Simple File Input And Output

You will learn how to write to and read from text and serialized files in Java.

James Tam

Storing Information On Files

Types of files

- Text files
- Binary files

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Text Files

Text files

- Every 8 bits represents a character
- e.g., '0' = 48, '1' = 49

110000 → '0'

110001 → '1'

Binary files

- Includes all other types of files (it's a catch all term for non-binary files)
- e.g., Interpret the bit pattern as a 16 bit unsigned short

110001110010_2 → 3186_{10}

James Tam

(You Should Now Know Why You Can Get Garbage In Text Editors)

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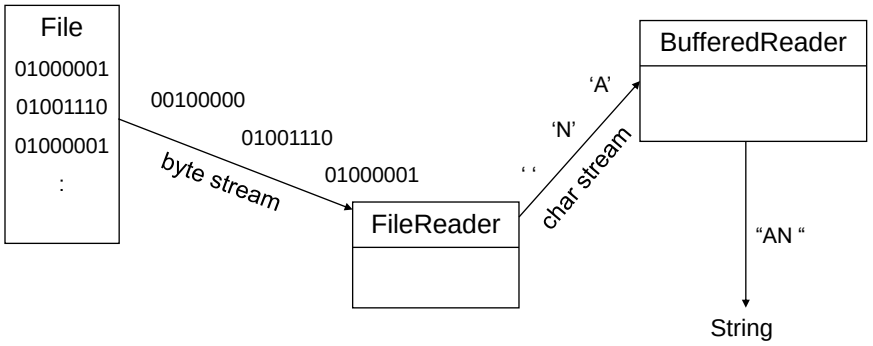
Reading Text Input From A File



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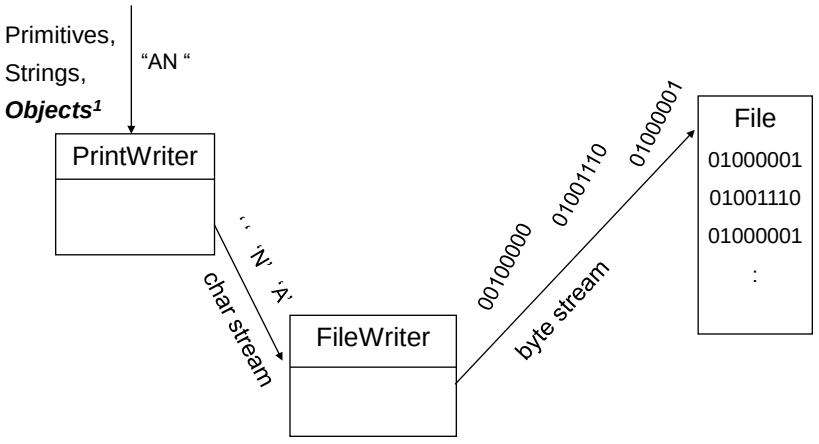
Writing Text Output To A File



1 By objects we of course mean references to objects

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An Example Of Simple Input And Output

Location of the online example:
/home/coures/233/examples/fileIO/firstExample

OR

www.cpsc.ucalgary.ca/~tamj/233/examples/fileIO/firstExample

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Class IntegerWrapper

```
public class IntegerWrapper
{
   private int num;

   public IntegerWrapper ()
   {
         num = (int) (Math.random() * 100);
   }
   public void setNum (int newValue)
   {
         num = newValue;
   }
   public int getNum ()
   {
         return num;
   }
}
```

James Tam

Class SimpleIO

```
import java.io.*;

public class SimpleIO
{
   public static void main (String [] argv)
   {
      IntegerWrapper iw1 = new IntegerWrapper ();
      IntegerWrapper iw2 = new IntegerWrapper ();
      String filename = "data.txt";
      PrintWriter pw;
      FileWriter fw;
      BufferedReader br;
      FileReader fr;
```

James Tam

Class SimpleIO (2)

```
      try
      {
         fw = new FileWriter (filename);
         pw = new PrintWriter (fw);

         System.out.println("Written to file: " + iw1.getNum());
         pw.println(iw1.getNum());
         System.out.println("Written to file: " + iw2.getNum());
         pw.println(iw2.getNum());
         fw.close();
```

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Class SimpleIO (3)

```
            fr = new FileReader(filename);
            br = new BufferedReader(fr);
            System.out.println("Read from file: " + br.readLine());
            System.out.println("Read from file: " + br.readLine());
            fr.close();
        }
```

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Class SimpleIO (4)

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

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Reading Until The End-Of-File Is Reached

```
String filename = "data.txt";
BufferedReader br = null;
FileReader fr = null;
String temp = null;

try
{
      fr = new FileReader(filename);
      br = new BufferedReader(fr);
      temp = br.readLine ();
      while (temp != null)
      {
            :     :     :
           temp = br.readLine ();
      }
}
 :     :     :
```

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Checking For More Specific Error Types

```
String filename = null;
BufferedReader br;
FileReader fr;
boolean fileError = true;

while (fileError == true)
{
   try
   {
      System.out.print("Enter name of input file: ");
      Scanner in = new Scanner (System.in);
     in.nextLine ();

      fr = new FileReader(filename);
      br = new BufferedReader(fr);
            :           :
      fr.close ();
      fileError = false;
   }
```

James Tam

Checking For More Specific Error Types (2)

```
    catch (FileNotFoundException e)
    {
        System.out.println("File called " + filename +
                                " not in the current  directory");
    }
    catch (IOException e)
    {
        System.out.println("General file input error occured.");
        e.printStackTrace();
    }
}
```

James Tam

Writing Objects Out To File: "The Hard Way"

Location of the example:

/home/courses/233/examples/fileIO/secondExample

OR

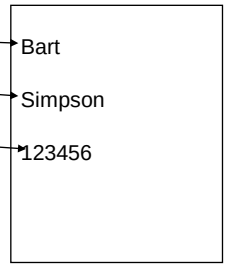
www.cpsc.ucalgary.ca/~tamj/233/examples/fileIO/secondExample

Each field is written out to a file individually

Student object:

- String firstName
- String lastName
- int id

data.txt



This approach is awkward because:

1. It requires knowledge of all the attributes of the class.
2. If attributes are not simple types or classes which can't be directly written to file the non-writable attribute must be broken down and written to file on a field-by basis.
3. Some attributes may have to be parsed or converted.

James Tam

The Driver Class

```
public class Driver
{
   public static void main (String [] args)
   {
      final String FILENAME = "data.txt";
      PrintWriter pw;
      FileWriter fw;
      BufferedReader br;
      FileReader fr;
      Student aStudent = new Student("Bart", "Simpson", 123456);
      int tempNum;
      String tempLine;
```

James Tam

The Driver Class (2)

```
      try
      {
         fw = new FileWriter (FILENAME);
         pw = new PrintWriter (fw);
         pw.println(aStudent.getFirstName());
         pw.println(aStudent.getLastName());
         pw.println(aStudent.getId());
         fw.close();

         fr = new FileReader(FILENAME);
         br = new BufferedReader(fr);
         aStudent.setFirstName(br.readLine());
         aStudent.setLastName(br.readLine());
         tempLine = br.readLine();
         aStudent.setId(Integer.parseInt(tempLine));
         fr.close();

         System.out.println(aStudent);
      }
```

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The Driver Class (3)

```
        catch (FileNotFoundException e)
        {
           e.printStackTrace();
        }
        catch (IOException e)
        {
           e.printStackTrace();
        }
        catch (NumberFormatException e)
        {
           e.printStackTrace();
        }
    }
}
```

James Tam

Class Student

```
public class Student
{
   private String firstName;
   private String lastName;
   private int id;

   public Student ()
   {
      firstName = "no name";
      lastName = "no name";
      id = -1;
   }
```

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Class Student (2)

```
public Student (String aFirstName,
                String aLastName,
                int anId)
{
   firstName = aFirstName;
   lastName = aLastName;
   id = anId;
}

public String getFirstName () { return firstName; }
public String getLastName () { return lastName; }
public int getId () { return id; }
```

James Tam

Class Student (3)

```
public void setFirstName (String name) { firstName = name; }
public void setLastName (String name) { lastName = name; }
public void setId (int anId) { id = anId; }
public String toString ()
{
   String s = new String ();
   s = s +
      "First name: " + firstName + "\n" +
      "Last name: " + lastName + "\n" +
      "ID No: " + id + "\n";
   return s;
}
}
```

James Tam

Writing Objects Out To File: A Better Way

Location of the example:
/home/courses/233/examples/fileIO/thirdExample

OR

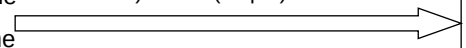
www.cpsc.ucalgary.ca/~tamj/233/examples/fileIO/thirdExample

Write all the data for the class all at once

Student object:

- String firstName
- String lastName
- int id

Object is 'serialized' (given a serial number) on the (output) stream



data.txt

Bart
Simpson
123456

Objects of a class can be serialized when the class implements the Serializable interface

James Tam

The Driver Class

```
public class Driver
{
   public static void main (String [] args)
   {
      final String FILENAME = "data.txt";

      try
      {
         // Write object to file.
         ObjectOutputStream out = new ObjectOutputStream
            (new FileOutputStream(FILENAME));
         Student aStudent = new Student("Bart", "Simpson", 123456);
         out.writeObject(aStudent);
         out.close();
         aStudent = null;
```

James Tam

The Driver Class (2)

```
            ObjectInputStream in = new ObjectInputStream
                (new FileInputStream(FILENAME));
             aStudent = (Student) in.readObject();
             System.out.println(aStudent);
          }
          catch (FileNotFoundException e)
          {
             e.printStackTrace();
          }
          catch (IOException e)
          {
             e.printStackTrace();
          }
          catch (ClassNotFoundException e)
          {
             e.printStackTrace();
          }
       }
}
```

James Tam

The Student Class: Key Difference

```
public class Student implements Serializable
{
   private String firstName;
   private String lastName;
   private int id;

   public Student ()
   {
      setFirstName(aFirstName);
      setLastName(lastName);
      setId(anId);
    }
```

James Tam

Note: The Data File For Serialized Objects Is In Binary Form

¬í?□sr? Student'±"‹Ìk ? I? idL?
firstNamet? Ljava/lang/String;L? lastNameq?~? xp?
â@t? Bartt? Simpson

James Tam

Note: Many 'Container' Classes Are Serializable

Serializable Containers:

- ArrayList
- LinkedList
- Vector
- :

The effect of having a serializable container class is that the entire container can be serialized

James Tam

Classes That Don't Implement The Serializable Interface

1. The contents of the class (data) are confidential.
2. The contents of the class is meaningful only while the program runs.

James Tam

You Should Now Know

How to write to files with Java classes

- FileWriter
- PrintWriter

How to reading text information from files with Java classes

- FileReader
- BufferedReader

How objects can be written to file in a serializable form.

James Tam