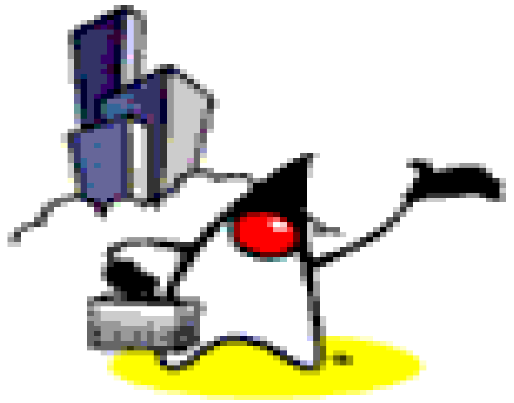
Serialization

Sang Shin
Michèle Garoche
www.javapassion.com
"Learn with Passion!"

Topics

- What is Serialization?
- What is preserved when an object is serialized?
- *Transient* keyword
- Process of serialization
- Process of deserialization
- Version control
- Changing the default protocol
- Creating your own protocol via *Externalizable*



What is Serialization?

What is Serialization?

- Ability to read or write an object to a stream
  - Process of "saving" an object
- Used to save object to some permanent storage
  - Its state should be written in a serialized form to a file such that the object can be reconstructed at a later time from that file

Streams Used for Serialization

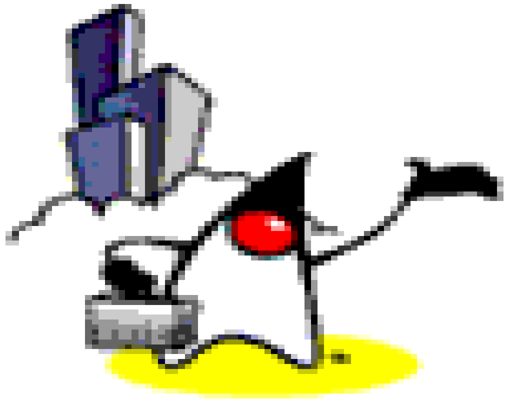
- ObjectOutputStream
  - For serializing (saving an object)
- ObjectInputStream
  - For deserializing (reconstructing an object)

Requirement for Serialization

- To allow an object to be serializable:
  - Its class should implement the *Serializable* interface or inherit class that implements the *Serializable* interface
    - *Serializable* interface is marker interface (meaning it does not have any methods)
  - Its class should also provide a default constructor (a constructor with no arguments)

Non-Serializable Objects

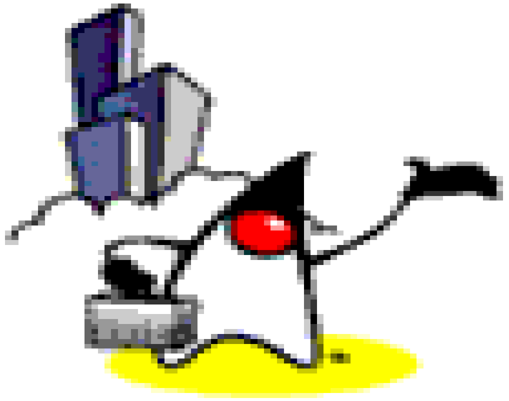
- Most Java classes are serializable
- Objects of some system-level classes are not serializable
  - Because the data they represent constantly changes
    - Reconstructed object will contain different value anyway
    - For example, thread running in my JVM would be using my system's memory. Persisting it and trying to run it in your JVM would make no sense at all.
- A *NotSerializableException* is thrown if you try to serialize non-serializable objects



What is preserved when an Object is serialized?

What is preserved when an object is serialized?

- Enough information that is needed to reconstruct the object instance at a later time
  - Property values of the object are preserved
  - Methods and constructors are not part of the serialized stream
  - Class information is included, however



Process of Serialization

Serialization: Writing an Object Stream

- Use its *writeObject* method of the *ObjectOutputStream* class

```
public final void writeObject(Object obj)
                              throws IOException
```

where,

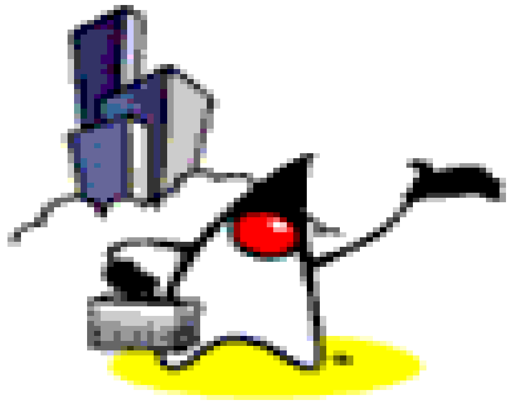
- *obj* is the object to be written to the stream (meaning it is the object to be serialized)

Serialization: Writing an Object Stream

```
import java.io.*;
public class SerializeBoolean {
   SerializeBoolean() {
      Boolean booleanData = new Boolean("true");
      try {
         FileOutputStream fos = new
                     FileOutputStream("boolean.ser");
         ObjectOutputStream oos = new
                     ObjectOutputStream(fos);
         oos.writeObject(booleanData);
         oos.close();
//continued...
```

Serialization: Writing an Object Stream

```
        } catch (IOException ie) {
            ie.printStackTrace();
        }
    }

    public static void main(String args[]) {
        SerializeBoolean sb = new SerializeBoolean();
    }
}
```



Process of Deserialization

Deserialization: Reading an Object Stream

- Use its *readObject* method of the *ObjectInputStream* class

```
 public final Object readObject()
         throws IOException, ClassNotFoundException
```

- The *Object* type returned should be typecasted to the appropriate class before methods on that class can be executed

Deserialization: Reading an Object Stream

```
import java.io.*;
public class UnserializeBoolean {
    UnserializeBoolean() {
      Boolean booleanData = null;
      try {
         FileInputStream fis = new
                      FileInputStream("boolean.ser");
         ObjectInputStream ois = new
                      ObjectInputStream(fis);
         booleanData = (Boolean) ois.readObject();
         ois.close();
//continued...
```

Deserialization: Reading an Object Stream

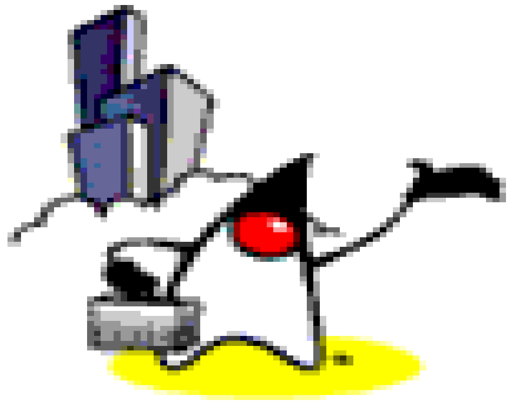
```
        } catch (Exception e) {
            e.printStackTrace();
        }
        System.out.println("Unserialized Boolean from "
                                   + "boolean.ser");
        System.out.println("Boolean data: " +
                                   booleanData);
        System.out.println("Compare data with true: " +
              booleanData.equals(new Boolean("true")));
    }
//continued...
```

Deserialization: Reading an Object Stream

```
   public static void main(String args[]) {
       UnserializeBoolean usb =
                                    new UnserializeBoolean();
    }
}
```

Demo:

SerializeAndDeserializeCurrrentTime
1043_javase_serialization.zip



Transient keyword

When to use *transient* keyword?

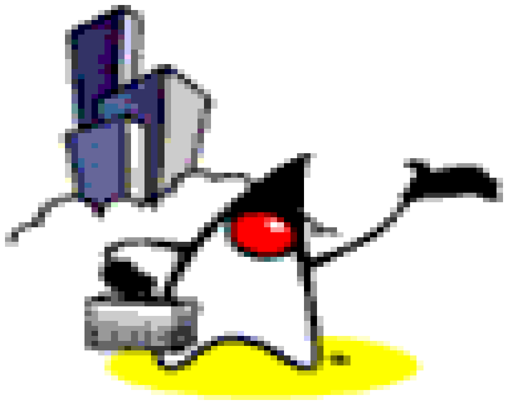
- How do you serialize an object of a class that contains a non-serializable class as a field?
  - Like a Thread object
- What about a field that you don't want to to serialize?
  - Some fields that you want to recreate anyway
  - Performance reason
- Mark them with the *transient* keyword
  - The *transient* keyword prevents the field from being serialized
  - Serialization does not care about access modifiers such as *private*

Example: transient keyword

```java
class MyClass implements Serializable {

    // Skip serialization of the transient field
    transient Thread thread;
    transient String fieldIdontwantSerialize;

    // Serialize the rest of the fields
    int data;
    String x;

    // More code
}
```

Demo:

SerializeAndDeserializeCurrrentTimeTransient
1043_javase_serialization.zip



Version Control

Version Control: Problem Scenario

- Imagine you create a class, instantiate it, and write it out to an object stream
- That saved object sits in the file system for some time
- Meanwhile, you update the class file, perhaps adding a new field
- What happens when you try to read in the flattened object?
  - An exception will be thrown -- specifically, the *java.io.InvalidClassException*
  - Why? (See next slide)

Unique Identifier

- Why exception is thrown?
  - Because all persistent-capable classes (*.class files) are automatically given a unique identifier
  - If the identifier of the class does not equal the identifier of the saved object, the exception will be thrown

Version Control: Problem Scenario Again

- However, if you really think about it, why should it be thrown just because I added a field? Couldn't the field just be set to its default value and then written out next time?
- Yes, but it takes a little code manipulation. The identifier that is part of all classes is maintained in a field called *serialVersionUID*.
- If you wish to control versioning, you simply have to provide the *serialVersionUID* field manually and ensure it is always the same, no matter what changes you make to the class file.

How Do I generate a Unique ID? Use *serialver* utility

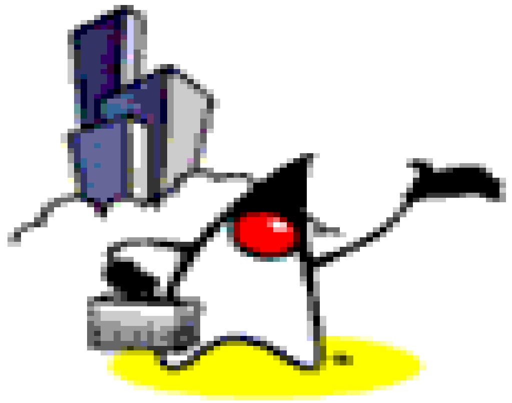
- *serialver* utility is used to generate a unique ID
- *Example*

  serialver MyClass

  MyClass static final long serialVersionUID = 10275539472837495L;

Demo:

SerializeAndDeserializeCurrrentTimeVersionControl
1043_javase_serialization.zip



Customizing the Default Protocol

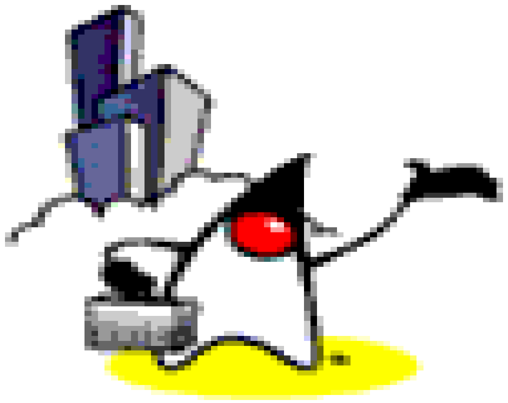
Provide your own readObject() and writeObject() methods

- Used when the default behavior of *readObject*() and *writeObject*() are not sufficient
- You provide your own *readObject()* and *writeObject()* in order to add custom behavior
- Example

```
 // My own readObject method
private void readObject(ObjectInputStream in)
                   throws IOException, ClassNotFoundException {

    // our "pseudo-constructor"
    in.defaultReadObject();
    // now we are a "live" object again, so let's run rebuild and start
    startAnimation();

}
```

Demo:

SerializeAnimationThreadNotStarted, SerializeAnimationThreadStarted 1043_javase_serialization.zip



Creating Your own Protocol via Externalizable interface

Externalizable Interface

- The *writeExternal* and *readExternal* methods of the *Externalizable* interface can be implemented by a class to give the class complete control over the format and contents of the stream for an object and its supertypes
- These methods must explicitly coordinate with the supertype to save its state
- These methods supersede customized implementations of writeObject and readObject methods

How does Object Serialization Scheme works with Externalizable

- Object Serialization uses the *Serializable* and *Externalizable* interfaces
- Each object to be stored is tested for the *Externalizable* interface
  - If the object supports *Externalizable*, the *writeExternal* method is called
  - If the object does not support *Externalizable* and does implement *Serializable*, the object is saved using *ObjectOutputStream*.

Demo:

SerializeObjectReaderWriter
1043_javase_serialization.zip

Thank you!

Check JavaPassion.com Codecamps!
http://www.javapassion.com/codecamps
"Learn with Passion!"