Java characters
Lecture 8

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Presentation outline

Estimated duration presentation

Questions at end presentation

Topics discussed:

- Method and constructor parameters
- Boxing & Autoboxing
- String class
- Character class
- Randomness
- Conditional operator (?:)
- Precedence

Primitives

Passed as parameters

Primitive object passed as parameter:

- Copy passed to method
- Change copy in method
- Variable outside method unchanged

```
public class ArrayParameters {
    public static void testPrimitiveParam (){
        int val = 0;
        System.out.println.(val);//prints 0
        modifyPrimitive(val);
        System.out.println(val);//prints 0
    }
    public static void modifyPrimitive(int v) {
        v = 100;
    }
}
```

Arrays

Passed as parameters

Array reference passed as parameter:

- Argument references same object before and after call
- Changes to array in method persist outside method

```
public class ArrayParameterPassing {
    public static void testArrayParam() {
        int[] ar = {1,2,3};
        System.out.println(ar[2]);//prints 3
        modifyArray(ar);
        System.out.println(ar[2]);//prints 100
    }
    public static void modifyArray(int[] a) {
        a[2] = 100;
    }
}
```

Wrapper class

AutoBoxing (Boxing & Unboxing)

- Applies to wrapper classes such as Integer, Byte and so on
- Eight wrapper classes Java 7
- Example: automatic conversion from primitive *int* to *Integer*
- Known as **boxing**
- Useful as keys in collections, e.g. ArrayList where primitives disallowed

```
//Boxing
//ArrayList<int> values: <-------not allowed
// Below i is autoboxed through method invocation.
ArrayList<Integer> values = new ArrayList<>();
for (int i = 0; i < 10; i += 1) {
    values.add(i);
}
```

Wrapper class

Unboxing

- Example: automatic conversion from *Integer* object to *int*
- Referred to as **unboxing**

```
ArrayList<Integer> values = new ArrayList<>();
for (int i = 0; i < 10; i += 1) {
    values.add(i);
}
int[] ar = new int[values.size()];
for (int i = 0; i < ar.length; i += 1)
{
  ar[i] = values.get(i);
  System.out.println(ar[i]);
}
```

Wrapper class

Unboxing

```
ArrayList<Double> ar = new ArrayList<>();
ar.add(3.1416); // PI is autoboxed through method invocation.
//Unboxing through assignment
double pi = ar.get(0);
System.out.println("pi = " + pi);
```

Java String class

Has several constructors and methods

- `compareTo(String anotherString)`
- `toUpperCase()`
- `equalsIgnoreCase(String anotherString`
- `length()`
- `valueOf(int i)` //int to String

```
//string literal
String str = new String("textwidth");
int length = str.length();
//converts textwidth to TEXTWIDTH
str.toUpperCase();
```

```
//creates string "100" referenced by str
String str = String.valueOf(100);
String str2 = "online";
//compares str and str2, returning false
      unless both strings equivalent
str.equalsIgnoreCase(str2);
```

Java String class

Manipulate characters in String object

- String an ordered collection characters
- Zero-indexed array
- `charAt(int pos)` accesses character at position pos

Concatenate string objects

- `concat(String str)` concatenates str to existing string
- Overloaded + operator achieves same effect

```
String str = "TEXT"
str.charAt(0) is "T"
str.charAt(1) is "E"
str.charAt(2) is "X"
str.charAt(3) is "T"
```

```
String s3 = "why ";
String s4 = "not?";
String s5 = s3 + s4;
System.out.println("s3 + s4 " + s5);
System.out.println("s3 + s4 "+s3.concat(s4));
//both statements output: s3 + s4 why not?
```

String objects immutable

Health warning: String objects once created cannot be modified
References below list other similar cases such as wrapper classes, example:

- Integer
- Byte
- Long

```
String str = new String("java");
//str is reference pointing to string object "java"
str.toUpperCase();//has no effect. Produces no warning.
System.out.println(str);//outputs java, not JAVA
str = "JAVA";//reference str points to different object
System.out.println(str);//outputs JAVA
```

String objects immutable

Easy to think otherwise

```
String s1 = new String("java");
System.out.println(s1); // Output: java
s1.toUpperCase();
System.out.println(s1); // Output: java
System.out.println(s1.toUpperCase()); // Output: JAVA
```

Character

Java primitive

- char is a primitive Java type
  - `char ch = 'a';`
  - `System.out.println(ch);`
    - outputs **a**
- Expose underlying integer representation
  - `int chInt = (int)ch;`
  - `System.out.println(chInt);`
    - outputs **97**

Character

Java wrapper class

- Facilitates use of *char* where object required

```
/* This code snippet outputs:
 * a A
 */
Character c = new Character('a');
ArrayList<Character> characters = new ArrayList<>();
characters.add(c);
characters.add('A');
for (Character character : characters)
{
    System.out.print(character + " ");
}
```

Character class

Some useful methods

- Determines if character `ch` is a digit
  - static boolean `isDigit`(char `ch`)
- Determines if character `ch` is a letter
  - static boolean `isLetter`(char `ch`)
- Determines if character `ch` is letter or digit
  - static boolean `isLetterOrDigit`(char `ch`)
- Determines if character `ch` is a lowercase
  - static boolean `isLowerCase`(char `ch`)
- Determines if character `ch` is upper case
  - static boolean `isUpperCase`(char `ch`)
- Determines if character `ch` is whitespace (space or tab)
  - static boolean `isWhitespace`(char `ch`)
- Converts character `ch` to lower case
  - static char `toLowerCase`(char `ch`)
- Converts character `ch` to upper case
  - static char `toUpperCase`(char `ch`)

Character class

Example isDigit method

```
public static void testIsDigit() {

    Character ch = 'a';
    boolean b = Character.isDigit(ch);

    if (b) {
      System.out.println("The character " + ch + " is a digit");
    }
    else {
      System.out.println("The character " + ch + " is not a digit");
    }
}
```

Java primitive *char*

Arithmetic

- Because **char** has underlying integer representation
- May be used in arithmetic expressions
  - Example: `'A'` convertible to 65
  - Example: `'B'` convertible to 66
- Character arithmetic used in method `isValid`

```
static boolean isValid2(String pin)
{
    for (int i = 1; i < pin.length(); i++)
    {
        if ((pin.charAt(i) - pin.charAt(i-1)) != 1)
        {
            return true;
        }
    }
    return false;
}
```

Number systems

Used in computing

Binary (base 2)

- 0,1
- 26 in binary: int binVal = 0b11010;

Decimal (base 10)

- 0,1,2,3,4,5,6,7,8,9
- 26 in decimal: int decVal = 26;

Hexadecimal (base 16)

- 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
- 26 in hex: int hexVal = 0x1a

Octal (base 8) sometimes used.

Binary	Decimal	Hexadecimal
1111	15	F
11111111	255	FF

Character encoding

Americal Standard Code for Information Exchange (ASCII)

Represents text in devices such as computers & printers
Character encoding scheme based on English alphabet
Encodes 128 specified characters, 33 non-printable, 95 printable

- 0 to 9
- a to z
- A to Z
- Some punctuation
- Control codes: example non-printable line feed, carriage return
- Blank space

Character encoding

Unicode standard

A superset of ASCII

Presently represents more than 110,000 characters

In excess of 100 scripts, for example:

- Left to right: Latin (English) Cyrillic (Russian) scripts
- Right to left: Arabic, Hebrew scripts
- Various symbols
- Implemented in:
  - Many operating systems
  - XML
  - Java

Several Unicode encodings exist

In excess 80% *www* uses UTF-8

- 1 byte (8 bits) used for ASCII chars

Character encoding

Examples

```
char c1 = 0x41;
char c2 = 65;
//Both output the letter A
System.out.println("char1 : " + char1);
System.out.println("char2 : " + char2);
```

ASCII	Hex	Symbol	ASCII	Hex	Symbol
96	60	`	112	70	p
97	61	a	113	71	q
98	62	b	114	72	r
99	63	c	115	73	s
100	64	d	116	74	t
101	65	e	117	75	u
102	66	f	118	76	v
103	67	g	119	77	w

Randomness

Generating random numbers

Many libraries available to generate (pseudo) random numbers

```
//Using Math.random()
//Returns a double value with a positive sign,
//greater than or equal to 0.0 and less than 1.0 : range [0 1).
StdOut.print("Pseudo-random number range [2,8] using Math library: ");
double rval = Math.random();
int rval1 = (int)(rval*7 + 2);
StdOut.print(rval1);
//Typical output: Pseudo-random number range [2,8] using Math library: 5
```

```
//Using java.util.Random
//Random nextInt(int n) generates random number in range [0 n)
StdOut.print("\nPseudo-random number range [2,8] using java.util library: ");
Random random = new Random();
int rval2 = random.nextInt(7) + 2;
StdOut.print(rval2);
//Typical output: Pseudo-random number range [2,8] using java.util library: 3
```

Java primitive *char*

Arithmetic

- Generate a random character

```
public static char randomCharacter()
{
    return (char) ('A' + (int) (Math.random()*26));
}
```

- Test range

```
public static boolean isDigit(char ch)
{
    return (ch >= '0' && ch <= '9');
}
```

Unicode Special Characters

Table of Escape sequences

An escape sequence comprises a character preceded by backslash.

`\n`	Newline (moves to the next line)
`\b`	Backspace
`\f`	Form feed (starts a new page)
`\r`	Return to the beginning of the current line
`\t`	Tab (moves horizontally to the next tab stop)
`\\`	The backslash character itself
`\'`	The character ' (required only in character constants)
`\"`	The character " (required only in string constants)
`\ddd`	Character whose Unicode value octal number `ddd`

Java Operator

Ternary

Conditional operator ?:

- Also known as *ternary* operator
- Can be thought of as *if-then-else* operator
- If condition true assign value1 else value2

```
int value1 = 1;
int value2 = 2;
int result;
boolean someCondition = true;
result = someCondition ? value1 : value2;
```

Java Operator

Ternary

A method to return the absolute value of an integer:

```
public static int absoluteValue(int a)
{
    if (a < 0) {
        return -a;
    }
    return a;
}
```

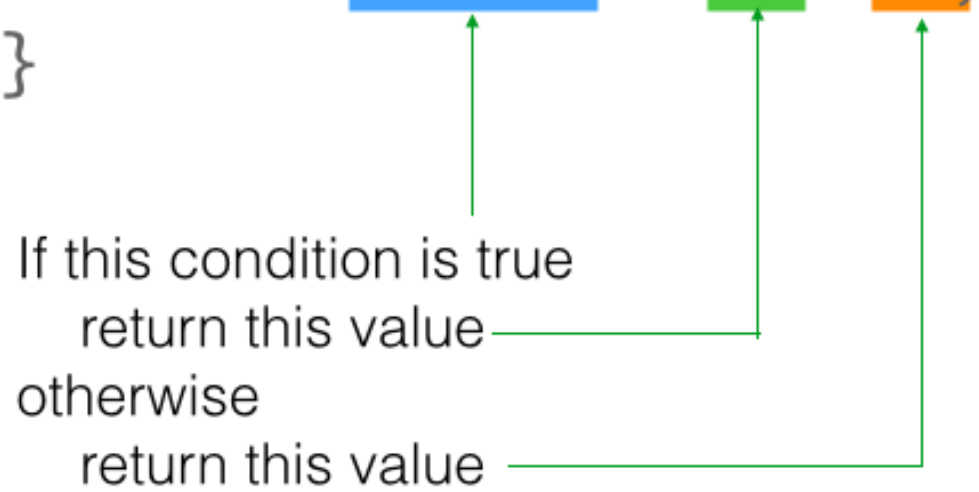
Alternative versions using ternary or conditional operator

```
public static int absoluteValue(int a)
{
    return a < 0 ? -a : a;
}
```

Java Operator

Ternary

```
public static int absoluteValue(int a)
{
   return a < 0 ? -a : a;
}
```



Operator Precedence

See the complete table listed in references

Order of evaluation rules

- Highest precedence include parentheses and array access
- Multiplication & division before addition & subtraction
- Logical operators lower than multiplication
- Lowest precedences ternary followed by assignment
- If in doubt use parens

Operators	Precedence
postfix	*expr*++ *expr*--
unary	++expr --expr !
multiplicative	* / %
additive	+ -
relational	< > <= >=
equality	!= ==
logical AND	&&
logical OR	||
ternary	? :
assignment	= += -= *= /= %=

Summary

- String class
  - comprises character array
  - String objects immutable
- Character class
  - primitive type
  - can represent keyboard characters
  - has underlying integer representation
  - examined some of its methods
- Number systems
  - decimal
  - binary
  - hexadcimal
  - octal
- Character encoding
  - ASCII
  - Unicode, example UTF-8

Summary

- String class
  - One of most widely used classes
- Randomness
  - Math and java.util packages
  - how to generate random character
  - Unicode special characters
- Conditional operator (?:)
  - also known as *ternary* operator
- Precedence
  - rules for order of evaluation
- Arrays
  - zero index based
  - comparison with ArrayList
- Boxing & Autoboxing

Referenced Material

1. Operator Precedence

`http://docs.oracle.com/javase/tutorial/java/nutsandbolts/operators.html`

[Accessed 2014-05-17]

2. Characters

`http://docs.oracle.com/javase/tutorial/java/data/characters.html`

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3. ASCII

`http://en.wikipedia.org/wiki/ASCII`

[Accessed 2015-02-19]

Referenced Material

4. Unicode

`http://en.wikipedia.org/wiki/UTF-8`

[Accessed 2015-02-19]

5. Binary to Decimal to Hexadecimal Converter

`http://www.mathsisfun.com/binary-decimal-hexadecimal-converter.html`

[Accessed 2015-02-19]

Referenced Material

6. ASCII Table

`http://ascii.cl/`

[Accessed 2015-02-19]

7. Immutable classes

`http://stackoverflow.com/questions/5124012/examples-of-immutable-classes` [Accessed 2015-02-23]