Operators, Expressions, Statements, Control Flow

Operators

- An ***operator*** is a symbol (or combination of a couple symbols) that is used with variables and values to simplify how you write certain program ***expressions***
  - Usually, operators are designed to mimic mathematical notation—but *do not be fooled* into confusing programming and mathematics!

Most Common Operators

String	boolean	char	int	double
	!		++ --	
+	||		+ -	+ -
	&&		* / %	* /
	== !=	< > <= >= == !=	< > <= >= == !=	< >

Most Common Operators

`String`	**`boolean`**	**`char`**	**`int`**	**`double`**
			`--`	
`+`			`-`	`+` `-`
			`%`	`*` `/`
	`==` `!=`	`<=` `>=` `==` `!=`	`>` `<=` `>=` `==` `!=`	`<` `>`

Best Practice: do not use `==` or `!=` with `String`s, but rather the `equals` method; details later.

Most Common Operators

String	boolean	char	int	double
	!			
+	||			-
	&&		/ %	/
	== !=	< > <= >= == !=	< > <= >= == !=	< >

Operators for ***or*** (||) and ***and*** (&&) use ***short-circuit evaluation***.

Most Common Operators

			int	double
			++ --	
			+ -	+ -
			%	* /
	== !=	> <= >= == !=	< > <= >= == !=	< >

Best Practice: be careful with the ***remainder*** (%) operator: the second operand must be positive; this is, unfortunately, not "clock arithmetic"; details later.

Most Common Operators

`String`	**`boolean`**	**`char`**	**`int`**	**`double`**
			`--`	
`+`	`|`		`-`	`+` `-`
	`&`		`%`	`*` `/`
	`==` `!=`	`<` `>` `<=` `>=` `==` `!=`	`>` `<=` `==` `!=`	`<` `>` `<=` `>=`

Best Practice: do not check **`double`**s for equality; details later.

Expressions

- An ***expression*** is a “syntactically well-formed and meaningful fragment” (roughly analogous to a *word* in natural language)
- Meaningful?
  - It has a value (of some type, of course)

Some Expressions

- Examples of code fragments that are expressions:

```
i
j + 7
"Hello" + " World!"
keyboardIn.nextLine()
n == 0
new SimpleWriter1L()
```

Some Expressions

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```
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new SimpleWriter1L()
```

What is the type of each of these expressions?

Some Expressions

- Examples of code fragments that are expressions:

```
i
j + 7
"Hello" + " World!"
keyboardIn.nextLi
n == 0
new SimpleWriter1L()
```

This fragment creates a new object of type `SimpleWriter1L`, and its value is a ***reference*** to that object; details later.

Statements

- A ***statement*** is a “smallest complete unit of execution” (roughly analogous to a *sentence* in natural language)
- A simple statement is terminated with a semi-colon '**;**'

Simple Statements

- Some examples of simple statements:

```
i = 12;
j += 7;
k++;
SimpleWriter fileOut =
  new SimpleWriter1L("foo.txt");
fileOut.print("Hi, Mr. Foo.");
```

Simple Statements

- Some examples of simple statements:

```
i = 12;
j += 7;
k++;
SimpleWriter fileOut =
  new SimpleWriter1L("foo.txt");
fileOut.print("Hi, Mr. Foo.");
```

This is the same as

```
j = j + 7;
```

Assignment Statement

- Assignment statement form:

```
variable = expression;
```

- ***Copies*** the value of the expression on the right side of the ***assignment operator*** `=` to the variable on the left side
- The `=` in Java code does not mean "equals" like in math!
  - Recall the tracing table earlier?

Compound Statements/Blocks

- Any sequence of zero or more statements enclosed in {…} is a ***block***
- Example:

```
{
   String s = in.nextLine();
   out.println ("s = " + s);
}
```

Compound Statements/Blocks

- Any sequence of zero or more statements enclosed in {…} is a ***block***
- Example:

```
{
   String s = in.nextLine();
   out.println ("s = " + s);
}
```

The ***scope*** of variable s is just the block in which it is declared.

Compound Statements/Blocks

- Any sequence of zero or more statements enclosed in {…} is a ***block***
- Example:

```
{
   String s = in.nextLine();
   out.println ("s = " + s);
}
```

There is no semi-colon after a block.

Control Flow

- ***Conditional*** or ***selection*** statements
  - if
  - if-else
  - if-else-if
  - switch
- ***Loop*** or ***iteration*** statements
  - while
  - for
  - do-while

Control Flow

- ***Conditional*** or ***selection*** statements
  - if
  - if-else
  - if-else-if
  - switch

We will normally use these, but you may use a switch statement if you like; details later.

- ***Loop*** or ***iteration*** statements
  - while
  - for
  - do-while

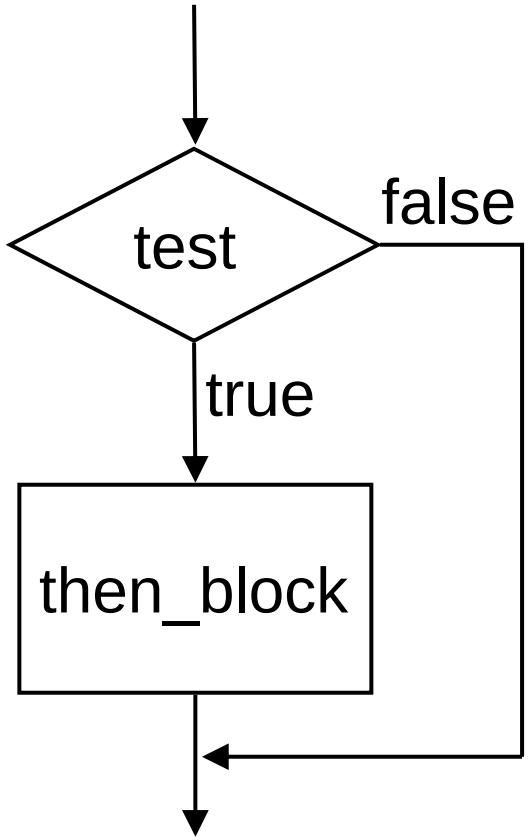
Control Flow

- ***Conditional*** or ***selection*** statements
  - if
  - if-else
  - if-else-if
  - switch
- ***Loop*** or ***iteration*** statements
  - while
  - for
  - do-while

We will normally use **`while`** loops, but you may use the others if you like.

`if` Statement

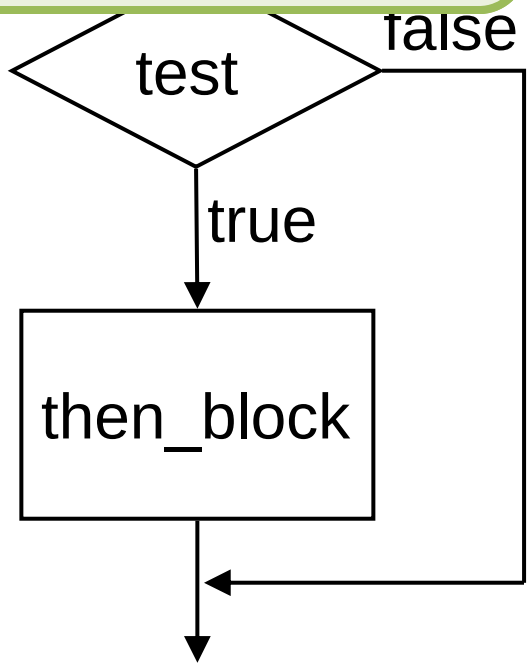
```
if (test) {
  then_block
}
```



`if` Statement

Any **`boolean`** expression may go here.

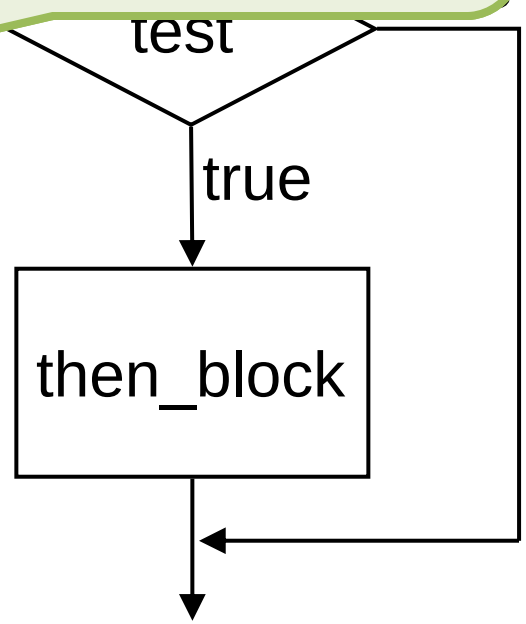
```
if (test) {
  then_block
}
```



`if` Statement

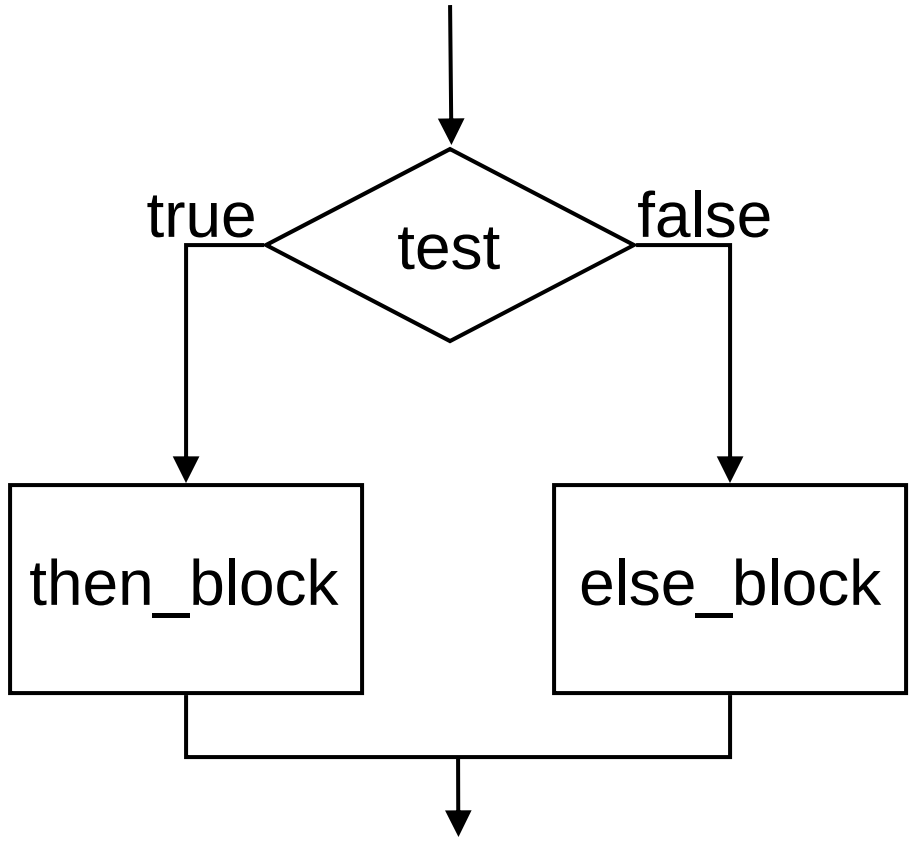
```
if (test) {
  then_block
}
```

Best Practice: even a single statement here should be in a block.



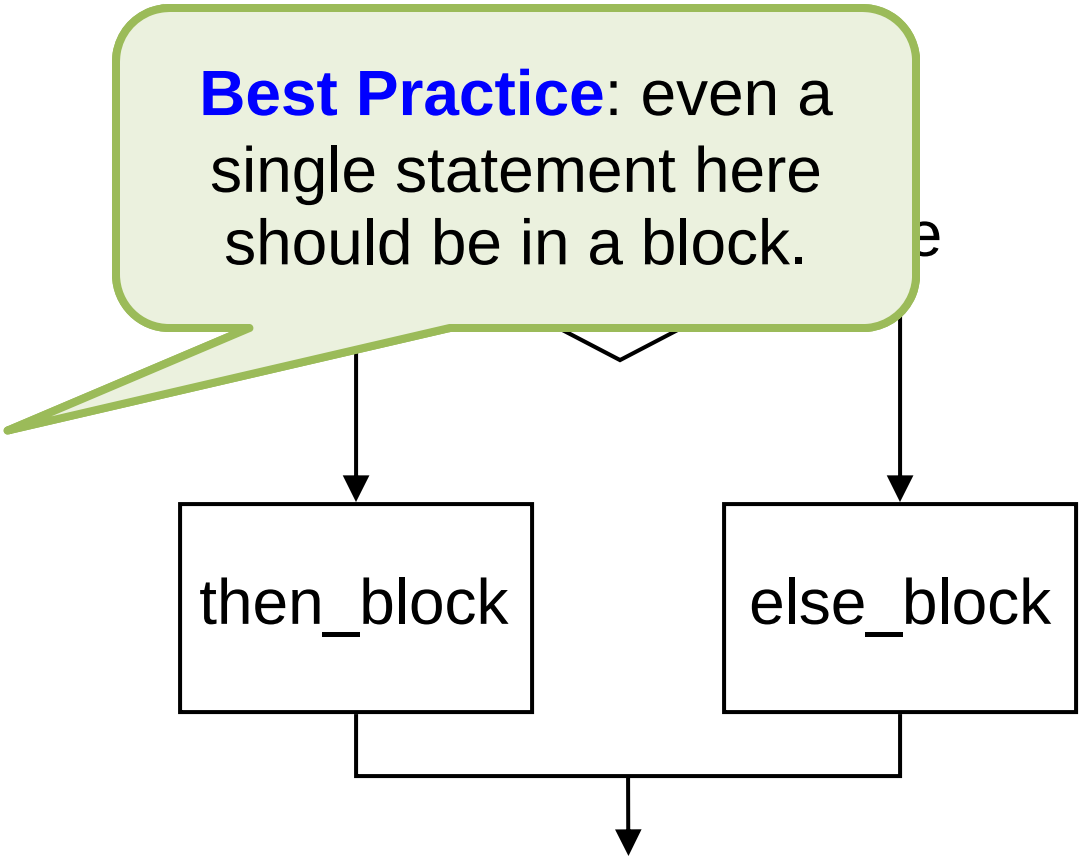
`if-else` Statement

```
if (test) {
   then_block
} else {
   else_block
}
```



`if-else` Statement

```
if (test) {
   then_block
} else {
   else_block
}
```



`if-else-if` Statement

```
if (test_1) {
   then_block_1
} else if (test_2) {
   then_block_2
} else {
   else_block
}
```

The `else if` part may be repeated.

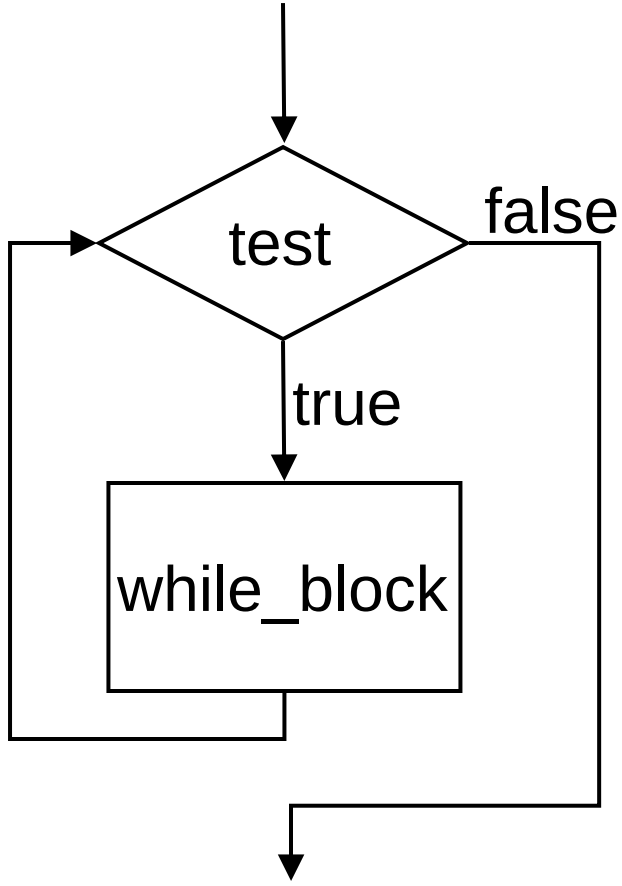
`if-else-if` Statement

```
if (test_1) {
  then_block_1
} else if (test_2) {
  then_block_2
} else {
  else_block
}
```

Can you draw a ***flow-chart*** for this statement?

`while` Statement

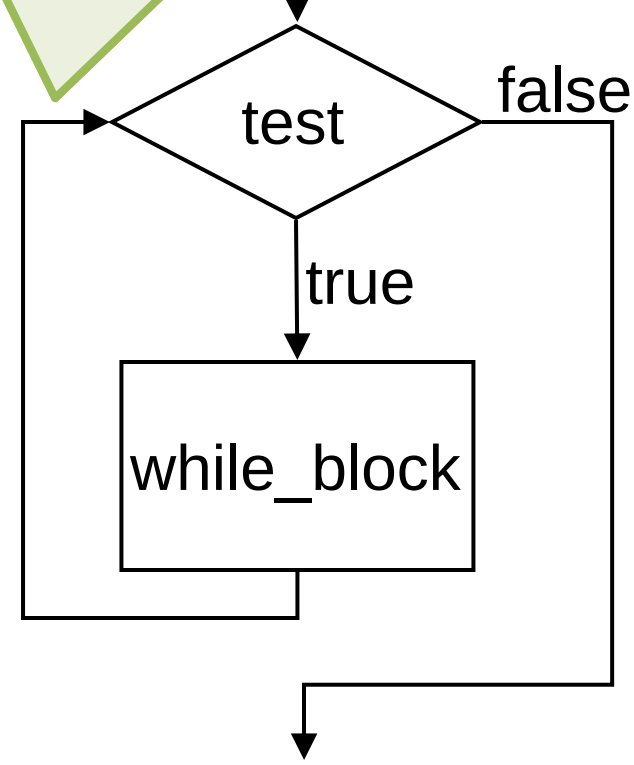
```
while (test) {
  while_block
}
```



while

```
while (test) {
  while_block
}
```

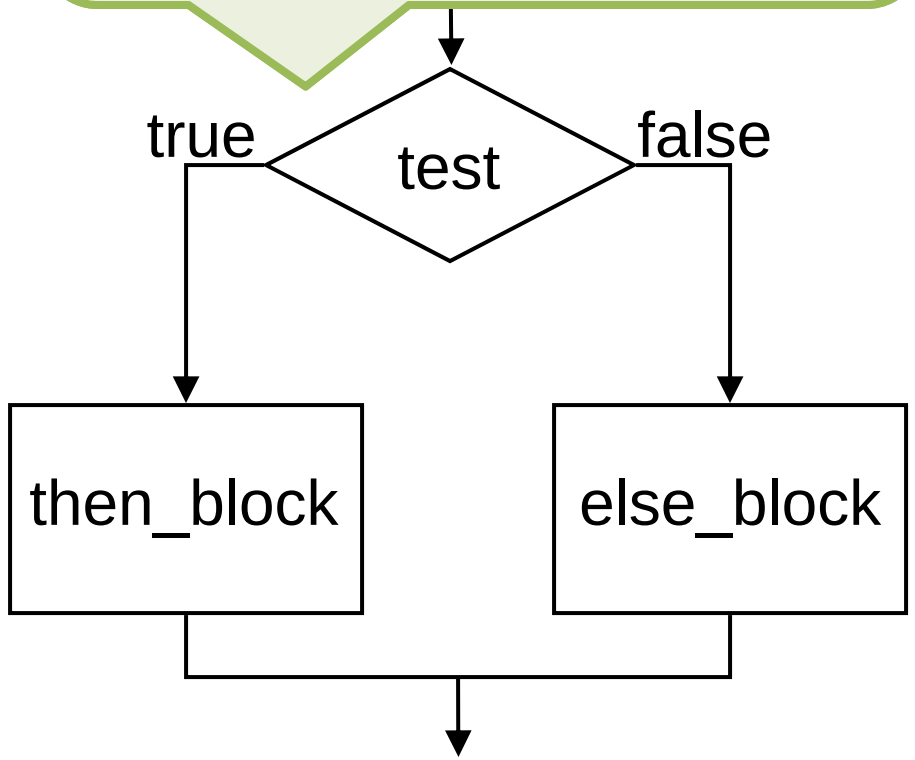
Control flow here can go backward, which creates a ***loop*** in the flow chart.



if-else

```
if (test) {
  then_block
} else {
  else_block
}
```

Control flow for `if` cannot go backward; there is no such thing as an “if loop”!



Expressions and Statements

```
public static void main(String[] args) {
    SimpleWriter output = new SimpleWriter1L();
    int x = 1, count = 0, n = 12345;
    while (x < n) {
        if (n % x == 0) {
            output.println(x);
            count = count + 1;
        }
        x++;
    }
    output.println("Number of factors: " + count);
    output.close();
}
```

Best Practices for `boolean`

If you want to say this, e.g., in an `if` *or* `while` *condition:*	*Say this instead:*
`b == true`	`b`
`b == false`	`!b`

`if (b) {`
`  return true;`
`} else {`
`  return false;`
`}`
	`return b;`

Resources

- *Big Java Late Objects*, Chapter 3
  - http://proquest.safaribooksonline.com.proxy.lib.ohio-state.edu/book/programming/java/9781118087886/chapter-3-decisions/navpoint-24
- *Big Java Late Objects*, Chapter 4
  - http://proquest.safaribooksonline.com.proxy.lib.ohio-state.edu/book/programming/java/9781118087886/chapter-4-loops/navpoint-33