COMP-248
Object Oriented Programming I

Week 3: Control Flow 1

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Announcements

Assignment 1 revised and posted on Moodle

Assignment 1 due date extended

If you have questions, first point of contact is your TA!

Procrastination Is Bad for Your Grades!

The results of a **5-year study of marketing students** at the Warwick Business School show an inverse correlation between procrastination and grades. The study of 777 students found that **students who turned in assignments just before a deadline performed worse on assignments than those who turned in their work more than 24 hours early**. There was **little statistical difference among students who submitted assignments more than 24 hours early**; however, after the 24-hour mark, average scores dropped at an increasing rate the closer the submission time was to the deadline. There was a **5% difference in scores** between students who submitted their work at the last minute and those who submitted it more than a day in advance, good for a full letter grade.

Flow of Control

1. **Sequence**:

   Unless specified otherwise, the order of statement execution is linear/sequential

   one statement after the other, in sequence

2. **Conditional statements**:

   a statement may or may not be executed depending on some condition

3. **Repetition statements (loops):**

   a statement is executed over and over, repetitively, until some condition becomes true or false

These decisions are based on a **boolean expression** (also called a *condition*) that evaluates to true or false

The order of statement execution is called the **flow of control**

In this chapter, we will see:

1. **The if statement**
2. The **if-else** statement
3. Relations Operators
4. Logical operators
5. Compound statements
6. Nested **if** statements
7. The **switch** statement
8. The conditional operator
9. The **while** loop
10. The **do-while** loop
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13. break, continue & exit

Conditional statements

let us choose which statement will be executed next

sometimes called ***selection statements***

Java has 3 conditional statements:

- the ***`if`*** statement
- the ***`if-else`*** statement
- the ***`switch`*** statement

1- The if statement (p.96)

syntax:

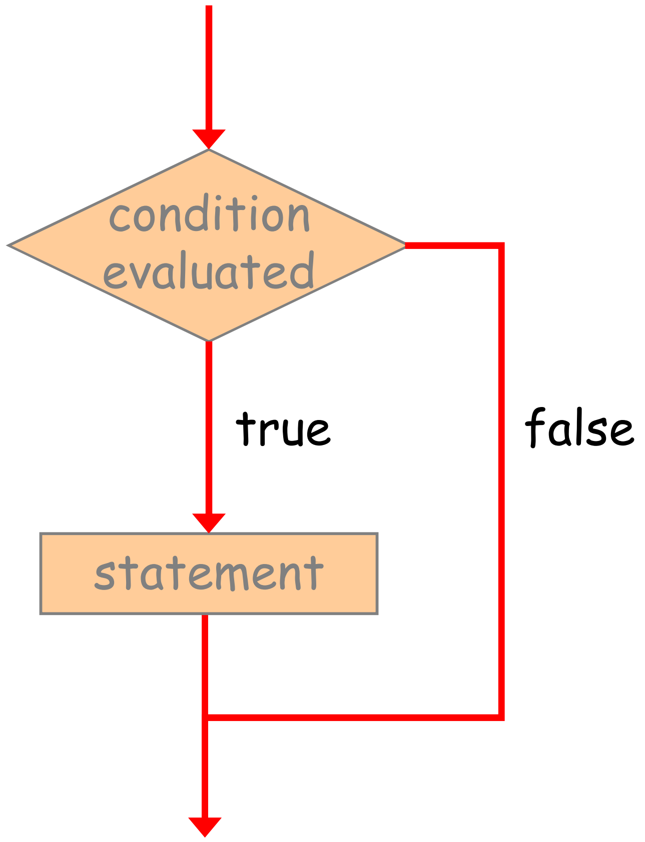
`if` is a Java reserved word

The *condition* is a boolean expression.
(evaluates to either true or false)

```
if ( condition )
   statement;
```

If the *condition* is true, the *statement* is executed.
If it is false, the *statement* is skipped.

Logic of an if statement



Example

```
System.out.print("Enter the sum: ");
int sum = myKeyboard.nextInt();
int delta = 0;

if (sum >= 100)
   delta = 5;

System.out.println("Delta is " + delta);
```

Output

```
Enter the sum: 5000
Delta is 5
```

Example: Age.java

```
final int MINOR = 18;

System.out.print("Enter your age: ");
int age = myKeyboard.nextInt();

if (age < MINOR)
    System.out.println("wonderful");
System.out.println("Oh well!");
```

Output

```
Enter your age: 16
wonderful
Oh well!
```

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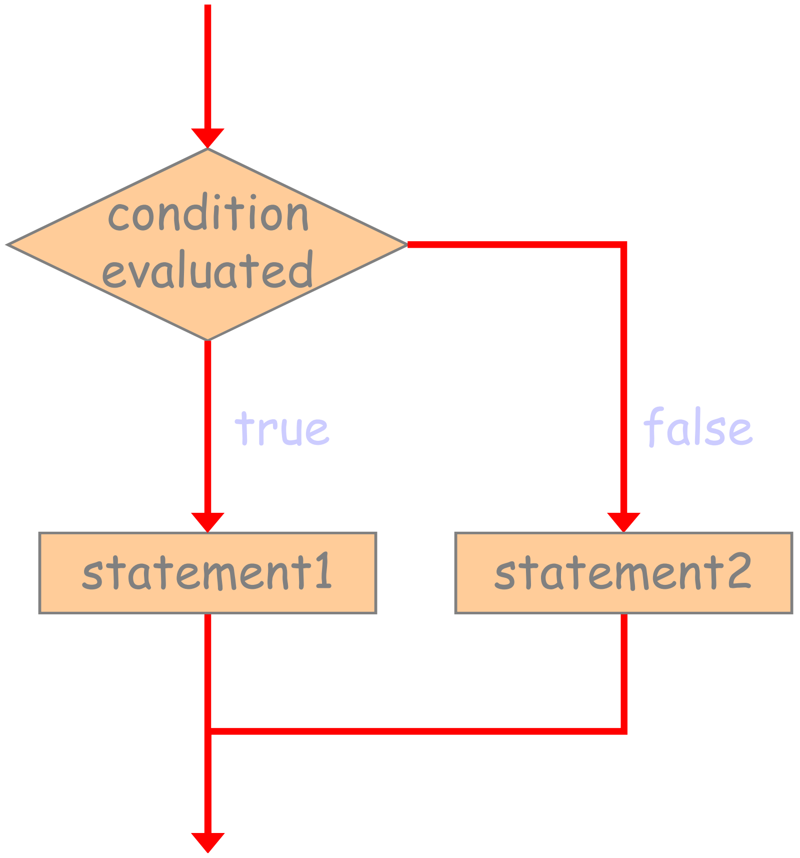
2- The if-else statement

An *else clause* can be added to an `if` statement to make an *if-else statement*

```
if ( condition )
    statement1;
else
    statement2;
```

Logic of an if-else statement



Example: Wages.java

```
final double RATE = 10.0;  // regular pay rate
final int STANDARD = 40;   // standard hours
double pay = 0;

System.out.print("Number of hours worked: ");
int hours = myKeyboard.nextInt();

// Pay overtime at "time and a half"
if (hours > STANDARD)
   pay = STANDARD*RATE + (hours-STANDARD) * (RATE*1.5);
else
   pay = hours * RATE;
System.out.println("Pay: " + pay);
```

Output

```
Number of hours worked: 50
Pay: 550.0
```

What is the output?

```
int speed = 55;
if (speed > 50)
   System.out.println("Going too fast – School zone");
 if (speed > 30)
   System.out.println("Going at the right speed");
 else
   System.out.println("You can go a bit faster");
```

```
A.  Going too fast – School zone      55
B.  Going at the right speed          55  45
C.  You can go a bit faster                   25
D.  Neither of the above choices
```

What is the output?

```
int num = 4;
if (num > 5)
System.out.println("line A");
else
System.out.println("line B");
if (num < 10)
System.out.println("line C");
System.out.println("line D");
```

```
A.  line A
    line B
    line C
    line D

B.  line A
    line C
    line D

C.  line B
    line C
    line D

D.  line B
    line C

E.  line B
    line D
```

See how much harder it is to read if not indented properly …

What is the output?

```
int someInt = 10;
if (someInt > 30)
   System.out.print("Moe ");
   System.out.print("Larry ")
System.out.print("Curly");
```

A. Curly

B. Moe Larry Curly

C. Larry Curly

D. no output; there is a compile-time error

E. no output; there is a run-time error

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3- Relational operators

needed in control structures (ex. **`if`**)

to write conditions (boolean expressions)

return boolean results (evaluates to **`true`** or **`false`**)

`==`	equal to
`!=`	not equal to
`<`	less than
`>`	greater than
`<=`	less than or equal to
`>=`	greater than or equal to

Note the difference between == and =

Example - IncomeTax.java

```
if (age == 18)
   System.out.println("you are 18");
else
   System.out.println("you are not 18");
```

Output

```
if (age = 18)
  System.out.println("you are 18");
else
  System.out.println("you are not 18");
```

Output

A note on comparing floats

be careful when comparing 2 floating point values (**`float`** or **`double`**) for equality

do not use the equality operator (==)

because floats are approximated

you want to see if two floats are "close enough"

```
if (Math.abs(f1 - f2) < 0.00001)
   System.out.println ("Essentially equal.");
```

A note on comparing characters

We can use the relational operators to compare 2 characters

The results are based on the Unicode character set

```
if ('+' < 'J')
   System.out.println("+ is less than J in Unicode");
```

```
char userAnswer = 'y';
if (userAnswer == 'Y')
   System.out.println("the user said yes");
```

Part of the Unicode Character Set (ASCII)

0	□	32		64	@	96	`	128	€	160		192	À	224	à
1	□	33	!	65	A	97	a	129	□	161	¡	193	Á	225	á
2	□	34	"	66	B	98	b	130	‚	162	¢	194	Â	226	â
3	□	35	#	67	C	99	c	131	ƒ	163	£	195	Ã	227	ã
4	□	36	$	68	D	100	d	132	„	164	¤	196	Ä	228	ä
5	□	37	%	69	E	101	e	133	…	165	¥	197	Å	229	å
6	□	38	&	70	F	102	f	134	†	166	¦	198	Æ	230	æ
7	□	39	'	71	G	103	g	135	‡	167	§	199	Ç	231	ç
8	□	40	(	72	H	104	h	136	ˆ	168	¨	200	È	232	è
9	□	41	)	73	I	105	i	137	‰	169	©	201	É	233	é
10	□	42	*	74	J	106	j	138	Š	170	ª	202	Ê	234	ê
11	□	43	+	75	K	107	k	139	‹	171	«	203	Ë	235	ë
12	□	44	,	76	L	108	l	140	Œ	172	¬	204	Ì	236	ì
13	□	45	-	77	M	109	m	141	□	173	-	205	Í	237	í
14	□	46	.	78	N	110	n	142	Ž	174	®	206	Î	238	î
15	□	47	/	79	O	111	o	143	□	175	¯	207	Ï	239	ï
16	□	48	0	80	P	112	p	144	□	176	°	208	Ð	240	ð
17	□	49	1	81	Q	113	q	145	‘	177	±	209	Ñ	241	ñ
18	□	50	2	82	R	114	r	146	’	178	²	210	Ò	242	ò
19	□	51	3	83	S	115	s	147	“	179	³	211	Ó	243	ó
20	□	52	4	84	T	116	t	148	”	180	´	212	Ô	244	ô
21	□	53	5	85	U	117	u	149	•	181	µ	213	Õ	245	õ
22	□	54	6	86	V	118	v	150	–	182	¶	214	Ö	246	ö
23	□	55	7	87	W	119	w	151	—	183	·	215	×	247	÷
24	□	56	8	88	X	120	x	152	˜	184	¸	216	Ø	248	ø
25	□	57	9	89	Y	121	y	153	™	185	¹	217	Ù	249	ù
26	□	58	:	90	Z	122	z	154	š	186	º	218	Ú	250	ú
27	□	59	;	91	[	123	{	155	›	187	»	219	Û	251	û
28	□	60	<	92	\	124	|	156	œ	188	¼	220	Ü	252	ü
29	□	61	=	93	]	125	}	157	□	189	½	221	Ý	253	ý
30	□	62	>	94	^	126	~	158	ž	190	¾	222	Þ	254	þ
31	□	63	?	95	_	127	□	159	Ÿ	191	¿	223	ß	255	ÿ

A note on comparing strings ⚠

We **cannot** use the relational operators to compare strings (<, ==, …)

use the **`equals()`** method

to determine if two strings have the same content

ex: **`firstString.equals(secondString)`**

returns a **`boolean`**:

`true` if **`firstString`** has the same content as **`secondString`**

`false` otherwise

A note on comparing strings

use the **`compareTo()`** method

- to determine if one string comes before another (based on the Unicode character set)

ex: **`firstString.compareTo(secondString)`**

returns an **`int`**:

- **negative** if **`firstString`** is lexicographically before **`secondString`**
- **positive** if **`firstString`** is lexicographically after **`secondString`**
- **0** if the 2 strings have the same content

Example 1

```
String s1 = "Java isn't just for breakfast.";
String s2 = "JAVA isn't just for breakfast.";

  if (s1.equals(s2))
    System.out.println("The two lines are equal.");
  else
    System.out.println("The two lines are not equal.");


  if (s2.equals(s1))
    System.out.println("The two lines are equal.");
  else
    System.out.println("The two lines are not equal.");
```

Example 1 - equalsIgnoreCase

```
String s1 = "Java isn't just for breakfast.";
String s2 = "JAVA isn't just for breakfast.";

if (s1.equalsIgnoreCase(s2))
  System.out.println("But the lines are equal, ignoring case.");
else
  System.out.println("Lines are not equal,even ignoring case.");
```

Example 2

	Syntax Error?	Output?
`System.out.println("aBcD" < "abcd");`	CE	
`System.out.println('aBcD' < 'abcd');`	CE	
`System.out.println("a" < "b");`	CE	
`System.out.println('a' < 'b');`		true
`System.out.println("aBcD".equals("abcd"));`		false

Example 2 ...

	Syntax Error?	Output?
`System.out.println("aBcD".equalsIgnoreCase ("aBcD"));`		true
`System.out.println("aBcD".compareTo("aBcD"));`		0
`System.out.println("aBcD".compareTo("aBcC"));`		+
`System.out.println("abc".compareTo("ab"));`		+
`System.out.println("abc".compareTo("abcd"));`		-

Next topic:

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