# COMP 250

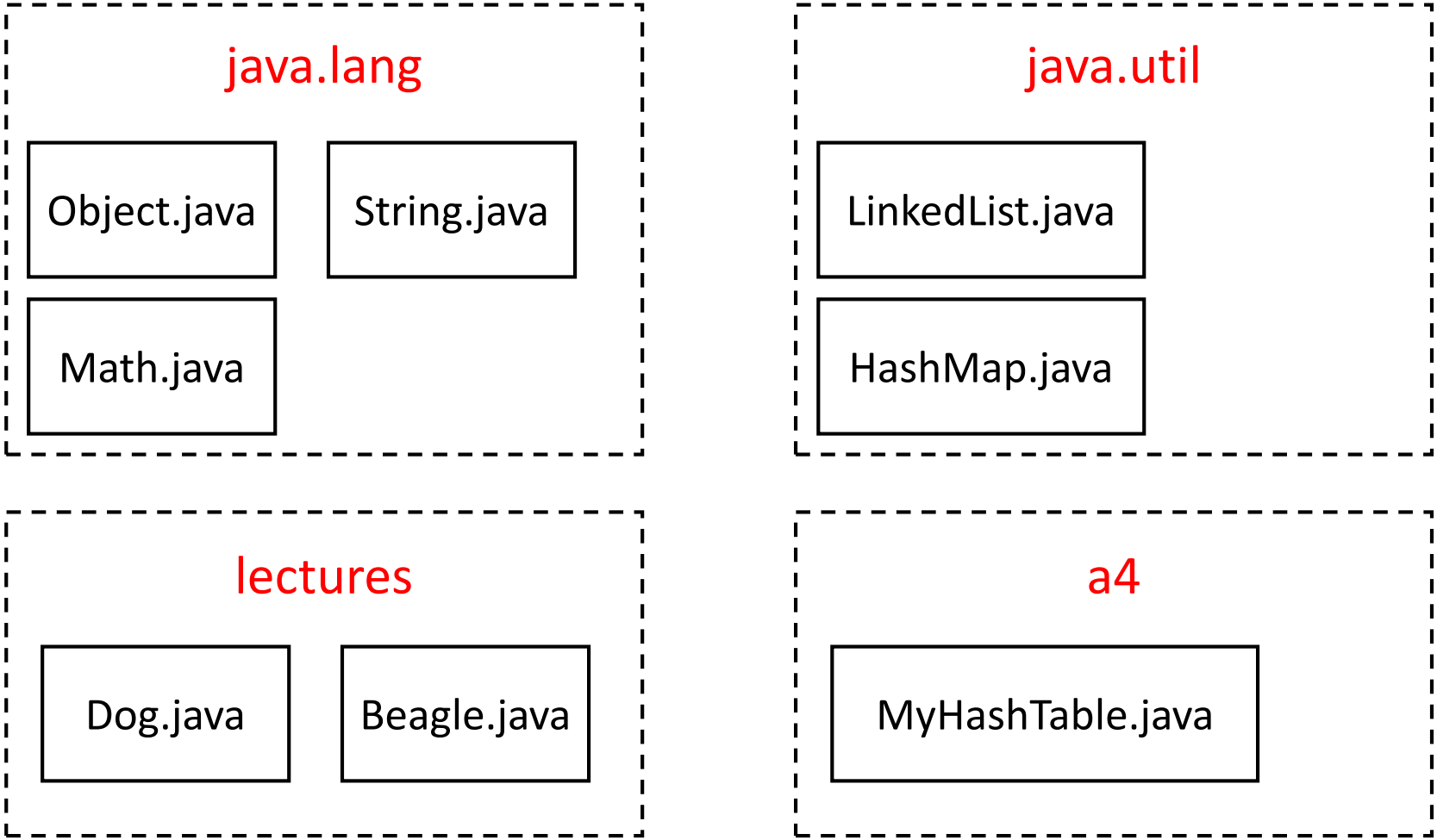
Lecture 36

# modifiers

- public, private
- static, final

Dec. 1, 2017

# Packages


java.lang
Object.java
String.java
Math.java
java.util
LinkedList.java
HashMap.java
lectures
Dog.java
Beagle.java
a4
MyHashTable.java

# visibility/access modifiers

- public
- package (default, so not a reserved word)
- protected (not discussed today)
- private

These modifiers can be for a class, or a class member i.e. method or field.

```
package lectures
public class Dog{
        :
}
```

```
package a3
class WordTree{
        :
        Dog   dog;
        :
}
```

Q: Does the compiler allow this?

A:

```
package lectures
public class Dog{
        :
}
```

```
package a3
class WordTree{
        :
        Dog   dog;
        :
}
```

Q: Does the compiler allow this?

A: Yes, because Dog is public.

```
package lectures
public class Dog{
        :
}
```

```
package a3
class WordTree{
        :
        Dog   dog;
        :
}
```

I did not write visibility modifier(s) on right side because they are irrelevant here. I am asking about the visibility of the Dog class on the left.

```
package lectures
~~public~~ class Dog{
        :
}
```

```
package a3
class WordTree{
        :
        Dog   dog;
        :
}
```

Q: Does the compiler allow this?

A:

```
package lectures
~~public~~ class Dog{
        :
}
```

```
package a3
class WordTree{
        :
        Dog   dog;
        :
}
```

Q: Does the compiler allow this?

A: No, because Dog class has package visibility only.

```
package lectures
public class Dog{
        :
}
```

```
package demo
class Husky extends Dog{
        :
}
```

Q: Does the compiler allow this?

A:

```
package lectures
public class Dog{
        :
}
```

```
package demo
class Husky extends Dog{
        :
}
```

Q: Does the compiler allow this?

A: Yes, because Dog class has public visibility.

```
package lectures
~~public~~ class Dog{
        :
}
```

```
package demo
class Husky extends Dog{
        :
}
```

Q: Does the compiler allow this?

A:

```
package lectures
~~public~~ class Dog{
        :
}
```

```
package demo
class Husky extends Dog{
        :
}
```

Q: Does the compiler allow this?

A: No, because Dog class has package visibility only.

```
public class Dog{
    public String name;
    public  Dog() {…}
}
```

```
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = “Buddy”;
    }
}
```

Q: Does the compiler allow this ?

A:

```
public class Dog{
    public String name;
    public  Dog() {…}
}
```

```
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = “Buddy”;
    }
}
```

Q: Does the compiler allow this ?

A: Yes, since name is public.

```
package lectures
public class Dog{
    public String name;
    public  Dog() {…}
}
```

```
package demo
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = "Buddy";
    }
}
```

Q: Does the compiler allow this ?

A:

```
package lectures
public class Dog{
    public String name;
    public  Dog() {…}
}
```

```
package demo
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = "Buddy";
    }
}
```

Q: Does the compiler allow this ?

A: No, since Dog.name has package visibility only.

```
package lectures
public class Dog{
    public String name;
    public  Dog() {…}
}
```

```
package lectures
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = "Buddy";
    }
}
```

Q: Does the compiler allow this ?

A: Yes, since Dog.name has package visibility and now the two classes are in the same package.

```
package lectures
public class Dog{
    private String name;
    public  Dog() {…}
}
```

```
package lectures
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = “Buddy”;
    }
}
```

Q: Does the compiler allow this ?

A:

```
package lectures
public class Dog{
    private String name;
    public  Dog() {…}
}
```

```
package lectures
class Person {
        :
    main() {
        Dog  myDog = new Beagle();
        myDog.name = “Buddy”;
    }
}
```

Q: Does the compiler allow this ?

A: No, since name is private.

# Getter and Setter methods

Java class fields are typically private.

Getters = “accessors” // don’t change field values

Setters = “mutators” // change field values

```
public  class   Dog {
        private  String  name;

        public  Dog(){   }

        public  String  getName( String name){
                this.name = name;
        }

        public   void   setName( String name){
                this.name = name;
        }
}
```

*This is the typical way to do things.*

```
public  class   Dog {
        public  String  name;

        public  Dog(){  }
}
```

Q:  What is the problem with making the field public ?

How could it possibly matter which of these you use?

```
        public   name;

        public   void   setName( String name){
                this.name = name;
        }
```

```
public class Dog {
    public String name;

    public Dog(){ }
}
```

Q: What is the problem with making the field public ?

A: If you use the setter on the previous slide, then it doesn't matter!

But suppose some client program has the following:

```
Dog    myDog        =  new Dog();
       myDog.name   =  "&$(!";
```

You probably don't want to allow that.

```
public  class   Dog {
        private  String  name;

        public  Dog(){ }

        public  void    setName( String name){
              //  verify that name obeys some rules
        }

        public  String  getName( String name){
              //   now needed also
        }
}
```

*Thus,  using setter methods gives you more control over what clients can do.*

*And if you make the field private,  then you need a getter too.*

Ever noticed…? You cannot define visibility modifiers for a local variable within a method.

```
public class  Beagle {
            :
        private  Person  owner;

        Beagle()  { ….}

        public   hunt( ){
                Rabbit    rabbit = new Rabbit();
                        :
        }
        public  Person  getOwner(){
                return owner;}
        }
}
```

Ever noticed…? You cannot define visibility modifiers for a local variable within a method.

```
public class  Beagle {
            :
        private  Person  owner;

        Beagle()  { ….}

        public   hunt( ){
            Rabbit    rabbit = new Rabbit();
                :
        }
        public  Person  getOwner(){
            return owner;}
        }
}
```

*It is a scope issue. Other methods in this class (or other classes) cannot reference this variable.*

# Class Descriptors

Methods are here

Dog

class descriptor

Beagle

class descriptor

TestProgram

class descriptor

# Call Stack

Local variables and parameters of methods are here

hunt()
this
Rabbit rabbit

Test.main()

# Objects

Instance fields are here

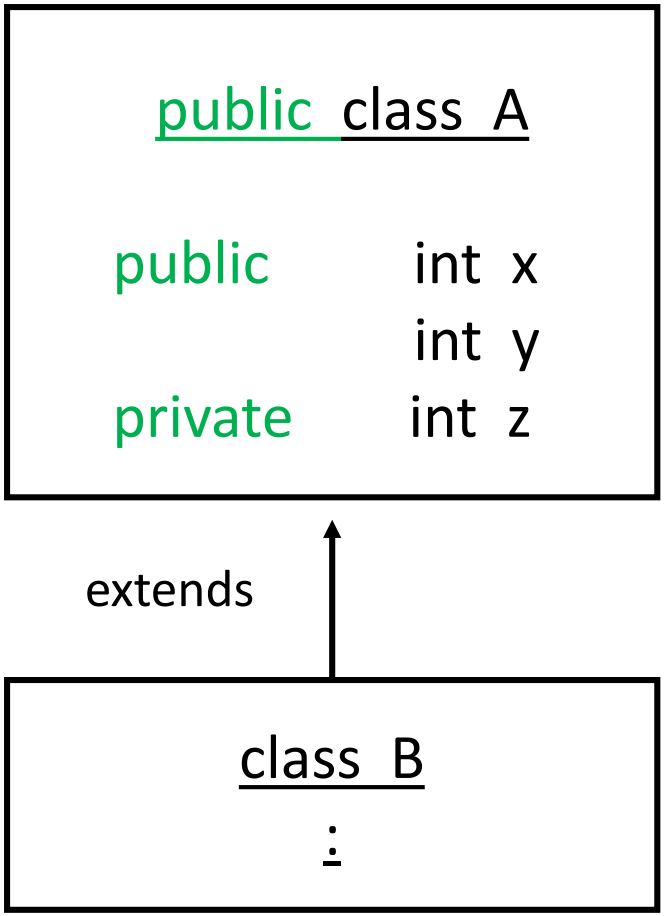
Beagle object

Person owner

Rabbit object

Person object

# visibility and inheritance




Q: Which of the variables in class A are inherited by class B ?

A: All three x, y, z are inherited.

```
public class A {
    public      int  x;
                int  y;
    private     int  z;

        :
}
```

```
class B  extends  A {
        B( ...,   int z)  {
                  :
                this.z  = z;
        }

}
```

Q: Does the compiler allow this ?

A: No. Variable z is not visible in B since it declared as private in A.

```
public class A {
    public      int  x;
                int  y;
    private     int  z;

    A(){ … };

        :

    public  int getZ{
        return  z;
    }

    public void   setZ( int z){
        this.z  = z;
    }
}
```

```
class B  extends  A {
        B( …,    int z)  {
                  :
                setZ(z);
        }

}
```

package java.util

```
public class LinkedList
⋮
```

extends

package lectures

```
class MySpecialLinkedList
```

We can extend any public class (even across packages)

package java.util

public class LinkedList

⋮

extends

package lectures

class MySpecialLinkedList

package a3

class WordTree

⋮

extends

package lectures

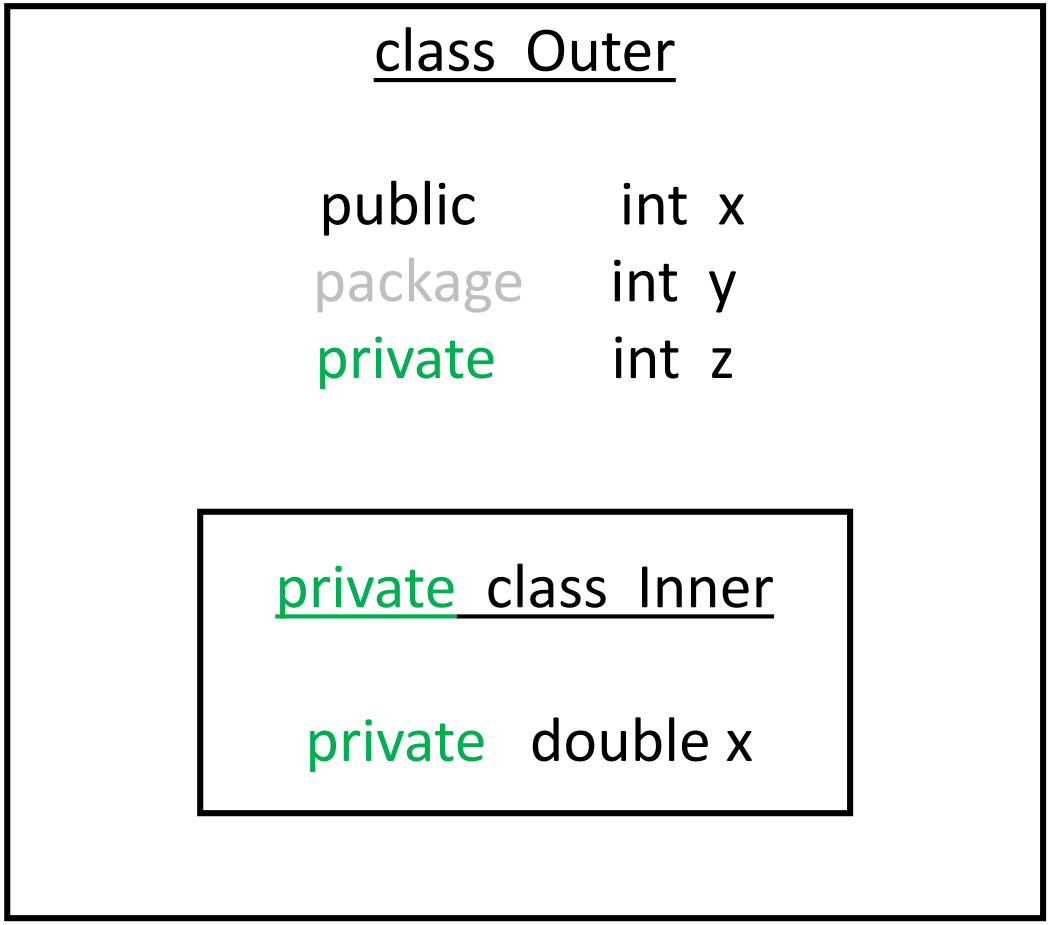
class Rectangle

We can extend any public class (even across packages)

Not allowed, since WordTree isn't visible.

**ASIDE:** Inner classes are a bit tricky.

(Recall SLinkedListIterator.)




Outer and Inner have access to all fields of each other.

*Details omitted.*

# COMP 250

Lecture 36

# modifiers

- public, private
- static, final

Dec. 1, 2017

# static fields and methods

```
class  Dog{
    String name;
    static   int  numDogs = 0;     //   a.k.a.  class field

    Dog(){  ..
        numDogs ++;
    }
    static  int  getNumDogs( ) {
        return  numDogs;
    }
}
```

# Class Descriptors

*All* methods are here

Static fields are here.

Dog

class descriptor

static int numDogs
static Dog queenDog
static Dog kingDog

Beagle

class descriptor

TestProgram

class descriptor

# Call Stack

Local variables and parameters of methods are here

bark()

Test.main()

# Objects

Instance fields are here

Beagle object

other objects

A method is static if it is not invoked by an object.

```
class  Test {
      public  int   methodA( ) {  .....  }
      public   static  void  main ( ) {   ...  }
}
```

# final modifier

```
final class Dog{
        :
}

class  Beagle  extends  Dog {          //  not allowed
       :
}
```

e.g.  Java.lang.{String, Math, ..}

```
class Dog{
    void  final   bark(){ …}
}


class Beagle extends Dog {
        void  bark(){ ….  }            //  not allowed
                                       //   compiler  error
}
```

```
class Dog{
    Dog  final  myDog;

    public static void main(){
        myDog  =  new  Beagle("Buddy");
            :
        myDog  =   new  Poodle("Willie");
          //  not allowed  (compiler error)
     }
}
```

# static + final modifiers

```
public final class Math{      //  static classes only allowed
                              //  as inner classes

        public  static  final  double   PI = 3.14…;
        public  static  final  double   E  = 2.71…;

        public  static  double sqrt( double x) { ….}
}

//  We need to say  Math.PI   since there is no Math object.
```

# Next Week

- Monday : Grad School
- Wed./Thurs. : Final exam & Beyond COMP 250