Tony Valderrama, SIPB IAP 2010

PROGRAMMING IN

Today

- Java API
  - java.util
  - java.io
- More OOP
  - Generics
  - Enum
- .jar files
- JNI
- Q & A

Announcements

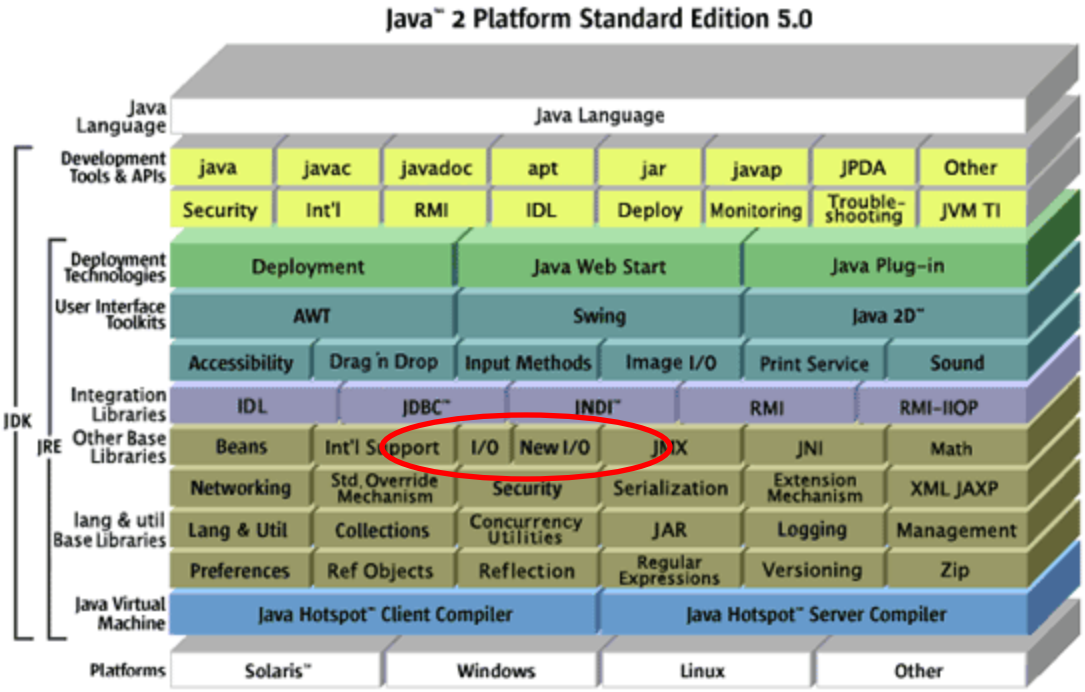
Course website: http://sipb.mit.edu/iap/java/

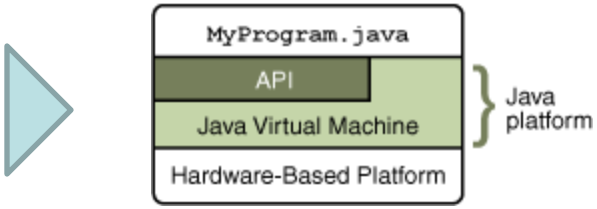
Email: sipb-iap-java@mit.edu

JAVA API

java.io

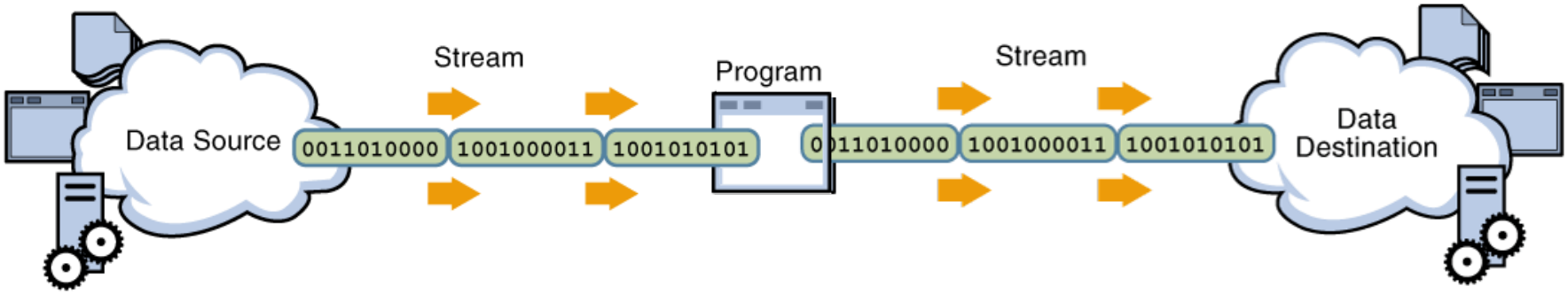
package java.io





Images from the Java Tutorial

I/O Streams



- socket
- file
- database
- byte array

<u>process data</u>

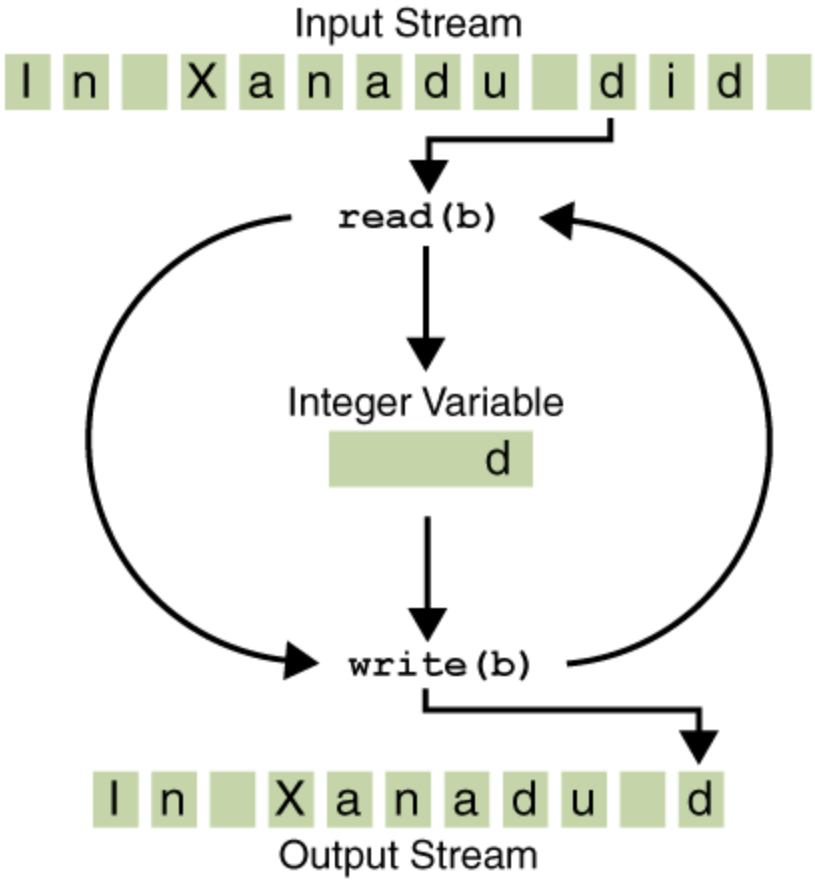
- transform
- split
- buffer

- socket
- file
- database
- byte array

```
// Always close your streams!
try {
    // doProcessing
} finally {
    stream.close();
}
```

Images from The Java Tutorial

Byte streams



Examples: CopyBytes.java, CopyCharacters.java, CopyLines.java

Other kinds of I/O

Standard:

- System.in
- System.out
- System.err

java.net.Socket:

- socket.getInputStream()
- socket.getOutputStream()

Serialization

- java.io.ObjectOutputStream
- java.io.ObjectInputStream

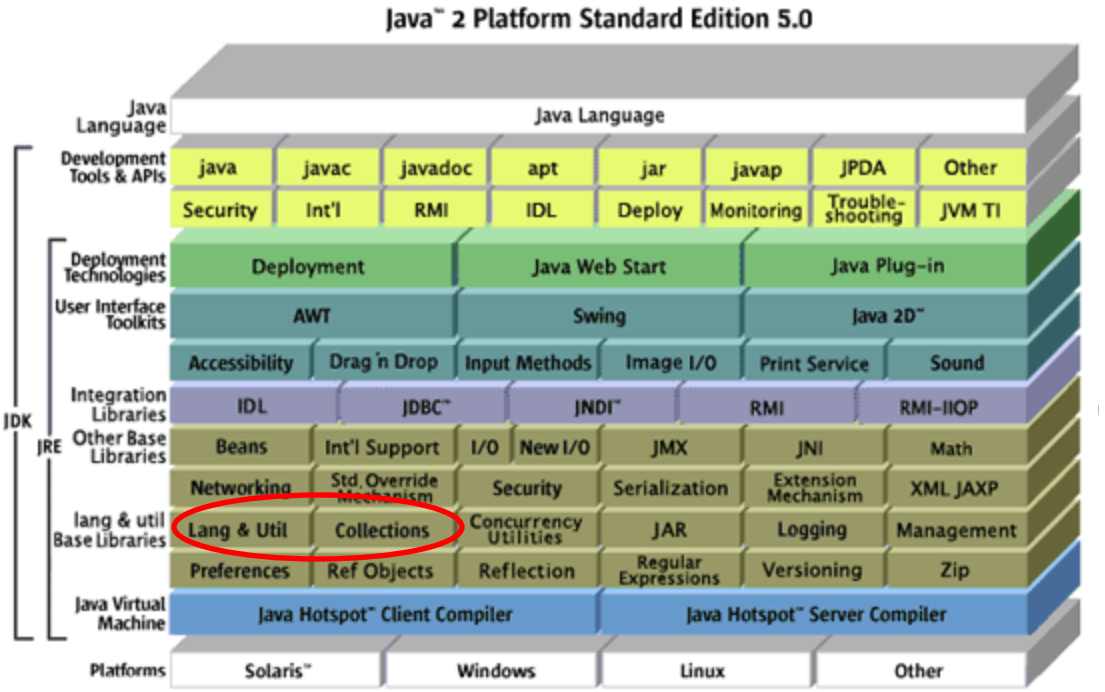
Interacting with the user

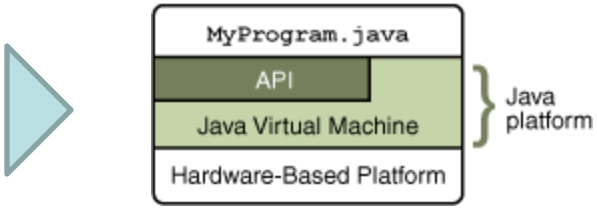
```
// construct a java.io.BufferedReader
BufferedReader in = new BufferedReader(
                            new InputStreamReader(System.in));
in.readLine();


// CAREFUL! This only exists when java is started from the command line
Console c = System.console();
c.readLine();
char[] passwd;
if ((passwd = c.readPassword("[%s]", "Password:")) != null) {
    // verify password
    java.util.Arrays.fill(passwd, ' ');
}

// use java.util.Scanner
Scanner s = new Scanner(System.in);
s.nextLine();
s.next(); // next parsing token (word, by default)
```

JAVA API

java.util

package java.util





Images from the Java Tutorial

Collection

At the most abstract level, a group of Objects.

```
package java.util;

public interface Collection {

    public boolean add(Object o);
    public void remove(Object o);
    public boolean contains(Object o);
    public int size(); // number of objects

    // returns true if it contains all elements in the given Collection.
    public boolean containsAll(Collection c);
    // adds all elements in the given Collection
    public boolean addAll(Collection c);
    // removes all elements in the given Collection from self.
    public boolean removeAll(Collection c);
    // removes all elements from the Collection.
    public void clear();

    // and more...
}
```

Data Structures

Each implementation is suited to a different situation:

General-purpose Implementations

Interfaces	Implementations				
	Hash table	**Resizable array**	**Tree**	**Linked list**	**Hash table + Linked list**
Set	HashSet		TreeSet		LinkedHashSet
List		ArrayList		LinkedList	
Queue				LinkedList	
Map	HashMap		TreeMap		LinkedHashMap

Collections

Allows abstract manipulation of collections.

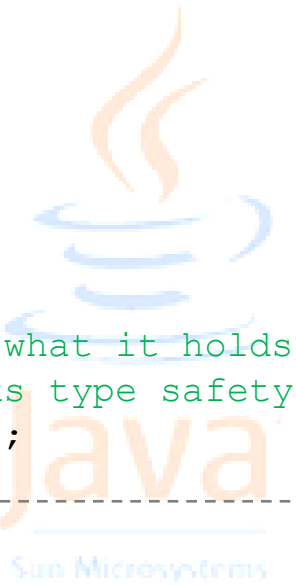
```
public class java.util.Collections {

    public static Object min(List);
    public static Object max(List);
    public static void fill(Object, List);
    public static void reverse(List);
    // guarantees n log(n) time --> optimized merge sort
    public static void sort(List);
    public static void shuffle(List);
    public static int frequency(Object, Collection);
    public static boolean disjoint(Collection, Collection);


    // and more...
}
```

ArrayList

```
List l = new ArrayList();

l.add(2);
l.add(3);
l.add(1);

Collections.sort(l);

System.out.print(l.toString());
```

The problem with generic utilities

```
List l = new ArrayList();

l.add(2);
l.add(3);
l.add(1);

Collections.sort(l);

// Data structure doesn't know what it holds at compile-time!
// We have to cast, which breaks type safety
Integer min = (Integer)l.get(0);
```



GENERICS

<Generics> to the rescue!

```
package java.util;

public interface List {

    public boolean add(Object o);
    public Object get();
    public int size(); // number of objects

    // adds all elements in the given Collection
    public boolean addAll(Collection c);
    // returns true if it contains all elements in the given Collection.
    public boolean containsAll(Collection c);
    // removes all elements in the given Collection from self.
    public boolean removeAll(Collection c);

    // removes all elements from the Collection.
    public void clear();

    // and more...
}
```

<Generics> to the rescue!

```
package java.util;

public interface List<E> {

    public boolean add(E o);
    public E get();
    public int size(); // number of objects

    // adds all elements in the given Collection
    public boolean addAll(Collection <? extends E> c);

    // and more...
}
```

```
public interface Map<K,V> {
    public V put(K key, V value);
    public V get(K key);
    public void putAll(Map<? extends K,? extends V>);
}
```

Caveats...

```
List<Integer> l = new ArrayList<Integer>();

l.add(1);
l.add(2);


// what if this were possible?
List<Number> m = l;


// this is perfectly valid
m.clear();
m.add(Math.PI);


// uh oh!
Integer i = l.get(0);
```

Wildcards

```
List<?> ints = new ArrayList<Integer>()

ints.add(0);
ints.add(2);

// valid
List<?> list = ints;
int size = list.size()

// CAN'T DO THIS! Unkown type --> compile time error
list.add(1);


// bounded wildcards
public <E> getRandomElement(List<? extends E> list){
    return list.get((int)(Math.random()*list.size()));
}

public void insertElementRandomly(T element, List<? super T> list) {
    list.add(element, (int)(Math.random()*list.size());
}
```

Type erasure

```
public class MyClass<E> {
    public static void myMethod(Object item) {
        if (item instanceof E) {
            //Compiler error
        }
        E item2 = new E();          //Compiler error
        E[] iArray = new E[10];     //Compiler error
        E obj = (E)new Object(); //Unchecked cast warning
    }

    public static void discoverClass(E item){
        item.getClass();            // every Object can do this
    }
}
```

ENUM

Enums

```
public class Day {
    public static final int
        SUNDAY = 1,
        MONDAY = 2,
        TUESDAY = 3,
        WEDNESDAY = 4,
        THURSDAY = 5,
        FRIDAY = 6,
        SATURDAY = 7;

    private int day;
    public Day(int day){this.day = day; }

    public boolean isWeekend(){
        switch (day) {
            case MONDAY: case TUESDAY: case WEDNESDAY:
            case THURSDAY: case FRIDAY:
                return true;
            case SATURDAY: case SUNDAY: default:
                return true;
        }
    }
}
```

Enums

```
enum Day {
    SUNDAY(true), MONDAY(false), TUESDAY(false), WEDNESDAY(false),
    THURSDAY(false), FRIDAY(false), SATURDAY(true);

    public final boolean isWeekend;
    // constructor
    Day(boolean isWeekend){ this.isWeekend = isWeekend; }
}

Day d = Day.SUNDAY;
boolean b = d.isWeekend;

switch(d){
    case SUNDAY: //...
    case MONDAY: //...
}



// if it's just to keep track of state
enum ThreadState{ STOPPED, RUNNING, WAITING }
```

JAR files

```
C:\$> javac tvald\applet\AnimatedApplet.java
C:\$> javac tvald\intro2java\examples\day4\DemoApplet.java

C:\$> jar cf DemoApplet.jar tvald\applet\AnimatedApplet.class tvald\int
ro2java\examples\day4\DemoApplet*

C:\$> dir
. .. tvald DemoApplet.jar
```

To create a JAR file: `jar cf jar-file input-file(s)`

To view contents: `jar tf jar-file`

To extract contents: `jar xf jar-file`

To run a JAR app: `java -jar app.jar`

Applets from JARs: `<applet code="foo.class" archive="foo.jar"></applet>`

Java Native Interface (JNI)

```
http://java.sun.com/developer/onlineTraining/Programming/JDCBook/jniexamp.html#comp

native <type> name(args...);

static { System.loadLibrary("nativelib"); }

// on the command line -> generates c/c++ header file
$> javah -jni Foo.java

/* Class: ReadFile
 * Method: loadFile
 * Signature: (Ljava/lang/String;)[B
 */
JNIEXPORT jbyteArray JNICALL Java_ReadFile_loadFile
        (JNIEnv *, jobject, jstring,...);

// implement this method in C or C++
// compile it with gcc as a dynamic or shared object library
// stick it where LD_LIBRARY_PATH will find it

$> java Foo
```

Thanks for coming!