



CS 149

Professor: Alvin Chao

Modulus operations

$9 / 4$	<i>evaluates to</i>	2
$10 / 4$	<i>evaluates to</i>	2
$11 / 4$	<i>evaluates to</i>	2
$12 / 4$	<i>evaluates to</i>	3
$13 / 4$	<i>evaluates to</i>	3
$14 / 4$	<i>evaluates to</i>	3
$15 / 4$	<i>evaluates to</i>	3
$16 / 4$	<i>evaluates to</i>	4

$9 \% 4$	<i>evaluates to</i>	1
$10 \% 4$	<i>evaluates to</i>	2
$11 \% 4$	<i>evaluates to</i>	3
$12 \% 4$	<i>evaluates to</i>	0
$13 \% 4$	<i>evaluates to</i>	1
$14 \% 4$	<i>evaluates to</i>	2
$15 \% 4$	<i>evaluates to</i>	3
$16 \% 4$	<i>evaluates to</i>	0

1. Which numbers $\% 4$ evaluate to 0 in the table above? If the table were extended to include more rows, which other numbers $\% 4$ would evaluate to 0?
2. Look at the expressions in the second table that evaluate to 1. How do the left operands in these expressions (9, 13, 17) differ from those that evaluate to 0?
3. List three numbers $\% 5$ that will evaluate to 0 and three numbers $\% 5$ that will evaluate to 2.



Evaluate the Java Expressions

- $14 \% 4$
 - $19 \% 4$
 - $19 \% 5$
 - $19 \% 6$
-
- Describe what the % operator does. How are the / and % operators related?



Java Expressions

“Twenty-nine days” means the same thing as “Four weeks and one day”. If **days** is a Java integer variable containing some number of days, develop expressions for:

- The number of weeks in days (4 in the example above).
- The number of days that are left over. (1 in the example above).

Primitive Types

Keyword	Size	Min Value	Max Value
<code>byte</code>	1 byte	-128	127
<code>short</code>	2 bytes	-32,768	32,767
<code>int</code>	4 bytes	-2^{31}	$2^{31} - 1$
<code>long</code>	8 bytes	-2^{63}	$2^{63} - 1$
<code>float</code>	4 bytes	$\pm 3.4 \times 10^{-38}$	$\pm 3.4 \times 10^{38}$
<code>double</code>	8 bytes	$\pm 1.7 \times 10^{-308}$	$\pm 1.7 \times 10^{308}$
<code>boolean</code>	N/A	<code>false</code>	<code>true</code>
<code>char</code>	2 bytes	<code>'\u0000'</code>	<code>'\uffff'</code>

- Which of the primitive types are integers?
- Which are floating point?
- Why can't computers represent every possible number in mathematics? Will they ever be able to do so?
- Since a byte can represent 256 different numbers, why is its max value 127 and not 128?

What is the data type for each of the following values?

1.14159	0	-1.0F	123
7.2E-4	0.0	-13L	'0'
-128	false	true	"0"

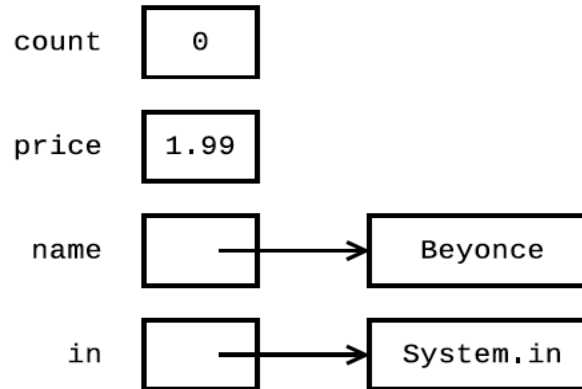


Which of the assignments are not allowed?

1. byte miles;
2. short minutes;
3. int checking;
4. long days;
5. float total;
6. double sum;
7. boolean flag;
8. char letter;
9. checking = 56000;
10. total = 0;
11. sum = total;
12. total = sum;
13. checking = miles;
14. sum = checking;
15. sum = days;
16. days = "0";

Reference Types

```
int count;  
double price;  
String name;  
Scanner in;  
  
count = 0;  
price = 1.99;  
name = "Beyonce";  
in = new Scanner(System.in);
```



- Java has eight primitive types we just looked at. All other types of data are called reference types, because **their value is a memory address**. When drawing state diagrams, use an arrow to reference other memory locations (rather than make up integer values for the actual addresses).
- What are the reference types in the example above?
- By convention, what is the difference between primitive and reference type names?
- Variables in Java can use at most eight bytes of memory. Explain why "Beyonce" and System.in cannot be stored directly in the memory locations for name and in.
- What is the value of the variable count? What is the value of the variable price?
- Carefully explain what it means to assign one variable to another. For example, what does the statement `price = count;` do in terms of memory?

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