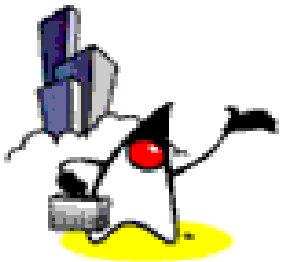
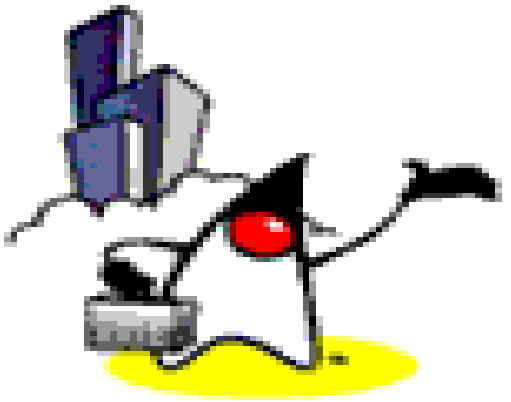
Serialization



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 "flattening" 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
- Used to pass on to another object via the *OutputStream* class
  - Can be sent over the network

Streams Used for Serialization

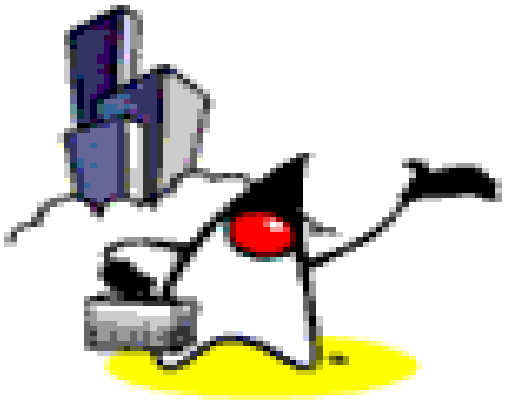
- ObjectOutputStream
  - For serializing (flattening an object)
- ObjectInputStream
  - For deserializing (reconstructing an object)

Requirement for Serialization

- To allow an object to be serializable:
  - Its class should implement the *Serializable* interface
    - *Serializable* interface is marker interface
  - Its class should also provide a default constructor (a constructor with no arguments)
- Serializability is inherited
  - Don't have to implement *Serializable* on every class
  - Can just implement *Serializable* once along the class hierarchy

Non-Serializable Objects

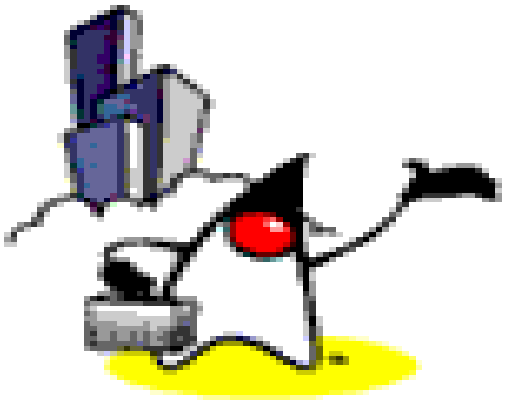
- Most Java classes are serializable
- Objects of some system-level classes are not serializable
  - Because the data they represent constantly changes
    - Reconstructed object will contain different value anyway
    - For example, thread running in my JVM would be using my system's memory. Persisting 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
  - Only the object's data are preserved
  - Methods and constructors are not part of the serialized stream
  - Class information is included



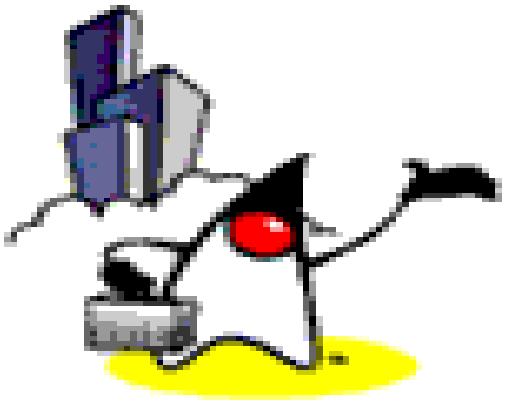
Transient keyword

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 data from being serialized
  - Serialization does not care about access modifiers such as *private* -- all nontransient fields are considered part of an object's persistent state and are eligible for persistence

Example: transient keyword

```
1  class MyClass implements Serializable {
2
3      // Skip serialization of the transient field
4      transient Thread thread;
5      transient String fieldIdontwantSerialization;
6
7      // Serialize the rest of the fields
8      int data;
9      String x;
10
11     // More code
12 }
```



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,

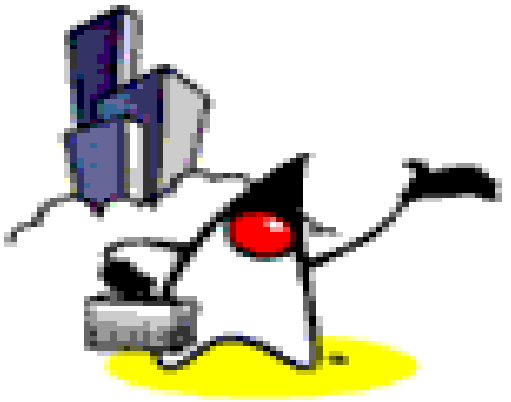
  - *obj* is the object to be written to the stream

Serialization: Writing an Object Stream

```
1  import java.io.*;
2  public class SerializeBoolean {
3     SerializeBoolean() {
4        Boolean booleanData = new Boolean("true");
5        try {
6           FileOutputStream fos = new
7                        FileOutputStream("boolean.ser");
8           ObjectOutputStream oos = new
9                        ObjectOutputStream(fos);
10          oos.writeObject(booleanData);
11          oos.close();
12 //continued...
```

Serialization: Writing an Object Stream

```
13          } catch (IOException ie) {
14              ie.printStackTrace();
15          }
16      }
17
18      public static void main(String args[]) {
19          SerializeBoolean sb = new SerializeBoolean();
20      }
21  }
```



Process of Deserialization

Deserialization: Reading an Object Stream

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

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

  where,

  – *obj* is the object to be read from the stream

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

Deserialization: Reading an Object Stream

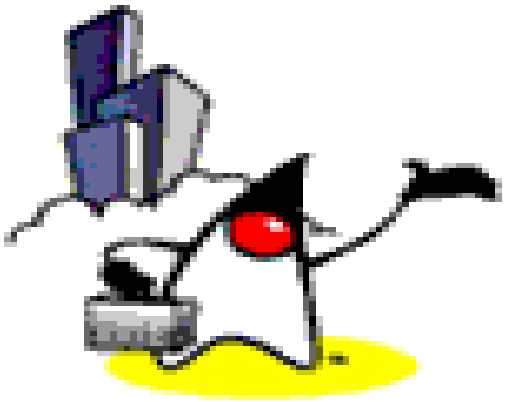
```
1  import java.io.*;
2  public class UnserializeBoolean {
3      UnserializeBoolean() {
4        Boolean booleanData = null;
5        try {
6           FileInputStream fis = new
7                              FileInputStream("boolean.ser");
8           ObjectInputStream ois = new
9                              ObjectInputStream(fis);
10          booleanData = (Boolean) ois.readObject();
11          ois.close();
12 //continued...
```

Deserialization: Reading an Object Stream

```
13          } catch (Exception e) {
14              e.printStackTrace();
15          }
16          System.out.println("Unserialized Boolean from "
17                                  + "boolean.ser");
18          System.out.println("Boolean data: " +
19                                  booleanData);
20          System.out.println("Compare data with true: " +
21                  booleanData.equals(new Boolean("true")));
22      }
23  //continued...
```

Deserialization: Reading an Object Stream

```
13    public static void main(String args[]) {
14        UnserializeBoolean usb =
15                                new UnserializeBoolean();
16    }
17 }
```



Version Control

Version Control: Problem Scenario

- Imagine you create a class, instantiate it, and write it out to an object stream
- That flattened 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 are automatically given a unique identifier
  - If the identifier of the class does not equal the identifier of the flattened object, the exception will be thrown

Version Control: Problem Scenario Again

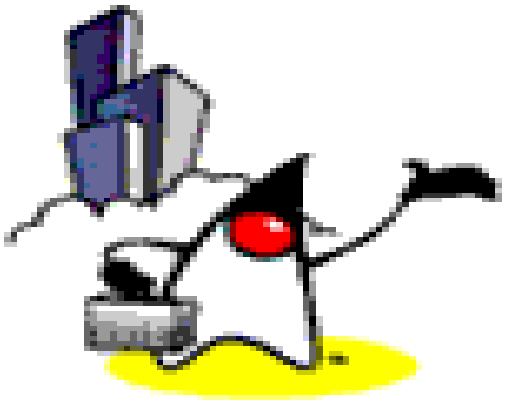
- However, if you really think about it, why should it be thrown just because I added a field? Couldn't the field just be set to its default value and then written out next time?
- Yes, but it takes a little code manipulation. The identifier that is part of all classes is maintained in a field called 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 classfile.

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 = 1027553947283749 5L;



Customizing the Default Protocol

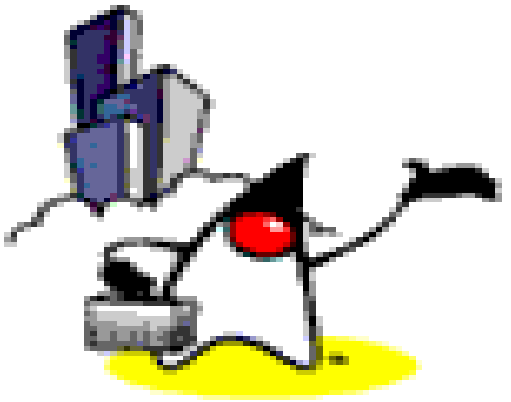
Provide your own readObject() and writeObject() methods

- 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

```
 // Provide your 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();

}
```



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.

Thank You!