Selections, and Mathematical Functions, Characters, and Strings

Introduction to Programming and Computational Problem Solving - 2
CSE 8B
Lecture 3
Announcements

• Assignment 1 is due Apr 6, 11:59 PM
• Assignment 2 will be released Apr 6
  – Due Apr 13, 11:59 PM
• Reading
  – Liang
    • Chapters 3 and 4
The boolean type and operators

• Often in a program you need to compare two values, such as whether $i$ is greater than $j$
• Java provides six comparison operators (also known as relational operators) that can be used to compare two values
• The result of the comparison is a Boolean value: true or false
• For example
  ```java
  boolean b = (1 > 2);
  ```
# Relational operators

<table>
<thead>
<tr>
<th>Java Operator</th>
<th>Mathematics Symbol</th>
<th>Name</th>
<th>Example</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>&lt;</td>
<td>less than</td>
<td>radius &lt; 0</td>
<td>false</td>
</tr>
<tr>
<td>&lt;=</td>
<td>≤</td>
<td>less than or equal to</td>
<td>radius &lt;= 0</td>
<td>false</td>
</tr>
<tr>
<td>&gt;</td>
<td>&gt;</td>
<td>greater than</td>
<td>radius &gt; 0</td>
<td>true</td>
</tr>
<tr>
<td>&gt;=</td>
<td>≥</td>
<td>greater than or equal to</td>
<td>radius &gt;= 0</td>
<td>true</td>
</tr>
<tr>
<td>==</td>
<td>=</td>
<td>equal to</td>
<td>radius == 0</td>
<td>false</td>
</tr>
<tr>
<td>!=</td>
<td>≠</td>
<td>not equal to</td>
<td>radius != 0</td>
<td>true</td>
</tr>
</tbody>
</table>
if statements

if (boolean-expression) {
    statement(s);
}

Braces are optional for a single statement; however, it is best practice (less error prone) to always use braces
if statements

if (radius >= 0) {
    area = radius * radius * PI;
    System.out.println("The area for the circle of radius "+
                        + radius + " is " + area);
}
if-else statements

if (boolean-expression) {
    statement(s)-for-the-true-case;
}
else {
    statement(s)-for-the-false-case;
}

Braces are optional for a single statement; however, it is best practice (less error prone) to always use braces.
if-else statements

if (radius >= 0) {
    area = radius * radius * 3.14159;
    System.out.println("The area for the " + "circle of radius " + radius + " is " + area);
}
else {
    System.out.println("Negative input");
}
Conditional operator

(boolean-expression) ? expression1 : expression2

if (x > 0) {
    y = 1;
} else {
    y = -1;
}

is equivalent to

y = (x > 0) ? 1 : -1;
Multiple if-else statements

- If score is greater than or equal to 90, grade is A.
- If score is greater than or equal to 80 and less than 90, grade is B.
- If score is greater than or equal to 70 and less than 80, grade is C.
- If score is greater than or equal to 60 and less than 70, grade is D.
- If score is less than 60, grade is F.
Multiple if-else statements

```java
if (score >= 90.0)
    System.out.print("A");
else
    if (score >= 80.0)
        System.out.print("B");
    else
        if (score >= 70.0)
            System.out.print("C");
        else
            if (score >= 60.0)
                System.out.print("D");
            else
                System.out.print("F");
```
Nested statements

- The `else` clause matches the most recent `if` clause in the same block

```
int i = 1, j = 2, k = 3;
if (i > j)
  if (i > k)
    System.out.println("A");
else
  System.out.println("B");
```

(9)

Braces are optional for a single statement; however, it is best practice (less error prone) to **always use braces**

Nothing is printed
Nested statements

• To force the else clause to match the first if clause, you must add a pair of braces

```java
int i = 1;
int j = 2;
int k = 3;
if (i > j) {
    if (i > k)
        System.out.println("A");
} else
    System.out.println("B");
```

Braces are optional for a single statement; however, it is best practice (less error prone) to always use braces

B is printed
Less error prone

if (number % 2 == 0) 
  even = true;
else 
  even = false;

Equivalent

boolean even = number % 2 == 0;

if (even) 
  System.out.println( 
    "It is even." );

Equivalent

if (even == true) 
  System.out.println( 
    "It is even." );
## Logical operators

<table>
<thead>
<tr>
<th>Operator</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>not</td>
<td>logical negation</td>
</tr>
<tr>
<td>&amp;&amp;</td>
<td>and</td>
<td>logical conjunction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>^</td>
<td>exclusive or (xor)</td>
<td>logical exclusion</td>
</tr>
</tbody>
</table>
Truth table for operator \( \neg \)!

<table>
<thead>
<tr>
<th>( p )</th>
<th>( \neg p )</th>
<th><strong>Example:</strong> age = 24 and weight = 140</th>
</tr>
</thead>
<tbody>
<tr>
<td>true</td>
<td>false</td>
<td>( \neg (\text{age} &gt; 18) ) is false, because ( (\text{age} &gt; 18) ) is true</td>
</tr>
<tr>
<td>false</td>
<td>true</td>
<td>( \neg (\text{weight} == 150) ) is true, because ( (\text{weight} == 150) ) is false</td>
</tr>
</tbody>
</table>
# Truth table for operator &&

<table>
<thead>
<tr>
<th>$p_1$</th>
<th>$p_2$</th>
<th>$p_1 &amp;&amp; p_2$</th>
<th>Example: $\text{age} = 24$ and $\text{weight} = 140$</th>
</tr>
</thead>
<tbody>
<tr>
<td>false</td>
<td>false</td>
<td>false</td>
<td>$(\text{age} \leq 18) &amp;&amp; (\text{weight} &lt; 140)$ is false, because both conditions are false</td>
</tr>
<tr>
<td>false</td>
<td>true</td>
<td>false</td>
<td>$(\text{age} \leq 18) &amp;&amp; (\text{weight} \geq 140)$ is false, because $(\text{age} \leq 18)$ is false</td>
</tr>
<tr>
<td>true</td>
<td>false</td>
<td>false</td>
<td>$(\text{age} &gt; 18) &amp;&amp; (\text{weight} &gt; 140)$ is false, because $(\text{weight} &gt; 140)$ is false</td>
</tr>
<tr>
<td>true</td>
<td>true</td>
<td>true</td>
<td>$(\text{age} &gt; 18) &amp;&amp; (\text{weight} \geq 140)$ is true, because both conditions are true</td>
</tr>
</tbody>
</table>
Truth table for operator $\|\|

<table>
<thead>
<tr>
<th>$p_1$</th>
<th>$p_2$</th>
<th>$p_1 | p_2$</th>
<th>Example: age = 24 and weight = 140</th>
</tr>
</thead>
<tbody>
<tr>
<td>false</td>
<td>false</td>
<td>false</td>
<td>(age &gt; 34)</td>
</tr>
<tr>
<td>false</td>
<td>true</td>
<td>true</td>
<td>(age &gt; 34)</td>
</tr>
<tr>
<td>true</td>
<td>false</td>
<td>true</td>
<td>(age &gt; 14)</td>
</tr>
<tr>
<td>true</td>
<td>true</td>
<td>true</td>
<td>(age &gt; 14)</td>
</tr>
</tbody>
</table>
## Truth table for operator ^

<table>
<thead>
<tr>
<th>$p_1$</th>
<th>$p_2$</th>
<th>$p_1 \land p_2$</th>
<th>Example: $\text{age} = 24 \text{ and } \text{weight} = 140$</th>
</tr>
</thead>
<tbody>
<tr>
<td>false</td>
<td>false</td>
<td>false</td>
<td>(age &gt; 34) \land (weight &gt; 140) is false, because both conditions are false</td>
</tr>
<tr>
<td>false</td>
<td>true</td>
<td>true</td>
<td>(age &gt; 34) \land (weight &gt;= 140) is true, because (age &gt; 34) is false and (weight &gt;= 140) is true</td>
</tr>
<tr>
<td>true</td>
<td>false</td>
<td>true</td>
<td>(age &gt; 14) \land (weight &gt; 140) is true, because (age &gt; 14) is true and (weight &gt; 140) is false</td>
</tr>
<tr>
<td>true</td>
<td>true</td>
<td>false</td>
<td>(age &gt; 14) \land (weight &gt;= 140) is false, because both conditions are true</td>
</tr>
</tbody>
</table>
switch statements

• When the value in a case statement matches the value of the switch-expression, the statements starting from this case are executed until either a break statement or the end of the switch statement is reached

```java
switch (switch-expression) {
    case value1:  statement(s)1;
        break;
    case value2: statement(s)2;
        break;
    ...
    case valueN: statement(s)N;
        break;
    default: statement(s)-for-default;
}
```
switch statements

• The switch-expression must yield a value of char, byte, short, int or String type and must always be enclosed in parentheses
• The value1, ..., and valueN must have the same data type as the value of the switch-expression
• The resulting statements in the case statement are executed when the value in the case statement matches the value of the switch-expression
• Note that value1, ..., and valueN are constant expressions (i.e., they cannot contain variables in the expression, such as 1 + x)

```
switch (switch-expression) {
    case value1: statement(s)1;
                break;
    case value2: statement(s)2;
                break;
    ...
    case valueN: statement(s)N;
                break;
    default: statement(s)-for-default;
}
```
switch statements

• The keyword break is optional, but it should be used at the end of each case in order to terminate the remainder of the switch statement
  – If the break statement is not present, the next case statement will be executed

• The default case, which is optional, can be used to perform actions when none of the specified cases matches the switch-expression

switch (switch-expression) {
    case value1:  statement(s)1;
        break;
    case value2: statement(s)2;
        break;
    ...
    case valueN: statement(s)N;
        break;
    default: statement(s)-for-default;
}

The default case is optional; however, it is best practice (less error prone) to always have a default case
switch statements

- status is 0: Compute tax for single filers → break
- status is 1: Compute tax for married jointly or qualifying widow(er) → break
- status is 2: Compute tax for married filing separately → break
- status is 3: Compute tax for head of household → break
- default: Default actions
switch statements

```java
switch (status) {
    case 0:  compute taxes for single filers;
             break;
    case 1:  compute taxes for married file jointly;
             break;
    case 2:  compute taxes for married file separately;
             break;
    case 3:  compute taxes for head of household;
             break;
    default: System.out.println("Error: invalid status");
             System.exit(1);
}
```

The default case is optional; however, it is best practice (less error prone) to always have a default case.
switch statements

switch (day) {
    case 1:
    case 2:
    case 3:
    case 4:
    case 5:
        System.out.println("Weekday");
        break;
    case 0:  \ Fall-through
        break;
    case 6:  \ Fall-through
        System.out.println("Weekend");
}
}
Operator precedence

- ( ), var++, var--
- ++var, --var, +, - (unary plus and minus), ! (not)
- (type) casting
- *, /, % (multiplication, division, and remainder)
- +, - (binary addition and subtraction)
- <, <=, >, >= (relational operators)
- ==, != (equality)
- ^ (exclusive OR)
- && (AND)
- || (OR)
- =, +=, -=, *=, /=, %= (assignment operators)
Operator associativity

• When two operators with the same precedence are evaluated, the associativity of the operators determines the order of evaluation

• All binary operators except assignment operators are left-associative
  \[a - b + c - d\] is equivalent to \(((a - b) + c) - d\)

• Assignment operators are right-associative
  \[a = b += c = 5\] is equivalent to \[a = (b += (c = 5))\]
Operator precedence and associativity

• The expression in the parentheses is evaluated first
  – Parentheses can be nested, in which case the expression in the inner parentheses is executed first
• When evaluating an expression without parentheses, the operators are applied according to the precedence rule and the associativity rule
• If operators with the same precedence are next to each other, their associativity determines the order of evaluation
Mathematical functions

• Java provides many useful methods in the Math class for performing common mathematical functions

• Math class constants
  - PI
  - E

• Math class methods
  - Trigonometric methods
  - Exponent methods
  - Rounding methods
  - min, max, abs, and random methods
Trigonometric methods

Math.toDegrees(radians)
Math.toRadians(degrees)
Math.sin(radians)
Math.cos(radians)
Math.tan(radians)
Math.acos(a)
Math.asin(a)
Math.atan(a)
Exponent methods

Math.exp(a) \quad e^a
Math.log(a) \quad \log_e (a)
Math.log10(a) \quad \log_{10} (a)
Math.pow(a, b) \quad a^b
Math.sqrt(a) \quad \sqrt{a}
Rounding methods

Math.ceil(x)
Math.floor(x)
Math.rint(x)

• If you want to return an integer type, then

  int Math.round(float x)
    • Returns (int)Math.floor(x + 0.5f)

  long Math.round(double x)
    • Returns (long)Math.floor(x + 0.5)
min, max, abs, and random methods

Math.min(a, b)
Math.max(a, b)
Math.abs(a)
Math.random()

– Returns a random double value in the range [0.0, 1.0)
char data type

```java
char letter = 'A'; // ASCII
char numChar = '4'; // ASCII
char letter = '\u0041'; // Unicode
char numChar = '\u0034'; // Unicode
```

- Java characters use Unicode, a 16-bit encoding scheme established by the Unicode Consortium to support the interchange, processing, and display of written texts in the world’s diverse languages.

- Unicode takes two bytes, preceded by \u, expressed in four hexadecimal numbers that run from \u0000 to \uFFFF
  - Unicode can represent 65536 characters
# Common and special characters

<table>
<thead>
<tr>
<th>Characters</th>
<th>Code Value in Decimal</th>
<th>Unicode Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>'0' to '9'</td>
<td>48 to 57</td>
<td>\u0030 to \u0039</td>
</tr>
<tr>
<td>'A' to 'Z'</td>
<td>65 to 90</td>
<td>\u0041 to \u005A</td>
</tr>
<tr>
<td>'a' to 'z'</td>
<td>97 to 122</td>
<td>\u0061 to \u007A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Escape Sequence</th>
<th>Name</th>
<th>Unicode Code</th>
<th>Decimal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>\b</td>
<td>Backspace</td>
<td>\u0008</td>
<td>8</td>
</tr>
<tr>
<td>\t</td>
<td>Tab</td>
<td>\u0009</td>
<td>9</td>
</tr>
<tr>
<td>\n</td>
<td>Linefeed</td>
<td>\u000A</td>
<td>10</td>
</tr>
<tr>
<td>\f</td>
<td>Formfeed</td>
<td>\u000C</td>
<td>12</td>
</tr>
<tr>
<td>\r</td>
<td>Carriage Return</td>
<td>\u000D</td>
<td>13</td>
</tr>
<tr>
<td>\</td>
<td>Backslash</td>
<td>\u005C</td>
<td>92</td>
</tr>
<tr>
<td>&quot;&quot;</td>
<td>Double Quote</td>
<td>\u0022</td>
<td>34</td>
</tr>
</tbody>
</table>
Casting between char and numeric data types

```java
int i = 'a'; // Same as int i = (int)'a';

char c = 97; // Same as char c = (char)97;
```
Comparing and testing characters

if (ch >= 'A' && ch <= 'Z')
    System.out.println(ch + " is an uppercase letter");
else if (ch >= 'a' && ch <= 'z')
    System.out.println(ch + " is a lowercase letter");
else if (ch >= '0' && ch <= '9')
    System.out.println(ch + " is a numeric character");

• Methods in the char class

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>isDigit(ch)</td>
<td>Returns true if the specified character is a digit.</td>
</tr>
<tr>
<td>isLetter(ch)</td>
<td>Returns true if the specified character is a letter.</td>
</tr>
<tr>
<td>isLetterOrDigit(ch)</td>
<td>Returns true if the specified character is a letter or digit.</td>
</tr>
<tr>
<td>isLowerCase(ch)</td>
<td>Returns true if the specified character is a lowercase letter.</td>
</tr>
<tr>
<td>isUpperCase(ch)</td>
<td>Returns true if the specified character is an uppercase letter.</td>
</tr>
<tr>
<td>toLowerCase(ch)</td>
<td>Returns the lowercase of the specified character.</td>
</tr>
<tr>
<td>toUpperCase(ch)</td>
<td>Returns the uppercase of the specified character.</td>
</tr>
</tbody>
</table>
String type

• The char type only represents one character
• To represent a string of characters, use the String type
• String is a predefined class in the Java library (just like the System class and Scanner class)
  
```java
String message = "Welcome to Java";
```
• The String type is not a primitive type; it is known as a reference type
  – Any Java class can be used as a reference type for a variable
# Simple String methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>length()</td>
<td>Returns the number of characters in this string.</td>
</tr>
<tr>
<td>charAt(index)</td>
<td>Returns the character at the specified index from this string.</td>
</tr>
<tr>
<td>concat(s1)</td>
<td>Returns a new string that concatenates this string with string s1.</td>
</tr>
<tr>
<td>toUpperCase()</td>
<td>Returns a new string with all letters in uppercase.</td>
</tr>
<tr>
<td>toLowerCase()</td>
<td>Returns a new string with all letters in lowercase.</td>
</tr>
<tr>
<td>trim()</td>
<td>Returns a new string with whitespace characters trimmed on both sides.</td>
</tr>
</tbody>
</table>

- These methods can only be invoked from a specific string instance
  - These methods are called instance methods
Instance methods vs static methods

• These methods can only be invoked from a specific string instance
  – These methods are called instance methods
  – The syntax to invoke an instance method is `referenceVariable.methodName(arguments)`

• A non-instance method is called a static method
  – A static method can be invoked without using an object (i.e., they are not tied to a specific object instance)
  – For example, all the methods defined in the Math class are static methods
Getting characters from a string

String message = "Welcome to Java";
System.out.println("The first character in message is " + message.charAt(0));

<table>
<thead>
<tr>
<th>Indices</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>message</td>
<td>W</td>
<td>e</td>
<td>l</td>
<td>c</td>
<td>o</td>
<td>m</td>
<td>e</td>
<td>t</td>
<td>o</td>
<td>J</td>
<td>a</td>
<td>v</td>
<td>a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

message.charAt(0)  message.length() is 15  message.charAt(14)
String concatenation

String s3 = s1.concat(s2); // These two are
String s3 = s1 + s2;       // equivalent

// Three strings are concatenated
String message = "Welcome " + "to " + "Java";

// String Chapter is concatenated with number 2
String s = "Chapter" + 2; // s becomes Chapter2

// String Supplement is concatenated with character B
String s1 = "Supplement" + 'B'; // s1 becomes SupplementB
Reading a string from the console

Scanner input = new Scanner(System.in);
System.out.print("Enter three words separated by spaces: ");
String s1 = input.next();
String s2 = input.next();
String s3 = input.next();
System.out.println("s1 is " + s1);
System.out.println("s2 is " + s2);
System.out.println("s3 is " + s3);
Reading a character from the console

Scanner input = new Scanner(System.in);
System.out.print("Enter a character: ");
String s = input.nextLine();
char ch = s.charAt(0);
System.out.println("The character entered is " + ch);
## Comparing strings

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>equals(s1)</td>
<td>Returns true if this string is equal to string s1.</td>
</tr>
<tr>
<td>equalsIgnoreCase(s1)</td>
<td>Returns true if this string is equal to string s1; it is case insensitive.</td>
</tr>
<tr>
<td>compareTo(s1)</td>
<td>Returns an integer greater than 0, equal to 0, or less than 0 to indicate whether this string is greater than, equal to, or less than s1.</td>
</tr>
<tr>
<td>compareToIgnoreCase(s1)</td>
<td>Same as compareTo except that the comparison is case insensitive.</td>
</tr>
<tr>
<td>startsWith(prefix)</td>
<td>Returns true if this string starts with the specified prefix.</td>
</tr>
<tr>
<td>endsWith(suffix)</td>
<td>Returns true if this string ends with the specified suffix.</td>
</tr>
</tbody>
</table>
## Substrings

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>substring(beginIndex)</code></td>
<td>Returns this string’s substring that begins with the character at the specified <code>beginIndex</code> and extends to the end of the string.</td>
</tr>
<tr>
<td><code>substring(beginIndex, endIndex)</code></td>
<td>Returns this string’s substring that begins at the specified <code>beginIndex</code> and extends to the character at index <code>endIndex - 1</code>. Note that the character at <code>endIndex</code> is not part of the substring.</td>
</tr>
</tbody>
</table>

### Indices

<table>
<thead>
<tr>
<th>Indices</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>W</td>
<td>e</td>
<td>l</td>
<td>c</td>
<td>o</td>
<td>m</td>
<td>e</td>
<td>t</td>
<td>o</td>
<td>J</td>
<td>a</td>
<td>v</td>
<td>a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```java
message.substring(0, 11)  // Welcome to Java
message.substring(11)    // Java
```
Finding a character or a substring in a string

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>indexOf(ch)</td>
<td>Returns the index of the first occurrence of \text{ch} in the string. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>indexOf(ch, fromIndex)</td>
<td>Returns the index of the first occurrence of \text{ch} after \text{fromIndex} in the string. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>indexOf(s)</td>
<td>Returns the index of the first occurrence of string \text{s} in this string. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>indexOf(s, fromIndex)</td>
<td>Returns the index of the first occurrence of string \text{s} in this string after \text{fromIndex}. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>lastIndexOf(ch)</td>
<td>Returns the index of the last occurrence of \text{ch} in the string. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>lastIndexOf(ch, fromIndex)</td>
<td>Returns the index of the last occurrence of \text{ch} before \text{fromIndex} in this string. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>lastIndexOf(s)</td>
<td>Returns the index of the last occurrence of string \text{s}. Returns $-1$ if not matched.</td>
</tr>
<tr>
<td>lastIndexOf(s, fromIndex)</td>
<td>Returns the index of the last occurrence of string \text{s} before \text{fromIndex}. Returns $-1$ if not matched.</td>
</tr>
</tbody>
</table>
Finding a character or a substring in a string

```java
int k = s.indexOf(' ');  
String firstName = s.substring(0, k);  
String lastName = s.substring(k + 1);  
```

![Diagram showing how to find characters and substrings in a string. The string is "Kim Jones" and the character ' ' is found at index 3. The substring before the space is "Kim" and the substring after the space is "Jones".]
Conversion between strings and numbers

```java
int intValue =
    Integer.parseInt(intString);
double doubleValue =
    Double.parseDouble(doubleString);

String s = number + "";
```
Formatting output

• Use the printf statement
  
  `System.out.printf(format, items);`

• Where `format` is a string that may consist of substrings and format specifiers
  
  – A format specifier specifies how an item should be displayed
  
  – Each specifier begins with a percent sign

  – An item may be a numeric value, character, Boolean value, or a string
## Common specifiers

<table>
<thead>
<tr>
<th>Specifier</th>
<th>Output</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>%b</td>
<td>a boolean value</td>
<td>true or false</td>
</tr>
<tr>
<td>%c</td>
<td>a character</td>
<td>'a'</td>
</tr>
<tr>
<td>%d</td>
<td>a decimal integer</td>
<td>200</td>
</tr>
<tr>
<td>%f</td>
<td>a floating-point number</td>
<td>45.460000</td>
</tr>
<tr>
<td>%e</td>
<td>a number in standard scientific notation</td>
<td>4.556000e+01</td>
</tr>
<tr>
<td>%s</td>
<td>a string</td>
<td>&quot;Java is cool&quot;</td>
</tr>
</tbody>
</table>

```java
int count = 5;
double amount = 45.56;
System.out.printf("count is %d and amount is %f", count, amount);
```

Display: 
```
count is 5 and amount is 45.560000
```
Next Lecture

• Loops
• Methods
• Reading
  – Liang
    • Chapters 5 and 6