# Lecture 5
# summary of Java SE

presentation

**Java Programming – Software App Development**

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# **Cristian Toma** – Business Card

# **Agenda** for Lecture 5 – Summary of JSE

Java annotations – annotation type, meta-annotation and Reflection mechanism

# Java Annotations & Reflection

# 1.1 Java Reflection

- **Java Reflection** is an “introspective technique” that allows a computer program to examine and modify the structure and behavior (specifically the values, meta-data, properties and functions) of an object at runtime. [WIKI]

- **Java Reflection** is an advanced technique and should be used by experienced programmers that have good knowledge of Java and JVM.

- **Java Reflection** is a technique which allows different applications to do various operations that are quit impossible otherwise. It is a common approach for high-level programming languages as Java or C#.

# 1.1 Java Reflection

Samples for objects and objects arrays in **Java Reflection**:

- Operator ***instanceof***
- Displaying class methods
- Obtaining info about constructors methods
- Obtaining info about class fields
- Invoking methods by name
- Creation of new objects
- Changing the value from various field
- Using the arrays/vectors in Java Reflection context

# 1.1 Java Reflection

What types of applications are using **Java Reflection**?
**Class Browser**
**Debugger**
**Test Tool**
**Dynamic Proxy**

What are the disadvantages / issues of the **Java Reflection** techniques?
**Performance** – the reflection acts at "byte-code" level, but some optimizations of JVM could not be applied.
**Security constraints** – almost impossible to be applied at Java Applet – Security Manager Module.
**Exposing the internal items of a class** – it is not recommended but it is possible to access private fields and methods.

Is this technique used within these lectures?
YES – FTP server sample
YES – together with annotations at EJB 3.0 and Web Services

# 1.2 Java Annotations

- Java Annotation “is the meta-tags that you will use in your code to give it some life.”

- There are two types: “***annotation type***” and “***annotation***”

- Define annotation – ***“annotation type”*** :

```
public @interface MyAnnotation {
   String doSomething();
}
```

- Use annotation – “***annotation***”:

```
@MyAnnotation (doSomething="What to do")
public void mymethod() { .... }
```

# 1.2 Java Annotations

Three kind of ***"annotation type"*** :

- 1. Marker – does NOT have internal elements

  Sample:

```
public @interface MyAnnotation { }
```

  Usage:

```
@MyAnnotation
 public void mymethod() { .... }
```

- 2. Single Element – has a single element represented by key=value

  Sample:

```
public @interface MyAnnotation {
    String doSomething();
}
```

  Usage:

```
@MyAnnotation ("What to do")
public void mymethod() { .... }
```

# 1.2 Java Annotations

Kind of ***"annotation type"*** :

- 3. Full-Value / Multi-Value – has multiple internal elements

  Sample:

```
public @interface MyAnnotation {
    String doSomething();
    int count;
    String date();
}
```

  Usage:

```
@MyAnnotation (doSomething="What to do", count=1, date="09-09-
  2005")
public void mymethod() { .... }
```

# 1.2 Java Annotations

Rules for defining – ***"annotation type"*** :

1. The defining of the annotation should start with '@interface' keyword.
2. The declared methods has no parameters.
3. The declared methods has no "throw exception" statements.
4. The data types of the method are:
    * primitive – byte, char, int, float, double, etc.
    * String
    * Class
    * enum
    * arrays of one of the types from above – int[], float[], etc.

In JDK 5.0 there are predefined / simple – ***"annotation"*** :

1. @Override
2. @Deprecated
3. @SupressWarnings

# 1.2 Java Annotations

Starting with JDK 5.0 there are *"meta-annotation"* that can be applied only to the *"annotation type"*:

1. Target

```
@Target(ElementType.TYPE)
@Target(ElementType.FIELD)
@Target(ElementType.METHOD)
@Target(ElementType.PARAMETER)
@Target(ElementType.CONSTRUCTOR)
@Target(ElementType.LOCAL_VARIABLE)
@Target(ElementType.ANNOTATION_TYPE)
```

2. Retention
   - @Retention(RetentionPolicy.SOURCE) – retinute la nivel cod sursa si sunt ignorate de compilator
   - @Retention(RetentionPolicy.CLASS) – retinute la nivel de compilare dar ignorate de VM la run-time
   - @Retention(RetentionPolicy.RUNTIME) – sunt retinute si utilizate doar la run-time

3. Documented – @Documented

4. Inherited – @Inherited

# Section Conclusion

Fact: **Java Annotations & Reflection**

In few **samples** it is simple to remember: Java annotations, annotations types, reflection and sample for combining annotation with reflection. The combining approach is used in behind by major web/app JEE servers for technologies like EJB or Web-Services plus XML parsing in JAXB and J-Unit for QA.


Java Libraries - JAR, Input / Output & JNI – Java Native Interface on Linux & Windows

# Java I/O & JNI

# 2.1 Java Library

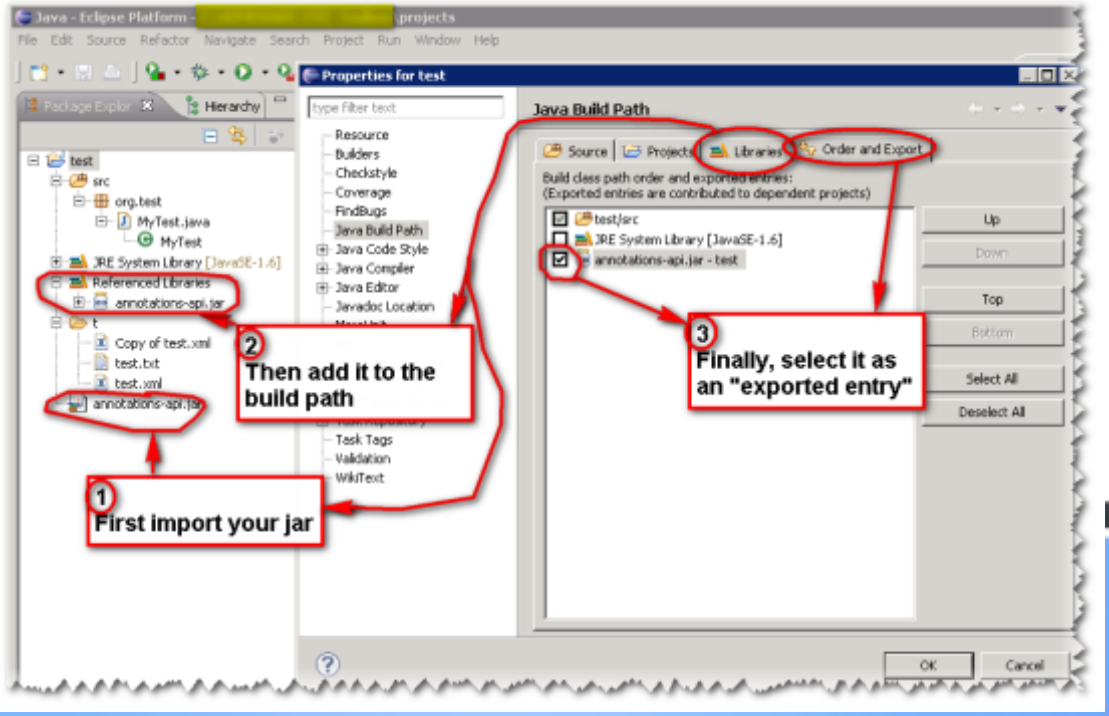
What is a **Java library**?

What are the advantages and disadvantages of Java libraries?

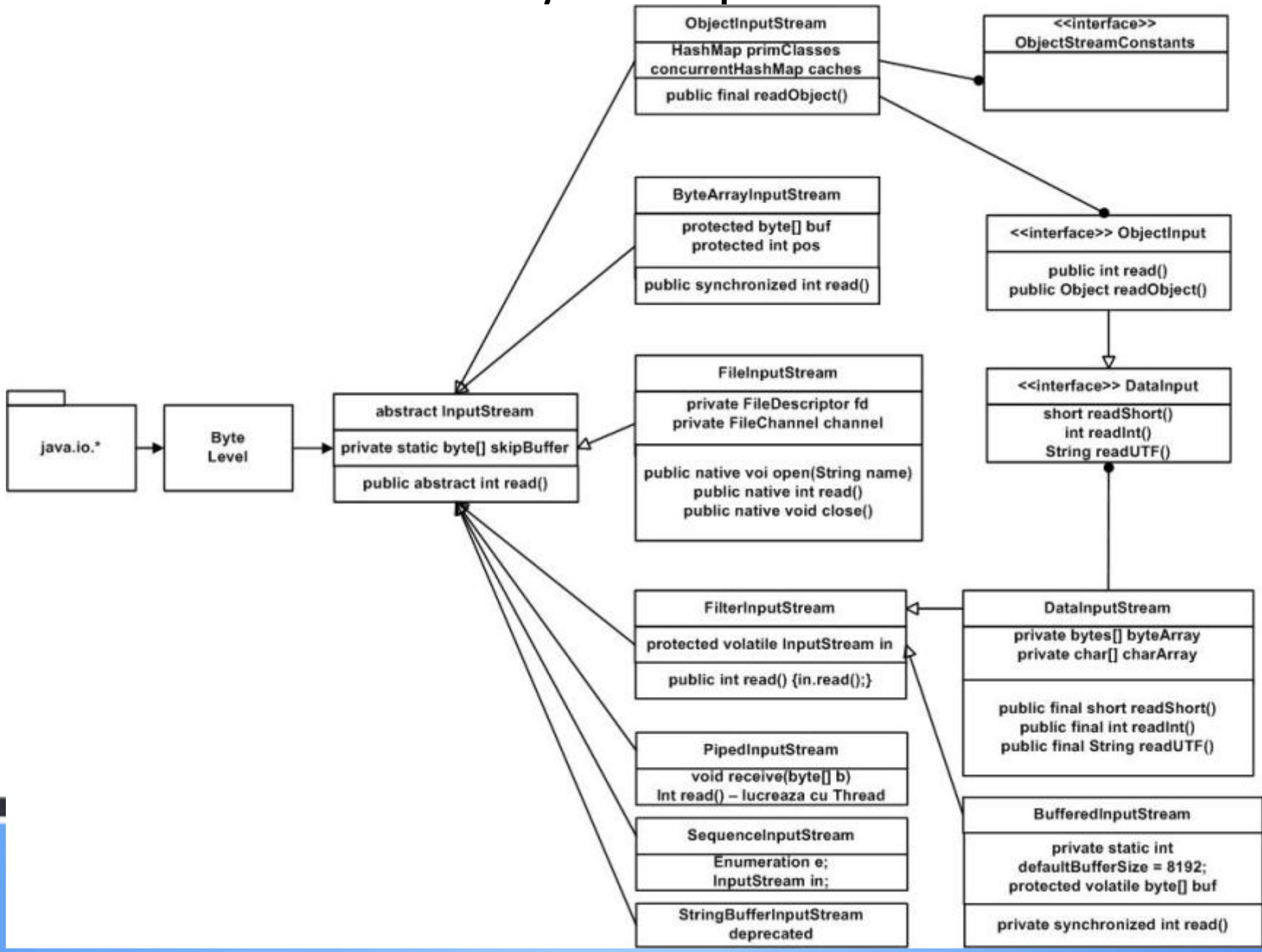
How can be solved in Java multiple dependencies or inclusions of the same class in the compilation phase? How were solved these problems in C/C++?

How should be created a Java library and how should be used – command line vs. IDE?

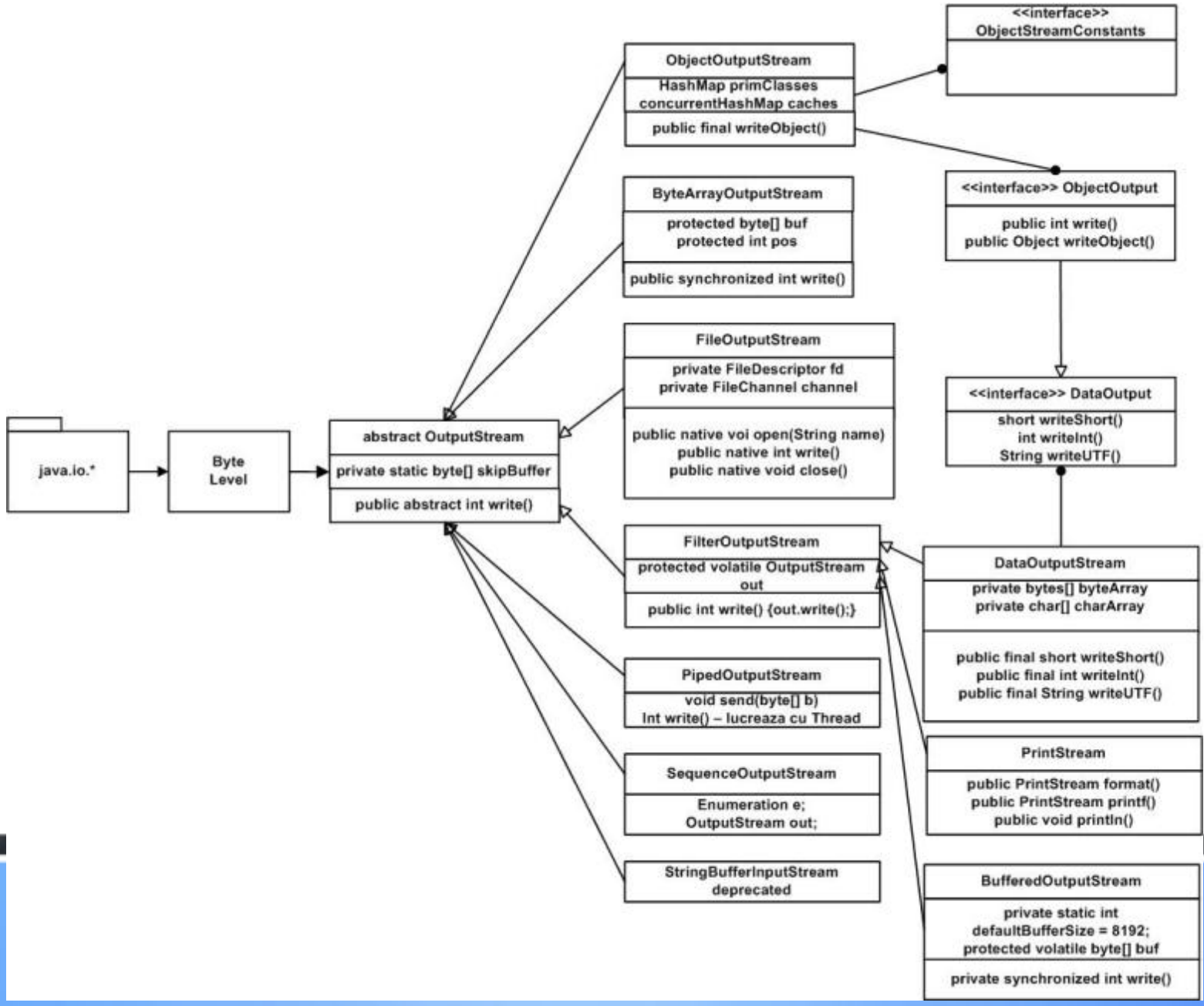
**>jar -cvf archive_name.jar files_names_to_compress**
**>javac -classpath .:archieve_name.jar *.java**
**>java –classpath .:archive_name.jar file_with_main_class**



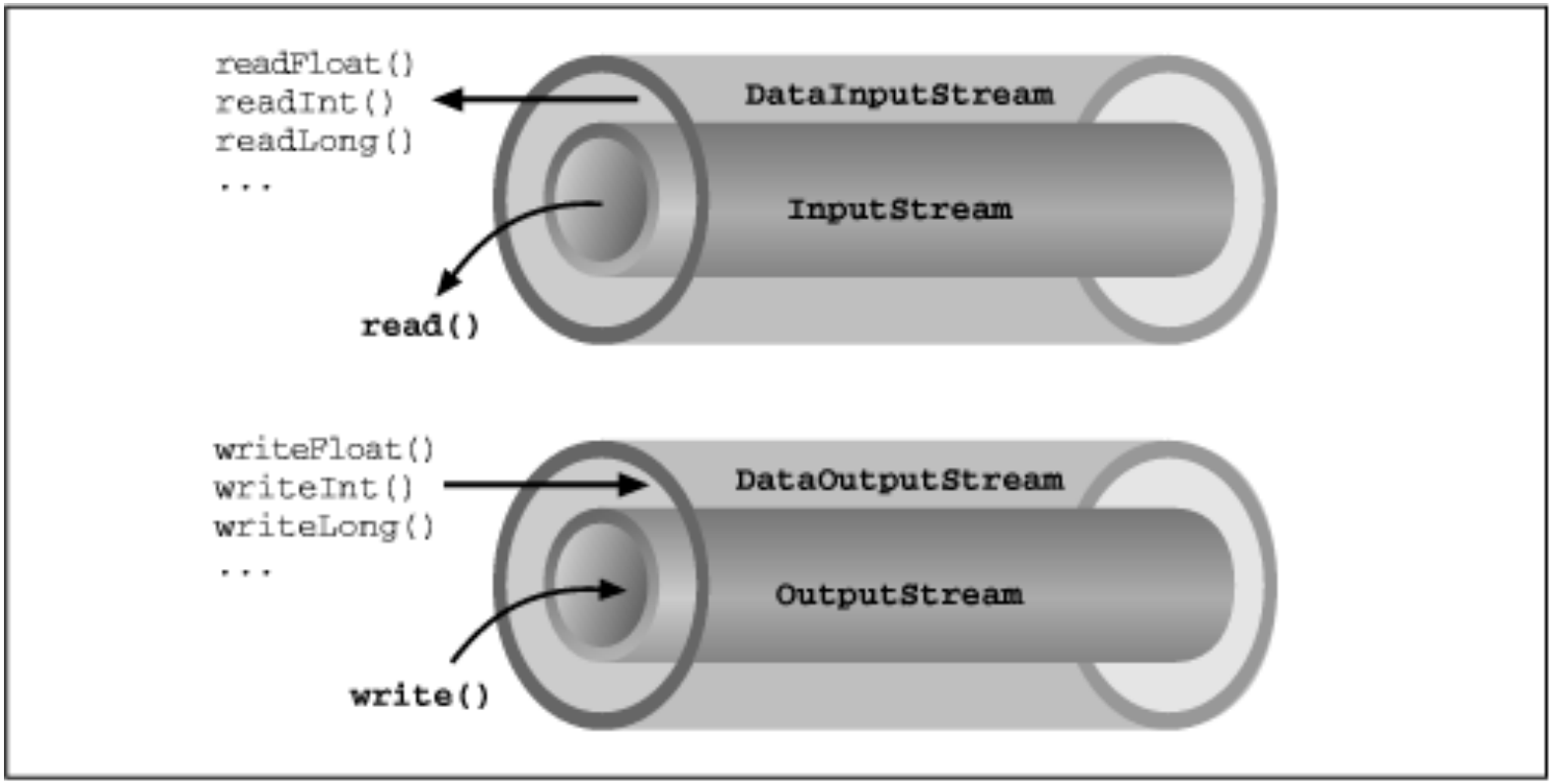
# 2.1 Java I/O – Input Stream



# 2.1 Java I/O – Output Stream

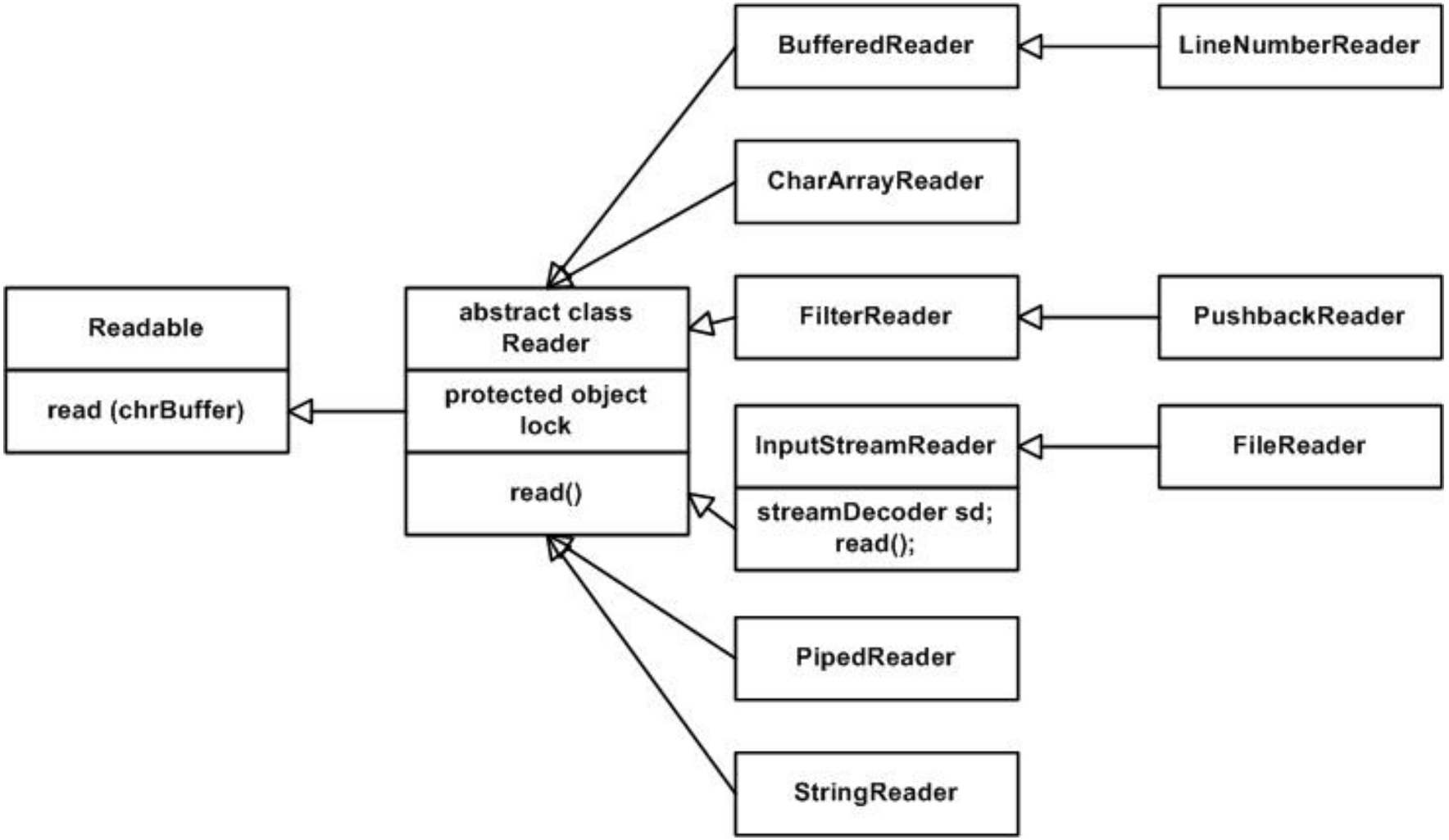


# 2.1 Java I/O – Streams Encapsulation

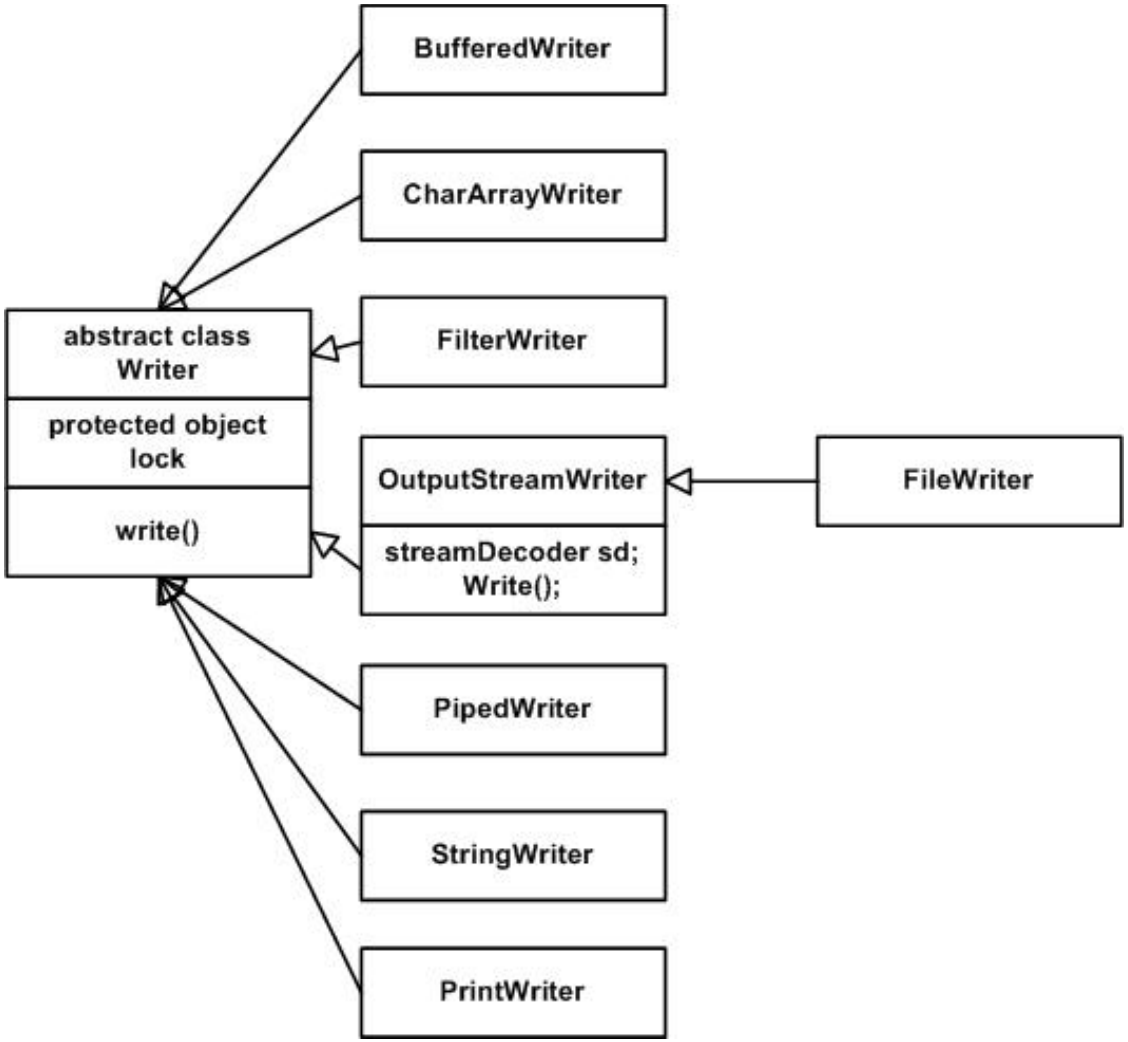



http://doc.sumy.ua/prog/java/exp/ch10_01.htm

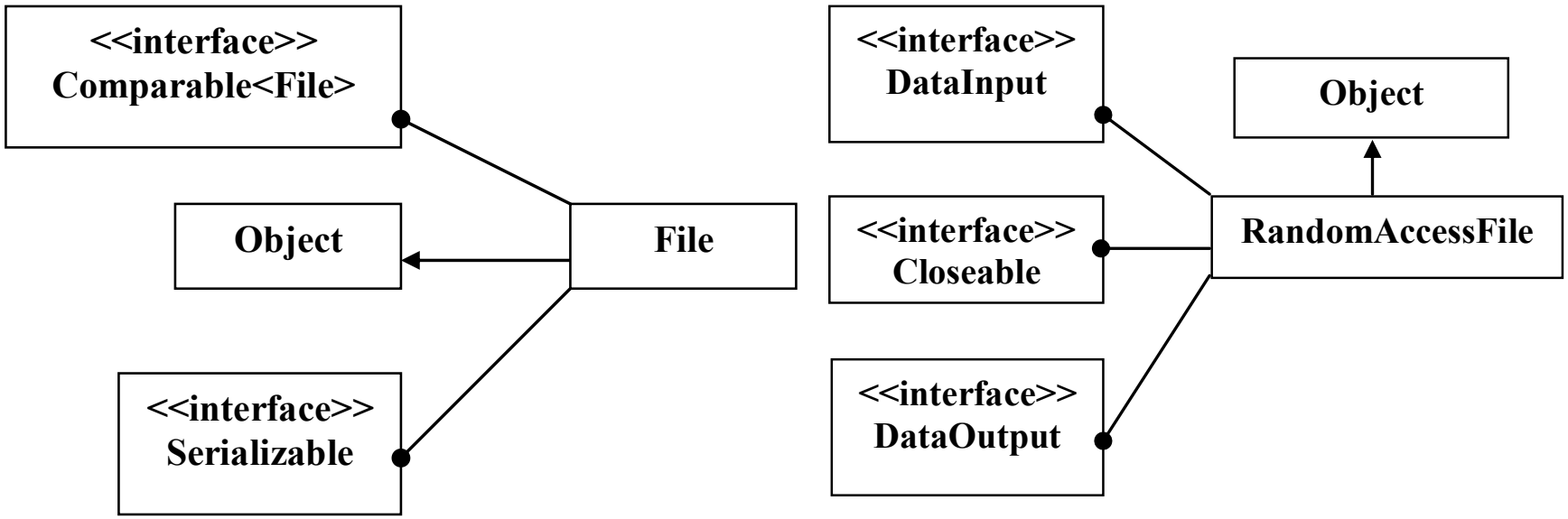
# 2.1 Java I/O – char level reading



# 2.1 Java I/O – char level writing

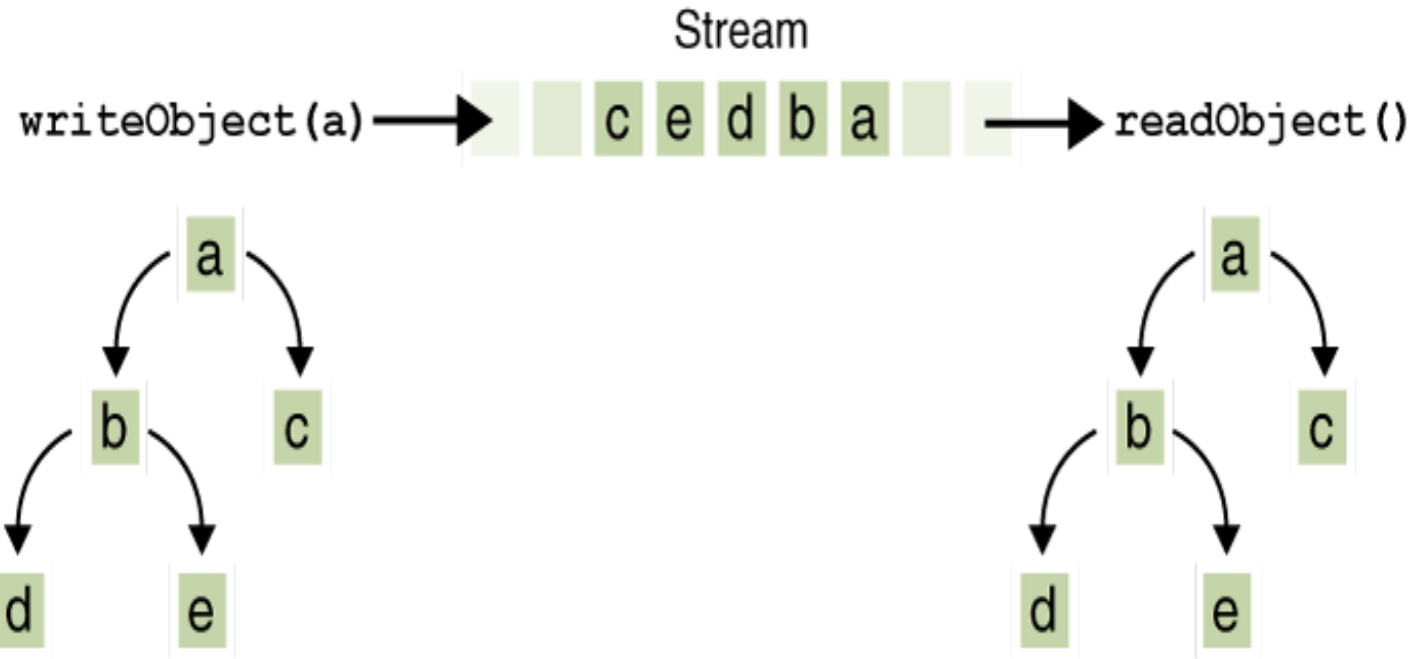


# 2.1 Java I/O – File Access



# 2.1 Java I/O – Serialization

This is demonstrated in the following figure, where `writeObject` is invoked to write a single object named **a**. This object contains references to objects **b** and **c**, while **b** contains references to **d** and **e**. Invoking `writeobject(a)` writes not just **a**, but all the objects necessary to reconstitute **a**, so the other four objects in this web are written also. When **a** is read back by `readObject`, the other four objects are read back as well, and all the original object references are preserved.



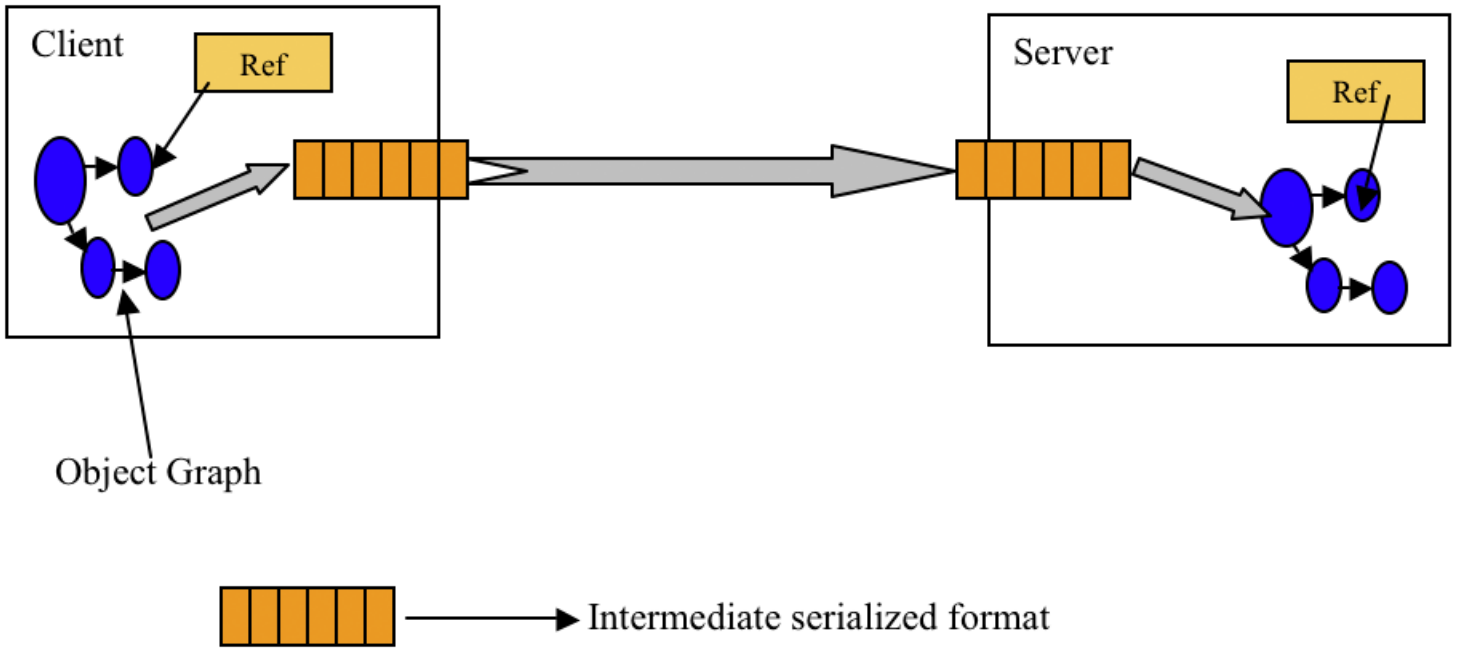

I/O of multiple referred-to objects

# 2.1 Java I/O – Serialization

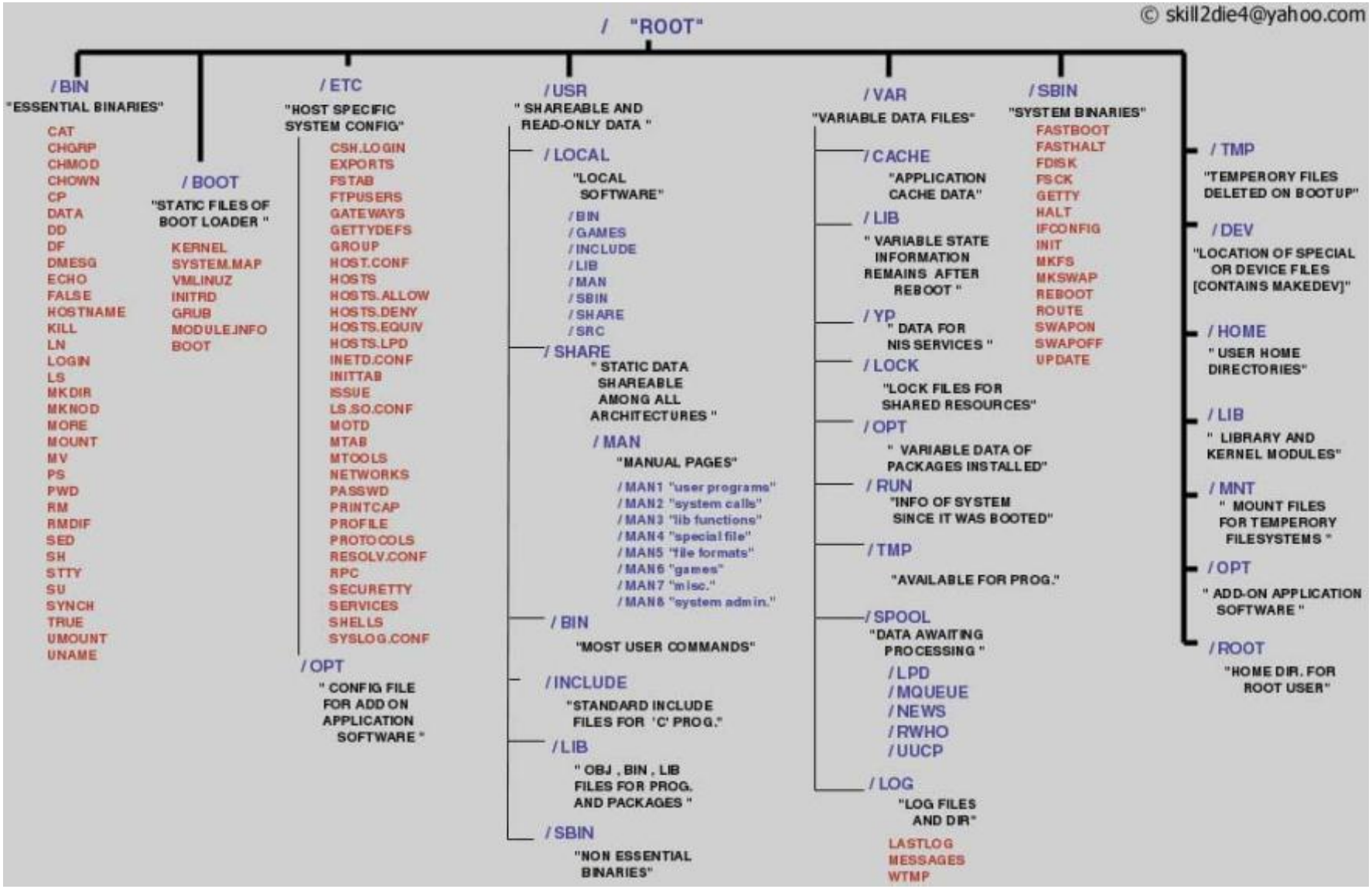
**What is going to be saved and restored by serialization in Java?**

- **Non-static fields? Static fields?**
- **Transient fields?**
- **Private and public fields and/or methods?**
- **Prototype / signature of the methods and / or the implementation of the methods?**

http://www.javaworld.com/community/node/2915



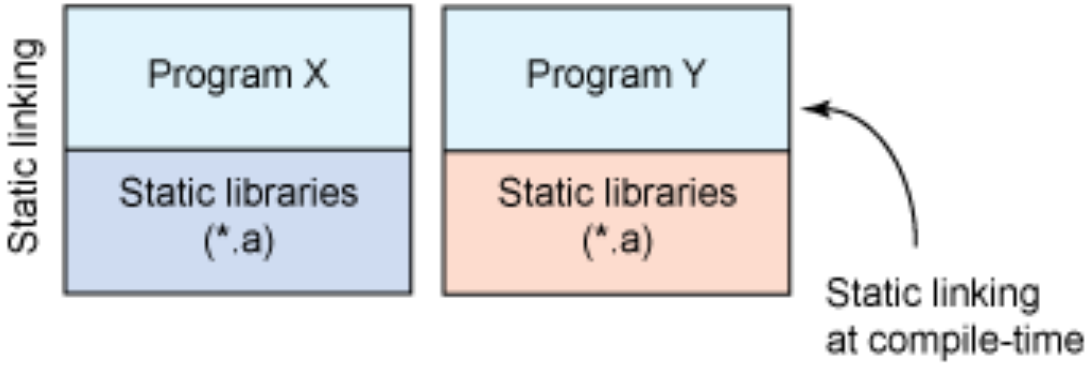
# 2.2 JNI – Linux Directories

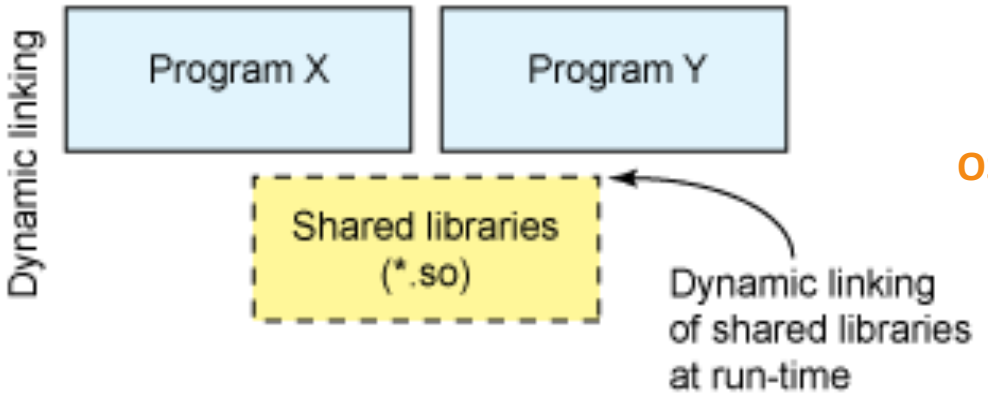



http://freshtutorial.com/file-structure-linux/

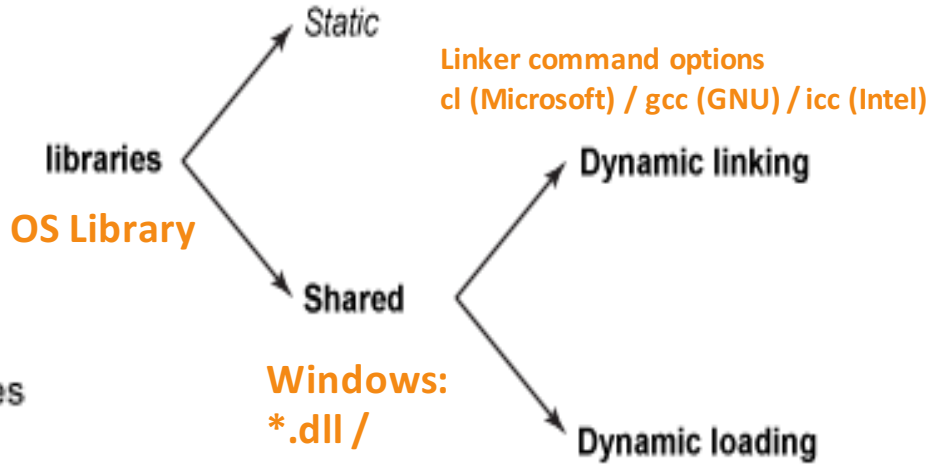
# 2.2 JNI – Linux vs. Win libraries

**http://www.ibm.com/developerworks/linux/library/l-dynamic-libraries/**




**Windows: *.lib / Linux: *.a**




**Linker command options**
**cl (Microsoft) / gcc (GNU) / icc (Intel)**

**OS Library**

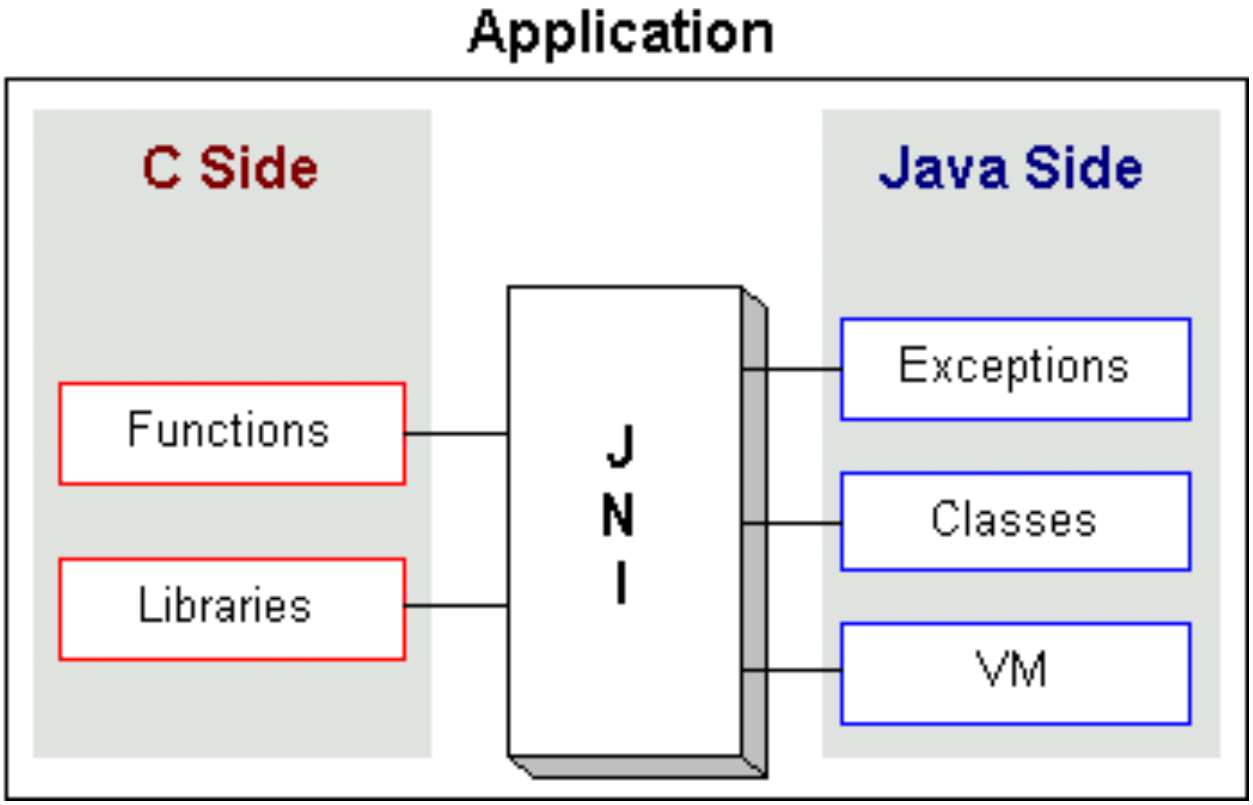
**Windows: *.dll /**

**Linux: *.so**

**@ Run-time**

```
/* Open the shared object */
dl_handle = dlopen( lib, RTLD_LAZY );
if (!dl_handle) {
  printf( "!!! %s\n", dlerror() );
  return;
}
```

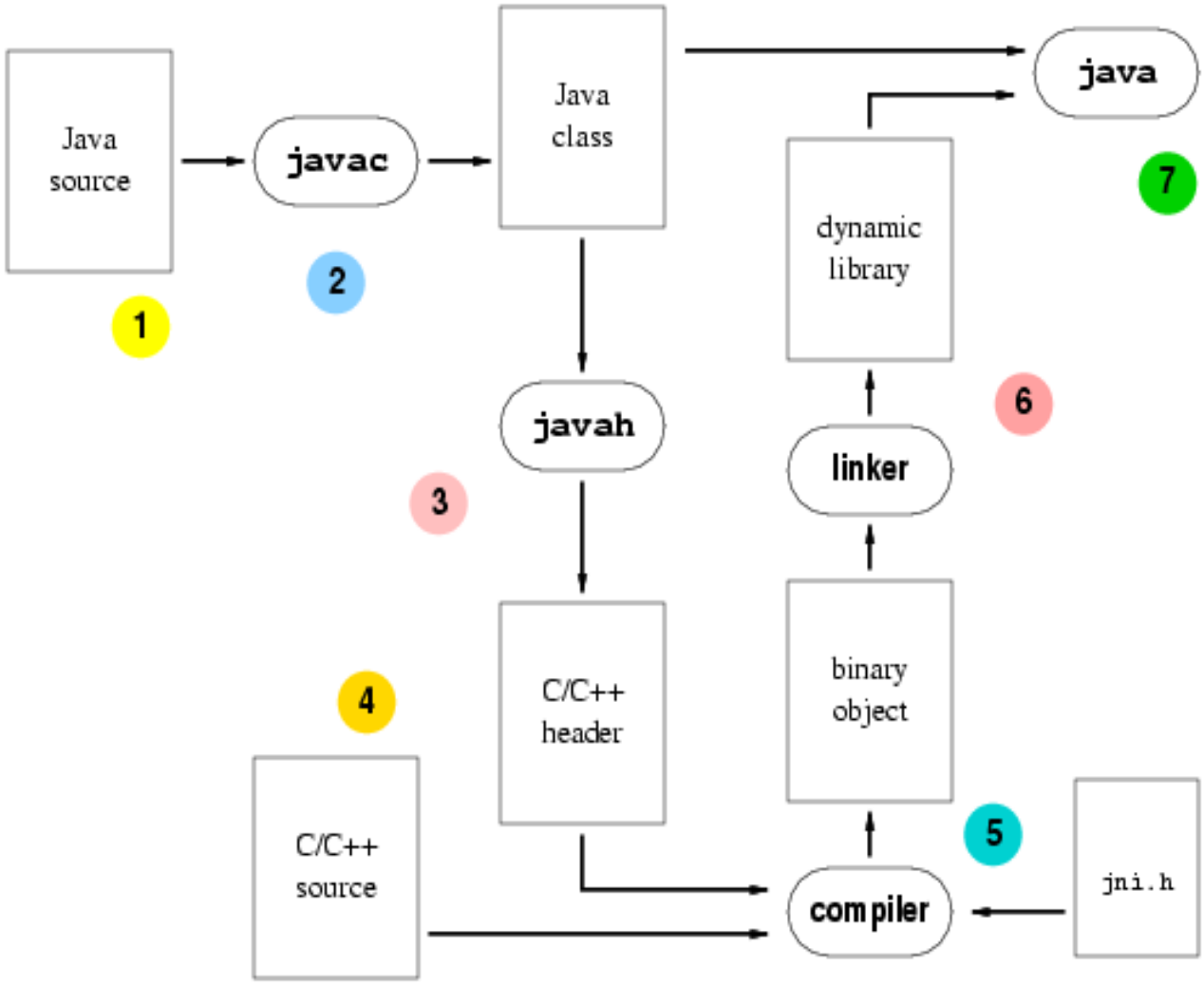
# 2.2 Java Native Interface




http://www.iam.ubc.ca/guides/javatut99/native1.1/concepts/index.html

# 2.2 Java Native Interface

http://cs.fit.edu/~ryan/java/language/jni.html




1. Create Java source code with native methods

native *return type* method (*arguments*);

2. Compile Java source code and obtain the class files
3. Generate C/C++ headers for the native methods; javah gets the info it needs from the class files
4. Write the C/C++ source code for the native method using the function prototype from the generated include file and the typedefs from include/jni.h
5. Compile the C/C++ with the right header files
6. Use the linker to create a dynamic library file
7. Execute a Java program that loads the dynamic library

static {
System.loadLibrary("*dynamic libary*"); }

Java I/O & Serialization + JNI
for easy sharing

# Section Conclusions

Java I/O helps the Java programmers to save / restore data to / from HDD – Hard-disk, SAN – Storage Area Network or Network – it is even in behind of database communications – JDCB.

Java I/O is divided in input / output streams that operates over byte level and readers / writers at char level. Both streams and readers / writers may be specialized to work with primitive data and even objects.

Java Serialization mechanisms helps the developers to save / restore the objects / instances from HDD, Network, SAN or JDBC-BLOB.

JNI – Java Native Interface is the intermediary bridge between JVM – Java Virtual Machine and OS – Operating System.

J-Unit Simple Example using Annotation, Full Intro in SQE/QA lectures

# J-Unit Minimal Intro

# 3. J-Unit Minimal Intro

Testing is the process of checking the functionality of an application to ensure it runs as per requirements. Unit testing comes into picture at the developers' level; it is the testing of single entity (class or method). Unit testing plays a critical role in helping a software company deliver quality products to its customers. Unit testing can be done in two ways – manual testing and automated testing.

| Manual Testing | Automated Testing |
|---|---|
| Executing a test cases manually without any tool support is known as manual testing. | Taking tool support and executing the test cases by using an automation tool is known as automation testing. |
| **Time-consuming and tedious** – Since test cases are executed by human resources, it is very slow and tedious. | **Fast** – Automation runs test cases significantly faster than human resources. |
| **Huge investment in human resources** – As test cases need to be executed manually, more testers are required in manual testing. | **Less investment in human resources** – Test cases are executed using automation tools, so less number of testers are required in automation testing. |
| **Less reliable** – Manual testing is less reliable, as it has to account for human errors. | **More reliable** – Automation tests are precise and reliable. |
| **Non-programmable** – No programming can be done to write sophisticated tests to fetch hidden information. | **Programmable** – Testers can program sophisticated tests to bring out hidden information |

**Full intro in SQE/QA lectures**

# 3. J-Unit Minimal Intro

**Full Intro in SQE/QA lectures**

## What is JUnit?

JUnit is a unit testing framework for Java programming language. It plays a crucial role test-driven development, and is a family of unit testing frameworks collectively known as xUnit.

**JUnit** promotes the idea of **"first testing then coding",** which emphasizes on setting up the test data for a piece of code that can be tested first and then implemented. This approach is like "test a little, code a little, test a little, code a little." It increases the productivity of the programmer and the stability of program code, which in turn reduces the stress on the programmer and the time spent on debugging.

# 3. J-Unit Minimal Intro

**Features of JUnit**

**Full Intro in SQE/QA lectures**

- JUnit is an open source framework, which is used for writing and running tests.
- Provides annotations to identify test methods.
- Provides assertions for testing expected results.
- Provides test runners for running tests.
- JUnit tests allow you to write codes faster, which increases quality.
- JUnit is elegantly simple. It is less complex and takes less time.
- JUnit tests can be run automatically and they check their own results and provide immediate feedback. There's no need to manually comb through a report of test results.
- JUnit tests can be organized into test suites containing test cases and even other test suites. JUnit in IDE shows test progress in a bar that is green if the test is running smoothly, and it turns red when a test fails.

**What is a Unit Test Case ?**

A Unit Test Case is a part of code, which ensures that another part of code (method) works as expected. To achieve the desired results quickly, a test framework is required. JUnit is a perfect unit test framework for Java programming language. A formal written unit test case is characterized by a known input and an expected output, which is worked out before the test is executed. The known input should test a precondition and the expected output should test a post-condition. There must be at least two unit test cases for each requirement – one positive test and one negative test. If a requirement has sub-requirements, each sub-requirement must have at least two test cases as positive and negative.

# 3. J-Unit Minimal Intro

## Full Intro in SQE/QA lectures

JUnit is a **Regression Testing Framework** used by developers to implement unit testing in Java, and accelerate programming speed and increase the quality of code. JUnit Framework can be easily integrated with either of the following –

- IDEs: e.g. Eclipse / IntelliJ IDEA
- Ant
- Maven
- Gradle

**Features of JUnit Test Framework**

JUnit test framework provides the following important features –

- Fixtures
- Test suites
- Test runners
- JUnit classes

# 3. J-Unit Minimal Intro

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1. Download J-Unit 4 JAR for compiling:
https://github.com/downloads/junit-team/junit/junit-4.10.jar
http://search.maven.org/remotecontent?filepath=junit/junit/4.12/junit-4.12.jar

2. Download JAR for running Junit tests and tests suites:
http://search.maven.org/remotecontent?filepath=org/hamcrest/hamcrest-core/1.3/hamcrest-core-1.3.jar

3. Run examples of J-Unit tests and tests suites as reference sample for using annotations and reflection.

Questions & Answers!

# Thanks!

Java Programming
End of Lecture 5 – summary of Java SE