CS202 Java Object Oriented Programming

Common Utility Classes and Methods

Chengyu Sun
California State University, Los Angeles

System.out

```
System.out.println( 3 );
System.out.println( 3.5 );
System.out.println( 'a' );
System.out.println( "Welcome to Java!" );
System.out.println( 3+4*5 );
System.out.println( !true || false );
System.out.println( "sum of 1+1 is " + (1+1) ); // coercion at work

System.out.print( 3+4*5 );
System.out.print( '\n' ); // \n is the newline character
System.out.print( '\t' ); // \t is the tab character
System.out.print( "\n\n\n\n" );
```

- System.out is easy to use
- System.in is not nearly so

ConsoleReader

- A wrapper of System.in
- Provides three methods:
  - `readLine()`
  - `readInt()`
  - `readDouble()`
- Available from the class homepage

ConsoleReader Usage – Code

```
/**
 * Usage test. read an integer and a double, and output
 * their sum.
 */
public static void main( String args[] )
{
  ConsoleReader in = new ConsoleReader();

  int a = in.readInt();
  double b = in.readDouble();

  System.out.println( a + " + " + b + " = " + (a+b) );
}
```

ConsoleReader Usage – Files

- Download ConsoleReader.java from the class homepage
- Copy it to the directory where your programs are
- Compile and run your programs as before
- NOTE: if you use Netbeans, and your program has a line says "package xxx.xx;", you need to add the same line to the beginning of ConsoleReader.java

Math

- Common constants and functions for mathematic calculation
- Fields
  - `E` and `PI`
- Methods
  - `random`, `abs`, `max`, `min`
  - `sin`, `cos`, `tan`, `asin`, `acos`, `atan`
  - `pow`, `sqrt`, `log`, `exp`
  - `ceil`, `floor`, `round`
- All members are `static`

Usage of Math Constants and Functions

```
double radius = 10.0; // radius of a circle
double area = Math.PI * radius * radius; // area of a circle

double a = 10.7;
long ta = (long) a; // truncation
long la = Math.round(a); // rounding

double x1 = y1 = 1.0;
double x2 = y2 = 2.0;

double distance; // distance between (x1,y1) and (x2,y2)
distance = Math.sqrt( (x1-x2)*(x1-x2) + (y1-y2)*(y1-y2) );
```

Random Number Generation

- Extremely important for scientific experiments and simulations
- Very useful for software testing and profiling
- And a good way to populate an array

Usage of Math.random()

- Returns a random `double` value in [0,1)
- Example: populate an array of size 10 with random integers in the range [23,35]
  - Or in the range [m,n]??

```
int a[] = new int[10];
for( int i=0 ; i < a.length ; ++i )
    a[i] = ??
```

Format Numerical Output

- DecimalFormat class
  - Constructor
    - DecimalFormat(String *pattern*)
  - String format(double num)
  - String format(long num)
- Symbols for *pattern*
  - 0, #, ., -, E, %, $

Usage of DecimalFormat

```
import java.text.DecimalFormat;
… …

double a = 1000.355;
double b = 0.765;
int c = 7354;

DecimalFormat f1 = new DecimalFormat( "##.##" );
DecimalFormat f2 = new DecimalFormat( "00.00" );

System.out.println( f1.format(a) );      // be ware of the
System.out.println( f1.format(b) );      // rounding behavior
System.out.println( f2.format(c) );
```

- Exercise: "$##.00", "0.##%", "0.000E0"

Timing

- The best way to appreciate a good algorithm is to see how fast it runs
- And time it
- Exercise: compare the speed of sequential search and binary search

System.currentTimeMillis

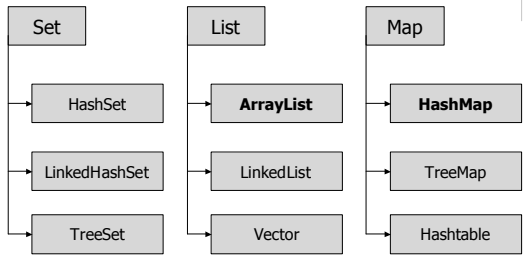
- Returns the current time in milliseconds
- We don't care about *current time*
- We do care about *elapsed time*
- NOTE: cTM is not very accurate

```
long startTime = System.currentTimeMillis();

/* some slow code here */
…

long endTime = System.currentTimeMillis();

System.out.println( startTime - endTime );
```

Arrays Are Not Enough

- The Good
  - Easy to use
  - Space efficient
  - Constant time to access an array element
- The Bad
  - Cannot dynamically add or remove elements

Collection Framework For Dummies



Choose From Collections

- Set
  - Elements are objects
  - No duplicates
- List
  - Elements are objects
  - Allow duplicates
- Map
  - Elements are *object pairs* <key,value>
  - No duplicate *keys*

Benefits and Limitations of Collection Classes

- Benefits
  - Resizable
  - Elements can be of any class type
- Limitation
  - Cannot hold values of primitive types
  - Element access via an `Object` reference

ArrayList

- Resizable array of `Object`
- Important methods
  - ArrayList()
  - add(Object o), remove(int index), get(int index)
  - contains(Object o), indexOf(Object o)
  - size()
  - isEmpty(), clear()

ArrayList Example

```
ArrayList a = new ArrayList();
…
a.add( new Integer.valueOf(st.nextToken()) );
…

int index = -1;
for( int i=0 ; i < a.size() ; ++i )
   if( ?? )
   {
      index = i;
      break;
   }

System.out.println( "found at index " + index );
```

HashMap

- Resizable array of `Object` pairs
- Important methods
  - HashMap()
  - put(Object key, Object value)
  - get(Object key)
  - containsKey(Object key), containsValue(Object value)
  - size(), clear()
  - keySet()

Iterator and Enumeration

- Iterator
  - hasNext()
  - next()
- Enumeration
  - hasMoreElements()
  - nextElement()
- Sequential access of elements
- Iterator is preferred

HashMap Example

- Lab 4, Ex.2