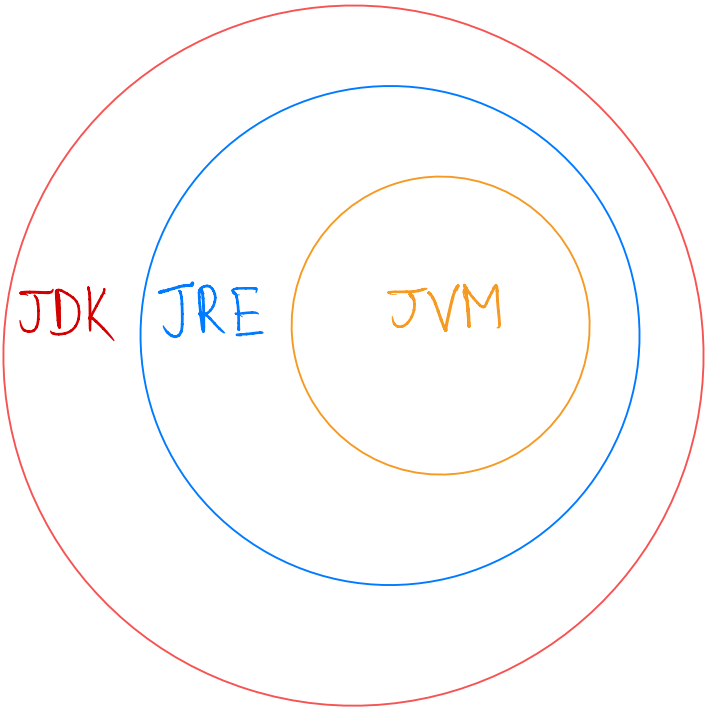
Building Blocks

Learning about the environment

Java Development Kit

- javac : convert .java source files → .class bytecode
- java : executes program
- jar : packages files
- javadoc : generates doc





Check version of Java:

javac -version

java -version

Class structure

Fields & methods

2 primary elements:

fields (variables) hold the state

methods (functions, procedures) operate on that state

method name + parameter types = method signature

```
public int numberVisitors(int month) {
    return 10;
}
```

→ signature: numberVisitors(int)

Comments

1> // Single-line comment

2> /* Multiple

* line comment

*/

3> /**

* Javadoc multiple-line comment

* @author _____

*/

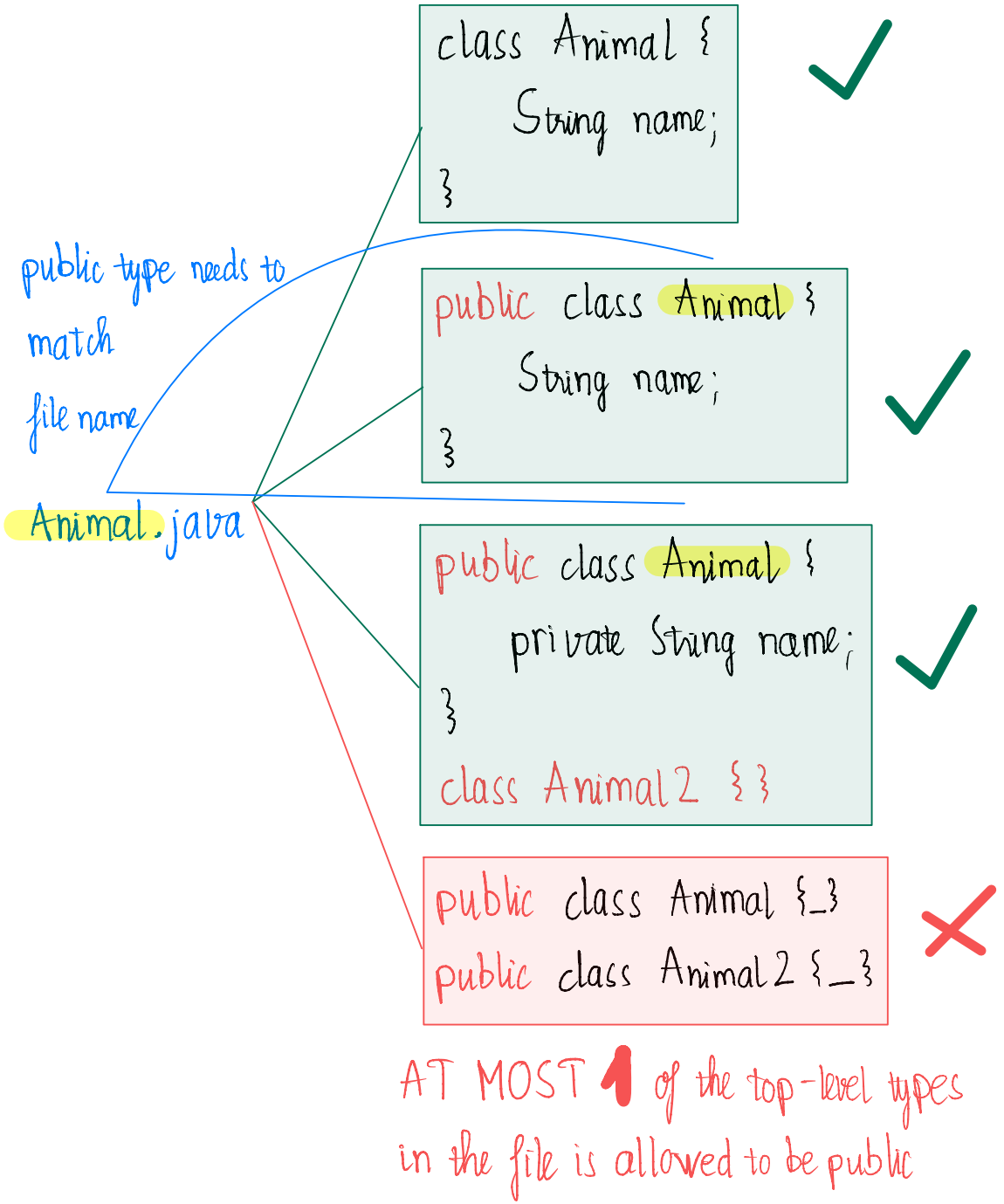
/*

* /* fish */

*/

extra */ → error

Classes & Source Files



Writing a main() Method

main() method: entry point into the program, the starting point that the JVM looks for when it begins running a new program

Create main()

Zoo.java

```
public class Zoo {
  public static void main(String[] args) {
    System.out.println(args[0]);
    System.out.println(args[1]);
  } //main() & args can be "final"
}
```

required for main()

→ javac Zoo.java

→ java Zoo

can be:

String options[]

String... friends

Passing Parameters

```
javac Zoo.java
java Zoo Bronx Zoo
```

args[0] args[1]

Output

Bronx

Zoo

```
javac Zoo.java
java Zoo "San Diego" Zoo
```

args[0] args[1]

Output

San Diego

Zoo

```
javac Zoo.java
java Zoo Zoo
```

args[0]

args[1] error: index out of bounds

Output

Zoo

Exception in thread "main" ___

```
javac ___.java
java ___ Agrs1
```

=

```
java ___.java Args1
```

launching single-file source-code program

Package declaration & import

Packages

Package name begins with:

java → came with the JDK

com.wiley.javabook → associated with "wiley.com"

Wildcards

```
import java.util.*;
```

→ only one *, must be at the end

import all classes in java.util

BUT NOT child packages, fields, or methods

java.lang (contains System class) is automatically imported

Redundant Imports

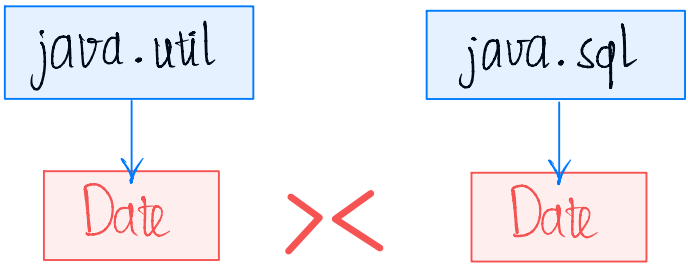
```
import java.lang.System;
import java.lang.*;
import java.util.Random;
import java.util.*;
```

→ redundant

```
import java.nio.file.Path.*;
```

cannot import methods

Naming Conflicts




```
import java.util.*;
import java.sql.*;
```

cause Date declaration to NOT compile

```
import java.util.Date;
import java.sql.*;
```

✓ default for Date

```
import java.util.Date;
import java.sql.Date;
```

✗ can't have 2 defaults

```
public class Conflicts {
   java.util.Date date;
   java.sql.Date sqlDate;
}
```

✓ fully qualified class name

Creating a new package

```
package packagea;
public class ClassA { }
```

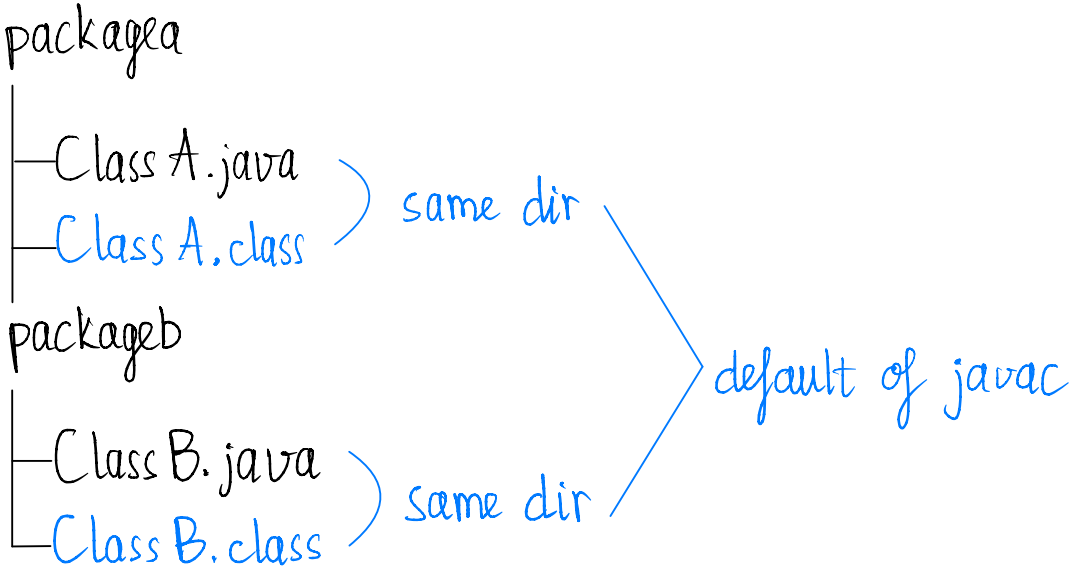
```
package packageb;
import packagea.ClassA;

public class ClassB {
  public static void main(String[] args) {
    ClassA a;
    System.out.println("Got it");
  }
}
```

```
$ javac packagea/ClassA.java packageb/ClassB.java
$ java packageb.ClassB
```

or: `$ javac packagea/*.java packageb/*.java`

can't include subdirectories



Compiling to another directory

Important javac options

-cp <classpath> or -classpath <classpath> or --class-path <classpath>	Location of classes needed to compile the program
-d <dir>	Directory in which to place generated class files

Important java options

-cp <classpath>	Location of classes needed to run the program
or -classpath <classpath>	
or --class-path <classpath>	

```
$ javac -d classes packagea/ClassA.java
        packageb/ClassB.java
$ java -cp classes packageb.ClassB
```

```
packagea
├─ClassA.java
packageb
├─ClassB.java
classes
├─packagea
│ └─ClassA.class
└─packageb
  └─ClassB.class
```

Compiling with JAR files

```
java -cp ".;C:\temp\otherLocation;C:\temp\myJar.jar"
    myPackage.MyClass
```

```
java -cp ".:/tmp/otherLocation:/tmp/myJar.jar"
    myPackage.MyClass
```

. → includes the current dir

;/: → separates parts of the classpath

```
java -cp "C:\temp\dirWithJars\*" myPackage.MyClass
```

add all JARs in dirWithJars
BUT NOT in subdirs of dirWithJars

Creating a JAR file

Important jar options

-c or --create	creates a new JAR file
-v or --verbose	prints details when working with JAR files
-f (or --file) <fileName>	JAR filename
-C <dir>	dir containing files to be used to create the JAR

```
jar -cvf myNewFile.jar
jar --create --verbose --file myNewFile.jar
jar -cvf myNewFile.jar -C dir
```

Ordering elements in a class

Element	Example	Required?
Package declaration	package abc;	✗
import statements	import java.util.*;	✗
Top-level type declaration	public class C	✓
Field declarations	int value;	✗
Method declarations	void method()	✗

```
/* header */

package structure;

// class Meerkat
public class Meerkat {}
```

```
import java.util.*;
package structure;
String name;
public class Meerkat {}
```

PIC
- package
- import
- class

Creating Objects

Calling Constructors

```
public class Chick {
  public Chick() {
    System.out.println("in constructor");
  }
}
```

match class's name

no return type

Executing Instance Initializer Blocks

```
public class Bird {
  public static void main(String[] args) {
    { System.out.println("Feathers"); }
  }
  { System.out.println("Snowy"); }
}
```

class definition

method declaration

inner block

instance initializer (appear **OUTSIDE** a method)

Following the Order of Initialization

- Fields & instance initializer blocks are run in the order in which they appear in the file
- The constructor runs after all fields & instance initializer blocks have run

```
public class Chick {
  private String name = "Fluffy"; 2
  { System.out.println("setting field"); } 3

  public Chick() {
    name = "Tiny"; 4
    System.out.println("setting constructor");
  }                                    5

  public static void main(String[] args) {
    Chick chick = new Chick(); 1
    System.out.println(chick.name); } } 6
```

Output

```
setting field
setting constructor
Tiny
```

```
{ System.out.println(name); }
private String name = "Fluffy";
```

Understanding Data Types

Primitive Types

the bit size depends on the JVM

Keyword	Type	Min value	Max value	Default value	Example
boolean	true or false	n/a	n/a	false	true
byte	8-bit integral value	-128	127	0	123
short	16-bit integral value	-32,768	32,767	0	123
int	32-bit integral value	-2,147,483,648	2,147,483,647	0	123
long	64-bit integral value	-2^{63}	$2^{63}-1$	0L	123L (or l)
float	32-bit floating-point value	n/a	n/a	0.0f	123.45f (or F)
double	64-bit floating-point value	n/a	n/a	0.0	123.456
char	16-bit Unicode value	0	65,535	\u0000	'a'

(suffix won't be printed)

Octal (digits 0-7): 017

Hexadecimal (digits 0-9 + letters A-F/a-f):

0xFF, 0xff, 0XFf (case insensitive)

Binary (digits 0-1): 0b10, 0B10

Underscores

CAN'T be added at
- the beginning/end of a literal
- right before/after a decimal point

```
double notAtStart = _1000.00;
double notAtEnd = 1000.00_;
double notByDecimal = 1000_.00;
```

✗

```
double annoyingButLegal = 1_00_0.0_0;
double reallyUgly = 1_____2;
```

✓

Reference Types

A reference "points" to an object (an instance of a class) by storing the memory address where the object is located.

- A reference can be assigned to another object of the same or compatible type.
- A reference can be assigned to a new object using the "new" keyword.

Primitive	Reference
Lowercase type names	Uppercase type names (not required, standard only)
Don't have methods declared on them	Can be used to call methods (when not null)
Can NOT be assigned null	Can be assigned null

Wrapper Classes

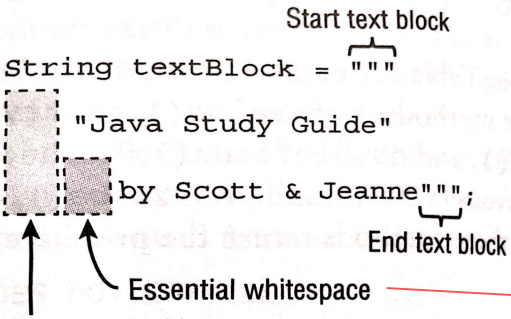
Primitive type	Wrapper class	Wrapper class inherits Number?	Example of creating
boolean	Boolean	No	Boolean.valueOf(true)
byte	Byte	Yes	Byte.valueOf((byte) 1)
short	Short	Yes	Short.valueOf((short) 1)
int	Integer	Yes	Integer.valueOf(1)
long	Long	Yes	Long.valueOf(1)
float	Float	Yes	Float.valueOf((float) 1.0)
double	Double	Yes	Double.valueOf(1.0)
char	Character	No	Character.valueOf('c')

```
Double apple = Double.valueOf("200.99");
System.out.println(apple.byteValue());   // -56
System.out.println(apple.intValue());    // 200
System.out.println(apple.doubleValue()); // 200.99
```

valueOf() → reference type

parse_() → primitive type

Text Blocks



Part of String

make the code easier to read

Output

```
"Java Study Guide"
 by Scott & Jeanne
```

```
String pyramid = """
        *
       * *
      * * *
    """
    );
System.out.print(pyramid);
```

Output

```
        *
       * *
      * * *
(empty line)
```

4 lines

Formatting	Meaning in regular String	Meaning in text block
\"	"	"
\"""	n/a – Invalid	"""
\"\"\"	"""	"""
Space (at end of line)	Space	Ignored
\s	Two spaces (\s is a space and preserves leading space on the line)	Two spaces
\ (at end of line)	n/a – Invalid	Omits new line on that line


```
String block = """doe""";
```

no line break after the opening """

```
String block = """
    doe \
    deer""";
```

```
doe  deer
```

1 line

```
String block = """
    "doe\"\"\"
    \"deer\"""
    """;
System.out.print("*" + block + "*");
```

```
* "doe"""
  "deer"""
*
```

Declaring Variables

Identifying Identifiers

An identifier is the name of a variable, method, class, interface, or package

4 RULES

- must begin with a letter / currency symbol ($, ¥, etc.) / _ symbol
- can include numbers
- a single _ is NOT allowed
- can NOT use Java reserved words

abstract	assert	boolean	break	byte
case	catch	char	class	const*
continue	default	do	double	else
enum	extends	final	finally	float
for	goto*	if	implements	import
instanceof	int	interface	long	native
new	package	private	protected	public
return	short	static	strictfp	super
switch	synchronized	this	throw	throws
transient	try	void	volatile	while

* The reserved words const and goto aren't actually used in Java. They are reserved so that people coming from other programming languages don't use them by accident—and, in theory, in case Java wants to use them one day.

```
long okidentifier;
float $OK2Identifier;
boolean _alsoOK1dentifi3r;
char __SStillOkbutknotsonice$;
```

```
int 3DPointClass;
byte hollywood@vine;
String *$coffee;
double public;
short _;
```

@, * are not in the allowed list

Declaring Multiple Variables

```
void paintFence() {
  int i1, i2, i3 =0;
}
```

only i3 was initialized

```
int num, String value;
```

different types in the same statement

Initializing Variables

Creating Local Variables

Local variables: defined within a constructor, method, or initializer block

```
final int y = 10;
int x = 20;
y = x + 10; // Error
```

```
final int[] favoriteNumbers = new int[10];
favoriteNumbers[0] = 10;
favoriteNumbers[1] = 20;
favoriteNumbers = null //Error
```

```
public int notValid() {
    int y = 10;
    int x; // not have a default value
    int reply = x + y; // Error
    return reply;
}
```

```
public int valid() {
    int y = 10;
    int x;
    x = 3;
    int z;
    int reply = x + y;
    return reply;
}
```

Local variables do not have a default value & must be initialized before use

Passing Constructor & Method Parameters

```
public void findAnswer(boolean check) {}

public void checkAnswer() {
   boolean value;
   findAnswer(value); // DOES NOT COMPILE
}
```

Instance & Class Variables

- An instance variable (a field) is a value defined within a specific instance of an object.
- A class variable is one that is defined on the class level & shared among all instances of the class.

* Don't need initializing
* Be given a default value as soon as we declare

Inferring the Type with var

```
public class Zoo {
   public void whatTypeAmI() {
      var name = "Hello";
      var size = 7;
   }
}
```

Only used for **LOCAL** variables

Not used in a multi-variable assignment

```
public void reassignment() {
   var number = 7;
   number = 4;
   number = "five"; // Error
}
```

the type is set once at compile time & does not change

```
public void doesThisCompile(boolean check) {
    var question; // Error
    question = 1;
    var answer; // Error
    if (check) {
        answer = 2;
    } else {
        answer = 3;
    }
    System.out.println(answer);
}
```

question & answer are not assigned values on the lines where they are defined

⇒ the compiler doesn't know what to make of them

```
public void twoTypes() {
    int a, var b=3; //Error
    var n=null; // Error
}
```

NULL is not allowed for var (null could be any reference type)

```
public int add(var a, var b){
    return a+b;
}
```

not used for method params

```
public class Var {
    public void var() {
        var var = "var";
    }
    public void Var() {
        Var var = new Var();
    }
}
```

var is not a reserved word & allowed to be used as an identifier

var is considered a reserved TYPE NAME (cannot be used to define a type, such as a class, interface, or enum)

Managing Variable Scope

Limiting Scope

```
public void eatIfHungry(boolean hungry) {
  if (hungry) {
    int bitesOfCheese = 1;
    {
      var teenyBit = true;
      System.out.println(bitesOfCheese);
    }
  }
  System.out.println(teenyBit); //Error
}
```

Applying Scope to Classes

```
public class Mouse {
   final static int MAX_LENGTH = 5;
   int length;
   public void grow(int inches) {
      if(length < MAX_LENGTH) {
         int newSize = length + inches;
         length = newSize;
      }
   }
}
```

stays in scope until the program ends

stays in scope as long as this Mouse object exists

Destroying Objects

Garbage Collection

refers to a process of automatically freeing memory on the heap by deleting objects that are no longer reachable in your program

eligible for garbage collection refers to an object's state of no longer being accessible in a program & therefore able to be garbage collected

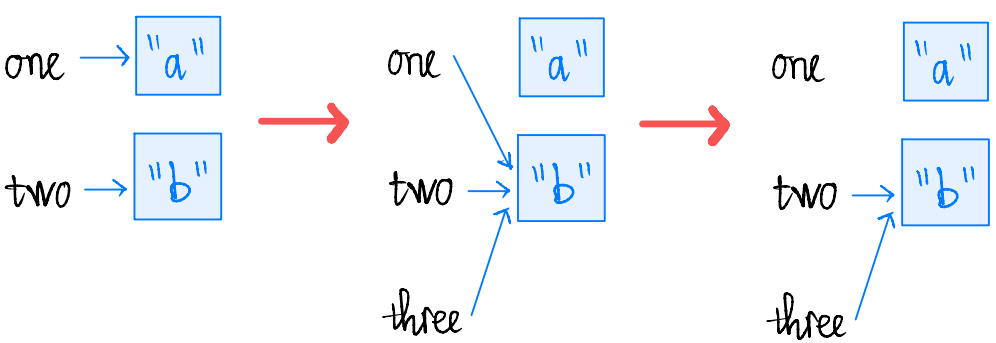
Tracing Eligibility

An object will remain on the heap until it is no longer reachable:

- The object no longer has any references pointing to it.
- All references to the object have gone out of scope.

> Garbage collection is **NEVER** guaranteed to run

```
public class Scope {
  public static void main(String[] args) {
    String one, two;
    one = new String("a");
    two = new String("b");
    one = two; // "a" is eligible for g.c.
    String three = one;
    one = null;
  }}
```



Review Questions

1/ D E ✓

2/ C D E ✓

3/ A E ✓

4/ B E G ✓

5/ A D F ✓

6/ F ✓

7/ C E ✓

8/ B D ~~H~~ **E** (1/0 is runtime exc.)

9/ E ✓

10/ A E F ✓

69,6%

11/ ~~D~~ **E** (in the same package)

12/ A C D ✓

13/ A B C ✓

14/ A B D E ✓

15/ C E F ✓

16/ A D ~~F~~ (incidental indentation)

17/ D F ~~H~~ **G** (not print f suffix)

18/ B C F ✓

19/ A **D** (parseLong → primitive)

20/ ~~H~~ **C** (long age; age = 1200; ok)

21/ D ✓

22/ C F G ✓

23/ D ~~H~~ **A** (double doesn't fit float)