CSE1710

Week 01, Lecture 05

Fall 2013 ◆ Tuesday, Sept 23, 2013

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Checklist (for Today)

What we are reinforcing with the exercises this class…

- ❑ recognizing the various different arithmetic operators (in situ)
- ❑ being able to perform (manual) type casting; recognizing when automatic promotion is going to happen
- ❑ being able to evaluate arithmetic expressions (including those with all the *different* arithmetic operators and with *automatic* promotion)

From Lecture #03
- ❑ read sections 1.3
- ❑ review Ch 1 KC's 14-17
- ❑ do RQ's 18-21
- ❑ do Ex's 1.17-1.22

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Checklist (Lecture 06)

What you should be doing to prepare for what comes next…

- ❑ Labtest #1 is coming this week.
- ❑ read sections 2.1
- ❑ review Ch 2 KC's 1-10
- ❑ do Ch 2 RQ's 1-18
- ❑ do Ch 2 Ex's 2.1-2.10

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Preliminaries

To print to the console:

```
PrintStream stdOut = System.out;

stdOut.println("Hello");
```

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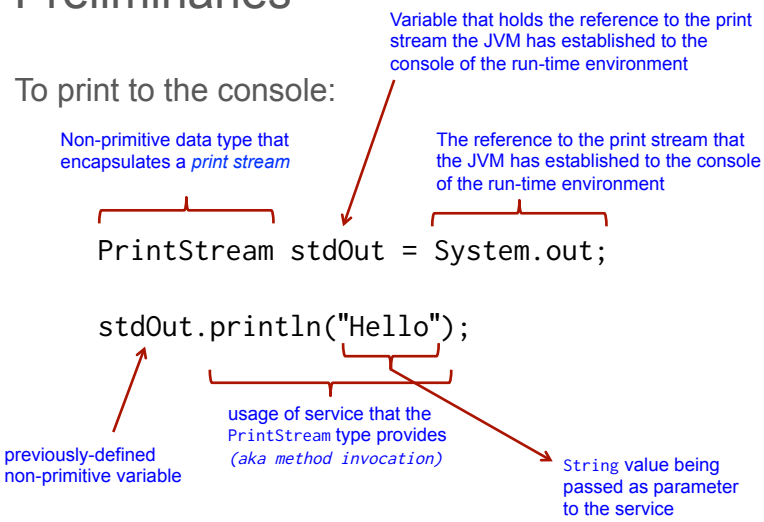
Preliminaries

To print to the console:



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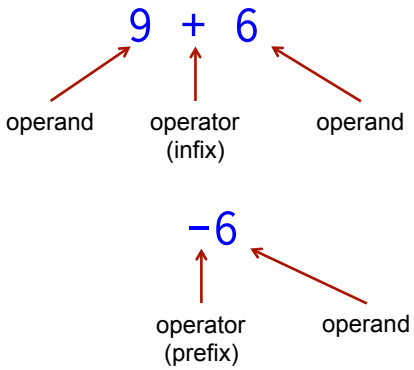
Preliminaries

What is meant by an operator and an operand?



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Preliminaries

What is the **representation standard** for `double`?

What is the **representation standard** for `int`?

True or False: Each of the 8 primitive types has its own unique representation standard.

See
In More Depth 1.5
p. 20

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

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The Infix Arithmetic Operators

Infix Arithmetic Operators

Name	Symbol	Is Overloaded?	Precedence	Example	Result
`int` addition	`+`	yes	-5	`9+9`	`18`
`int` subtraction	`-`	yes	-5	`9-3`	`6`
`int` multiplication	`*`	yes	-4	`3*2`	`6`
`int` quotient	`/`	yes	-4	`1/2`	`0`
`int` remainder	`%`	yes	-4	`7%2`	`3`
`long` addition	`+`	yes	-5	`9L+9L`	`18L`
`long` subtraction	`-`	yes	-5	`9L-3L`	`6L`
`long` multiplication	`*`	yes	-4	`3L*2L`	`6L`
`long` quotient	`/`	yes	-4	`1L/2L`	`0L`
`long` remainder	`%`	yes	-4	`7L%2L`	`3L`
`float` addition	`+`	yes	-5	`9.0F+9.0F`	`18F`
`float` subtraction	`-`	yes	-5	`9.0F-3.0F`	`6F`
`float` multiplication	`*`	yes	-4	`3F*2.5F`	`7.5F`
`float` division	`/`	yes	-4	`1F/2F`	`0.5F`
`float` remainder	`%`	yes	-4	`7F%2F`	`3.5F`
`double` addition	`+`	yes	-5	`9.0+9.0`	`18.`
`double` subtraction	`-`	yes	-5	`9.0-3.0`	`6.`
`double` multiplication	`*`	yes	-4	`3. * 2.`	`6.`
`double` division	`/`	yes	-4	`1./2.`	`0.5`
`doule` remainder	`%`	yes	-4	`7.%2.`	`3.5`

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Basics

What does **overloaded** mean?

True or False: an operator needs operands of a *specific* type

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Arithmetic Operations: Practise

For each expression below, identify the operators and the type of the operands.

[ref: next slide]

```
9+9          9.0F+9.0F
9-3          9.0F-3.0F
3*2          3F*2.5F
1/2          1F/2F
7%2          7F%2F
9L+9L        9.0+9.0
9L-3L        9.0-3.0
3L*2L        3.* 2.
1L/2L        1./2.
7L%2L        7.%2.
```


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Arithmetic Operations: Practise

RQ21. In these expressions, how does the compiler know which operator to use?

```
9+9             9.0F+9.0F
9-3             9.0F-3.0F
3*2             3F*2.5F
1/2             1F/2F
7%2             7F%2F
9L+9L           9.0+9.0
9L-3L           9.0-3.0
3L*2L           3.* 2.
1L/2L           1./2.
7L%2L           7.%2.
```


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Arithmetic Operators

1. How many different infix operators are defined?
2. In addition to the infix operators, what are the other arithmetic operators?
3. How many different arithmetic operators for each type:
   - `int`
   - `long`
   - `float`
   - `double`
   - `char`
   - `short`
   - `byte`
   - `boolean`

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Arithmetic Operations: Practise

For each expression below, identify the operators and operands.

[ref: next slide]

```
9+9L
9f-3
3*2.0
1/2
1/2.
1./2
1./2f
7%2.
3L*2F
7%2L
7%2.
```


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Operands of Mixed Types

p. 32, JBA

What happens when the compiler encounters an expression with operands of different types?

What happens with the compiler encounters an assignment statement in which the LHS is different from the RHS?

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Operands of Mixed Types

p. 32, JBA

The compiler will perform conversions automatically when

- two operands of an operator are not the same.
- both operands are byte
- the type of the RHS is different from the LHS

If the required conversion involves promotion, it is done automatically; but if it involves a demotion, then a compile-time error is triggered.

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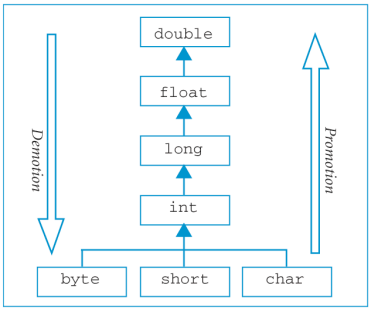
Operands of Mixed Types

p. 32, JBA

In arithmetic expressions, widening conversions are performed




```
9f + 6
```

`float` `int`

lower type gets converted into higher type

RQ22. Is conversion from a `long` value to a `double` a promotion or demotion?

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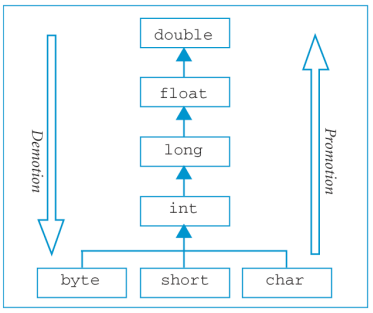
Assignment of Mixed Types

p. 32, JBA

In assignment expressions, widening conversions are performed




```
double x = 9f + 6;
```

expression evaluates to a `float` value, value is promoted to type of RHS

```
int y = 99.+ 1;
```

compile-time error
"type mismatch error"

RQ24. Can a `boolean` value be converted to any other type?

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Properties of data types

RQ.19
a) What is the closure property?
b) How does the integer type satisfy the closure property?

To answer this question, we will **first** answer some other preliminary questions

See In More Depth 1.5 p. 20

What is the **representation standard** for `double`?

What is the **representation standard** for `int`?

"signed two's complement" Java docs

What are some properties of these representations?

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

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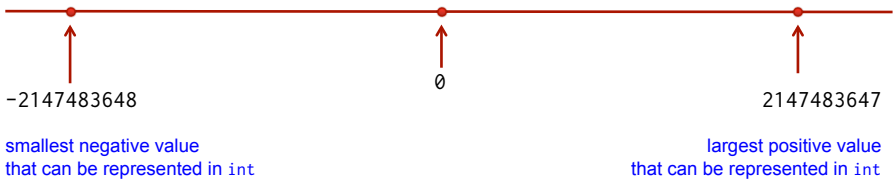
About the `int` data type



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About the `int` data type

What happens when I attempt to use the integer literal `2147483647`?
How about `-2147483648`?

What happens when I attempt to use the integer literal `2147483648`?
How about `-2147483649`?

What is the result for these expressions:

```
2147483647+1
-2147483648-1
10/0
```


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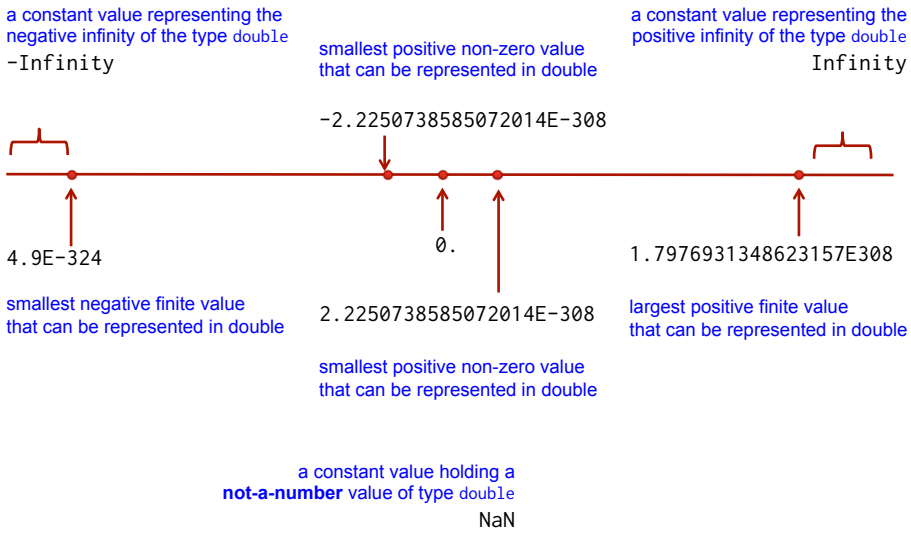
About the `double` data type



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About the `double` data type

What happens when I attempt to use the double literal `1.7976931348623157E308`?
How about `1.7976931348623157E309`?

What happens when I attempt to use the double literal `-4.9E-324`?
How about `-4.9E-325`?

What is the result for these expressions:

```
1.7976931348623157E308 + 1.7976931348623157E308
10./0
-10./0
10./0-10./0
```


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Properties of data types

FINALLY!!!

RQ.19
a) What is the closure property?
b) How does the integer type satisfy the closure property?
c) How does the double type satisfy the closure property?

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Exercises

RQ.20
What is the difference between the precedence level and the association rule of an operator?

Identify the precedence level and of all the arithmetic operators in the expression below:

$$9 + 6 - 5$$

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Note!

p. 32, JBA

If the required conversion involves promotion, it is done automatically; but if it involves a demotion, then a compile-time error is triggered.

There is an exception to this!

```
PrintStream stdOut = System.out;
char y = 65 + 1;
stdOut.println(y);
```


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Categories of Operators

The main categories of operators are:

- arithmetic *(Ch 1)*
- cast *(Ch 1)*
- *relational (Ch 3)*
- *boolean (Ch 5)*

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Manual Casting

Predict the result for each expression

```
(double) 4 / 3

(double) (4 / 3)

4 / (double) 3
```


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Thought Question

RQ 25. Specify a situation in which type conversion is crucial.

hint: It is related to the example in which 1/2 evaluates to 0

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