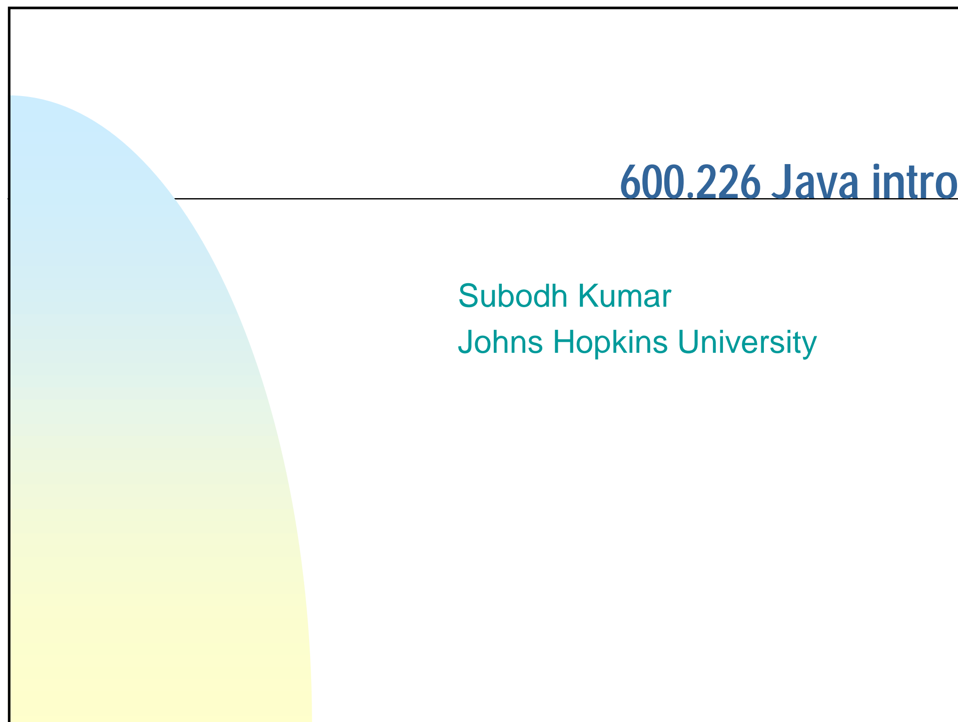
600.226 Java intro
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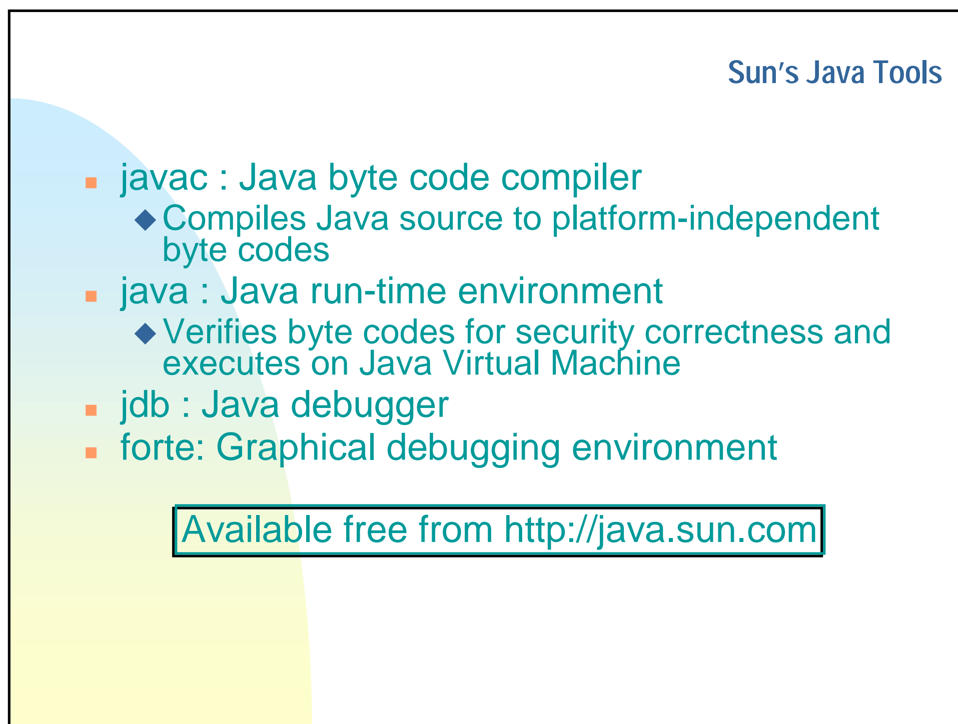

Sun's Java Tools
javac : Java byte code compiler
Compiles Java source to platform-independent byte codes
java : Java run-time environment
Verifies byte codes for security correctness and executes on Java Virtual Machine
jdb : Java debugger
forte: Graphical debugging environment
Available free from http://java.sun.com

Java: A high level objected oriented programming language

- Object Oriented language; like C++
  - Class, Object, method
  - No */& address ops
  - No free/delete/malloc
- Architecture independent
- In-built:
  - Graphics
  - Networking
  - Thread management
  - Garbage collection
  - Error/Exception handling Handling

Some Shortcomings

- Rather slow compared to fully-compiled code
  - Changing with on-the-fly compilation technology
- Some unavoidable space inefficiencies
- Difficult to take advantage of platform-specific features

Polymorphism

- Ability of variable to take on many forms
  - Class variable may contain exact class or any descendent
  - Interface variable may contain any class implementing the interface
- Allows for greater modularity

Using Inheritance

- Specialization
  - Override some parent methods
    - Refinement: call parent method and then do more
    - Replacement: just do something different
  - Handle differences in behavior between parent and child
- Extension
  - Add to the functionality of parent by adding new data and behaviors
- (Real examples often do some of both)

Primitive Types

boolean	true or false
char	16-bit Unicode character
byte	8-bit signed integer
short	16-bit signed integer
int	32-bit signed integer
long	64-bit signed integer
float	32-bit floating point
double	64-bit floating point

Differences from C++

- boolean true and false do not have integer equivalents
- char is not a byte, but a 16-bit Unicode
- No unsigned integer types (so byte goes to 128, not 256)
- All types have specified size

Classes

- Combine *fields* (variables) and *methods* (procedures)
- Fields and methods accessed by . (dot) operator

```
class MyClass {
  static int numInstances=0;
  protected int somethingImportant;
  public int tellAll() {
    return somethingImportant;
  }
}

MyClass myVar = new MyClass;
System.out.println(MyClass.numInstances + ", " +
   myVar.tellAll());
```

Declaring Classes

```
public class  Gnome {
// body
}
```

Extended/instantiated within package / by importer

otherwise only within the package

```
abstract class Gnome { }
```

Only abstract methods

```
final class Gnome { }
```

No subclasses allowed

Local variables

```
class  Gnome {
// Instance Variables
public Tot[] tots;              // class Tot is visible here.
                                // tot1 is exported with Gnome
protected String name;          // Visible to package and
                                //  sub-classes
private int age;                // Visible Only within the class
static final int NTOT = 2;      // Visible within package
                                // Value can't be changed
// Methods
}
```

Methods

```
abstract class  Gnome {
// Instance Variables

// Methods
  public abstract void hiFunda(int party);
  final int getAge() {
    return age;
  }
// May be public, protected, private
// static, final, and abstract (if the class is abstract)
}
```

Fields

Modifiers

- static : affects instantiation
- public, protected, private : affect visibility
- final : makes field a constant
- synchronized : used for multithreading

Field Instantiation

- Class fields
  - static - only one per class
  - May be accessed without a class variable
    - <classname>.<static field>
      - e.g. Math.PI
- Instance fields
  - non-static - one per class instance

Field and Method Visibility

public, protected, private, or “package” (default)

Accessible to:	public	protected	package	private
same class	yes	yes	yes	yes
class in same package	yes	yes	yes	no
subclass in different package	yes	yes	no	no
non-subclass, different package	yes	no	no	no

Methods

- Modifiers
  - Same as fields, plus abstract
- May be overloaded (methods with same name)
  - Must have different signatures (defined by parameter type sequence)
- `static` methods cannot access instance variables
- `this` provides reference to class instance
  - Can be passed as parameter to another method
  - Can disambiguate class fields from parameters

Instance initialization: Constructors

```
class  Gnome {
// Constructor Method
  public Gnome (String x) {
     name = x;
     tots = new Tots[NTOT];
  }
// May be public, protected, private
// static, final, abstract not allowed
}
Usage: Gnome gnome1 = new Gnome("Baital")
```

Initialization/Constructors

Initialization performed when class is *instantiated* by:

`new <class>[(params)]`

- Fields initialized to specified values or to defaults according to type
- Constructor called if there is one (params must match a constructor signature)
- Constructors may be overloaded as well

Inheritance

Enables class extensions with reuse of fields and methods

- All parent fields included in child instantiation
- Protected and public fields and methods directly accessible to child
- Parent methods may be *overridden*
- New fields and methods may be added to child
- Only single inheritance (unlike C++)

Deriving sub-classes

```
class  Gnome extends Dreblin {
// body
}
```

Redefine/Add to variables/methods.

```
class  Gnome implements Dreblin, Timken {
// body
}
```

Define methods of an interface

Initialization of Derived Classes

- super(): alias for constructor of parent class
  - Constructor of derived class can explicitly call **super()** (with or without arguments) to invoke parent constructor
  - If constructor does not call **super()** or **this()** at start of constructor
    - **super()** is automatically called (with no arguments)
  - Inside **super()** function, this object has been cast to parent class

Simple Inheritance Example

```
Class MyExtension extends MyClass {
  float newField;
  MyExtension() {
    super(); //call parent constructor
    newField = super.tellAll()*3.14;}
  int tellAll()   {return (int)newField;}
}

MyClass foo = new MyExtension;
System.out.println(foo.tellAll());
```

- Method accessed is that of actual instantiation type, not variable type
  - In C++ terminology, all functions are “virtual”

Casting of Class Variables

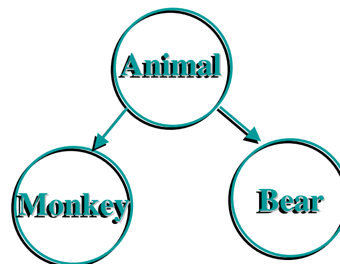
- “upward” casting
  - Casting derived class variable to ancestor class is always safe (and may be done implicitly)
- “downward” casting
  - Casting class variable to derived class fails if variable is not actually an instance of the derived class
    - run-time error
  - `instanceof()` function can be used to test class type before downward cast

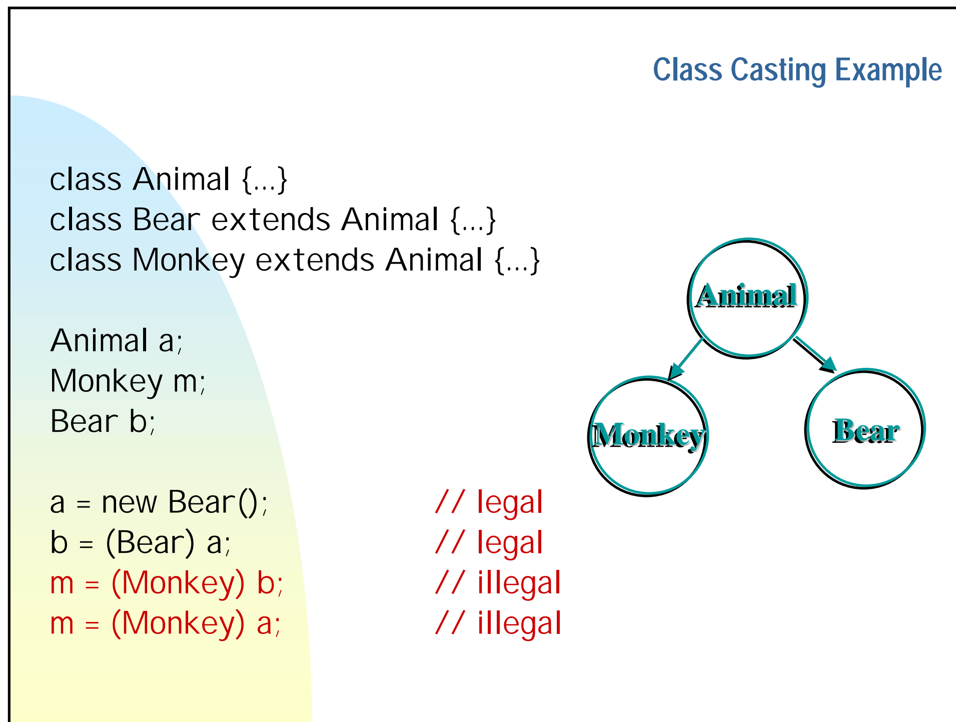
Class Casting Example

```
class Animal {...}
class Bear extends Animal {...}
class Monkey extends Animal {...}

Animal a;
Monkey m;
Bear b;

a = new Bear();
b = (Bear) a;
m = (Monkey) b;
m = (Monkey) a;
```





Abstract Classes

- Include one or more unimplemented abstract methods
- Enable inheritance of methods that don't make sense at the parent level

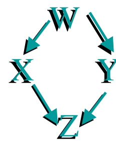
```
abstract class Shape {
  abstract public draw(); }
class Circle extends Shape {
  public draw() {...} }
class Rectangle extends Shape {
  public draw() {...} }
Shape s = new Circle();
s.draw();
```

Interfaces

- Similar to abstract classes
  - But *no* methods implemented or fields specified
- Class can be defined to *implement* one or more interfaces
  - More general mechanism than just single inheritance

```
interface Printable {
  print(); }
class Foo implements Printable {
  print(){…}; }
```

"Multiple Inheritance"



- Several ways to achieve in Java
  - combinations of interfaces and classes
  - W and Y are interfaces, X and Z are classes
  - W, X, and Y are interfaces, Z is class

Exceptions

- Language-level support for managing run-time errors
- You can define your own exception classes
- Methods declare which exceptions they might possibly *throw*
- Calling methods either *catch* these exceptions or pass them up the call stack

Throw

```
public void myMethod() throws BadThingHappened {
  ...
  if (someCondition)
    throw new BadThingHappened;
  ...
}

try
        ...
        myMethod()
        ...
catch (BadThingHappened BTH)
    {    block  of code    }
catch (exceptiontype id)
    {    block  of code    }
finally
    {    block of code     }   // ALWAYS executed!!
```