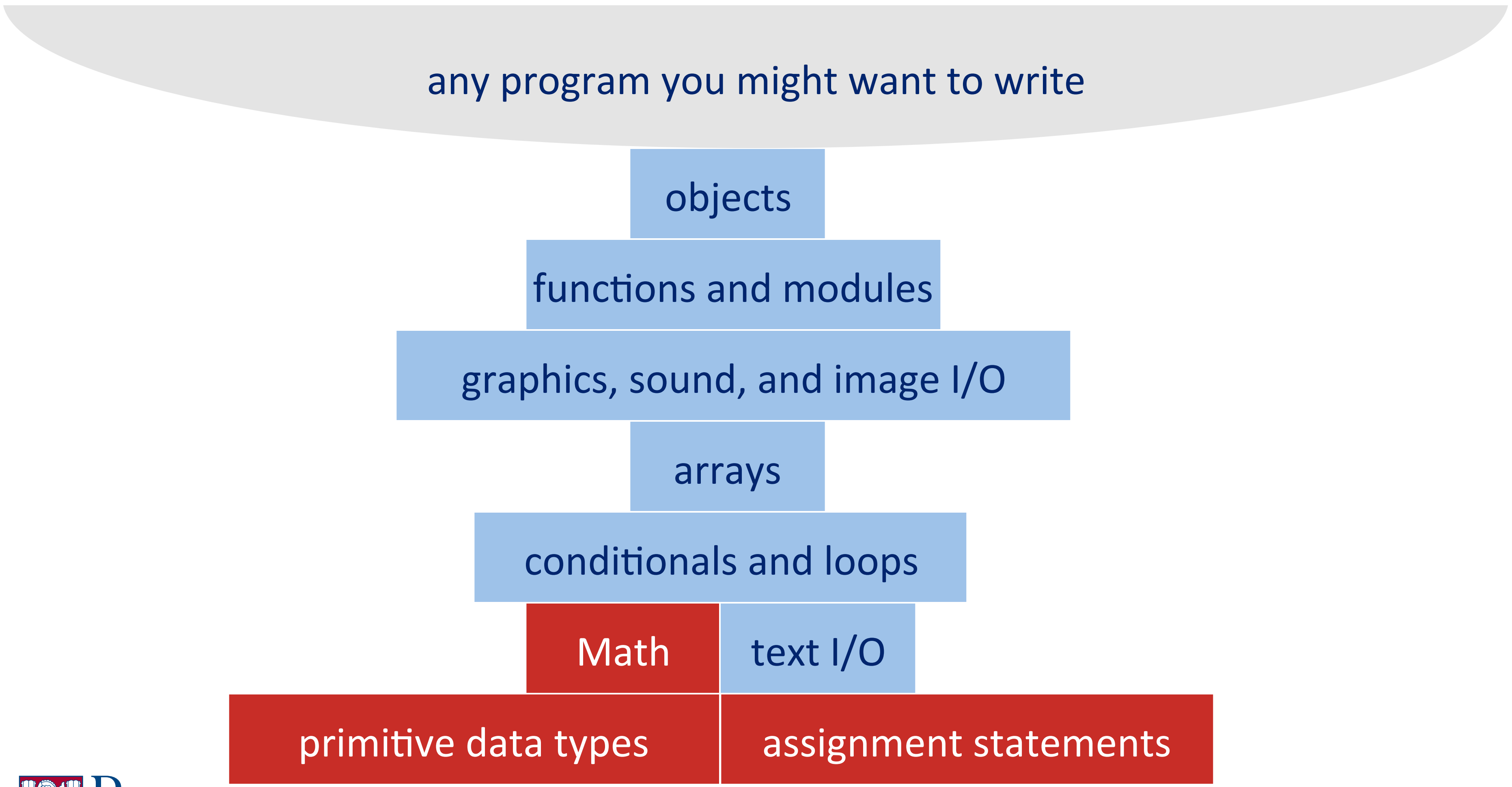
Variables

A Foundation for Programming



Variables

- A name to which data can be assigned
- A variable is declared as a specific data type
- Names must begin with a lowercase letter, '_' or '$' and can contain letters, digits, '_' and '$'

```
boolean bReady = true;
int i;
int j = 12;
float fSize = 10.0;
String name123 = "Fred";
```

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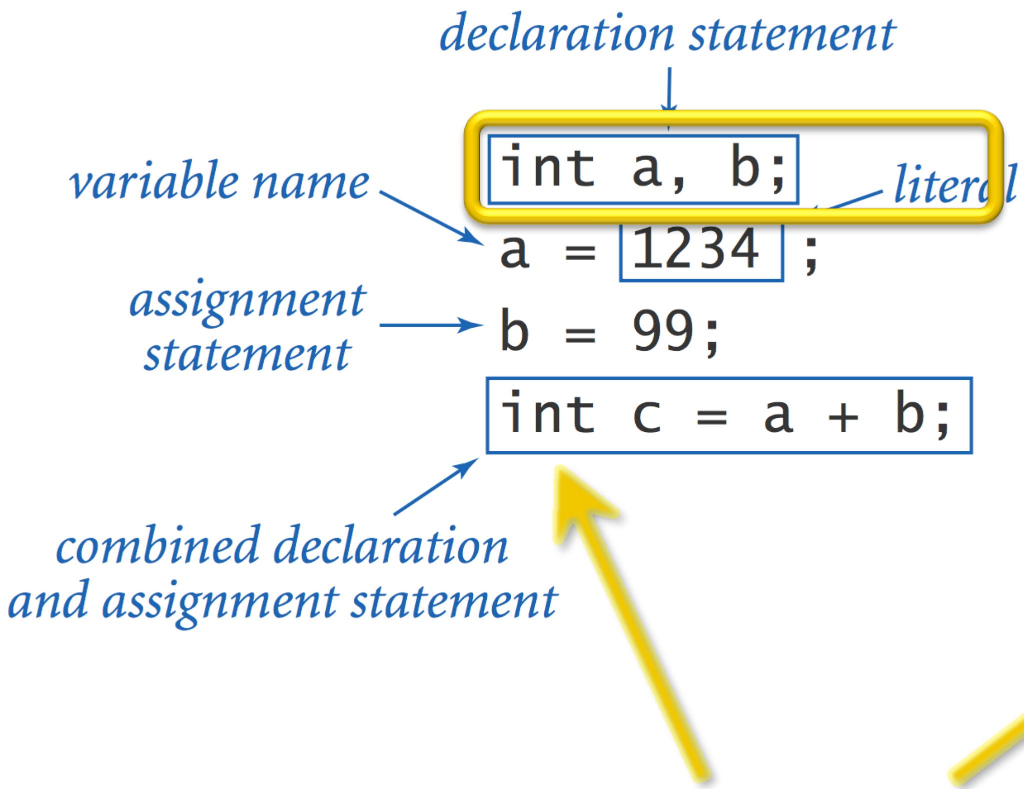
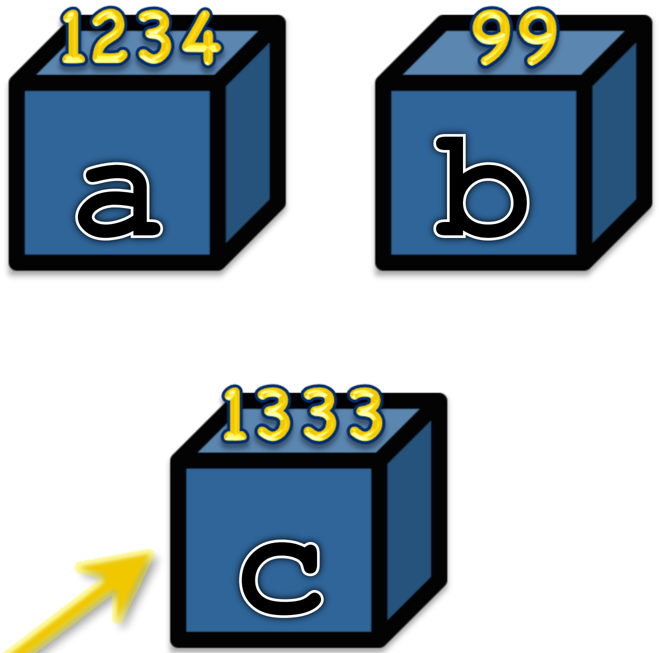
Variable Uses

- Use a value throughout your program,
  - but allow it to be changed
- As temporary storage for a intermediate computed result
- … etc

Variables and Types



```
int a, b;
a = 1234 ;
b = 99;
int c = a + b;
```



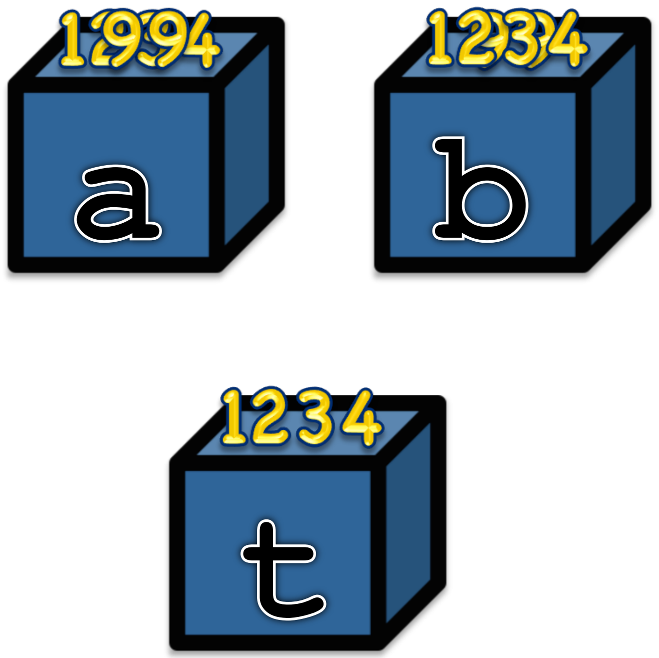
"int" means that the variable will <u>always</u> hold an integer

Assignment

```
int a, b;
a = 1234;
b = 99;
int t = a;
a = b;
b = t;
```

"=" *stores* a value in a variable

It is <u>not</u> for comparison, as in standard math



`int`: Integers (whole numbers)

`+`, `-`, `*`, `/`, `%` (modulo), `()`, `Integer.parseInt()`

Expression	Result?
`5 + 3`	
`5 - 3`	
`5 * 3`	
`5 / 3`	
`5 % 3`	
`5 % -3`	
`1 / 0`	
`3 * 5 - 2`	
`3 + 5 / 2`	
`3 - 5 / 2`	
`(3 - 5) / 2`	
`3 - (5 - 2) / 2`	
`Integer.parseInt("3")`	
`Integer.parseInt(3)`	

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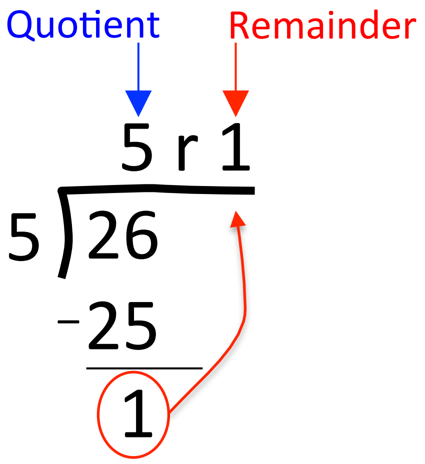
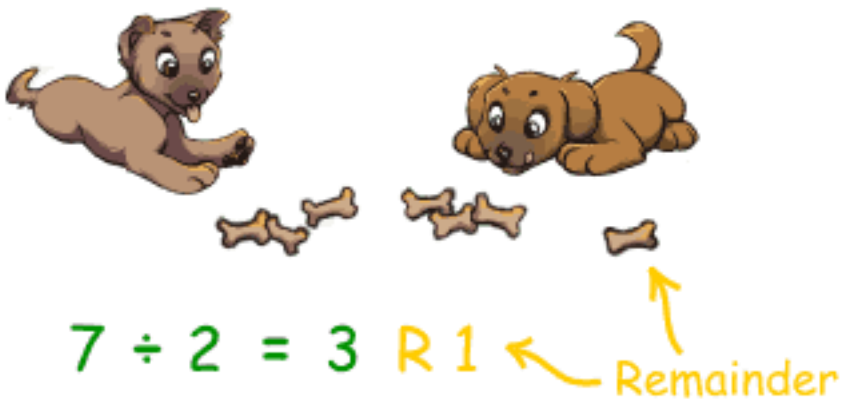
Modulo Operator (%)





Division gives the quotient:

26 / 5 == 5

Modulo gives the remainder:

26 % 5 == 1

Example: Determining whether an integer `n` is even or odd:

```
boolean isEven = (n % 2 == 0);
```

Dog image from http://www.mathsisfun.com/

Variable Scope

***Variable scope*:**

- That set of code statements in which the variable is known to the compiler
- Where it can be referenced in your program
- Limited to the ***code block*** in which it is defined
  - A ***code block*** is a set of code enclosed in braces (***{ }***)

`double`: Floating-Point (fractions)

`+`, `-`, `*`, `/`, `%` (modulo), `()`, `Double.parseDouble()`

Expression	Result?
3.141 + 0.03	
6.02e23 / 2.0	
5.0 / 3	
(int) 5.0 / 3	
5.0 / (int) 3	
10.0 % 3.141	
1.0 / 0.0	
-1.0 / 0.0	
0.0 / 0.0	
Math.sqrt(2)	
Math.sqrt(-1)	
Math.sqrt(2) * Math.sqrt(2)	
Math.PI	
Math.pi	

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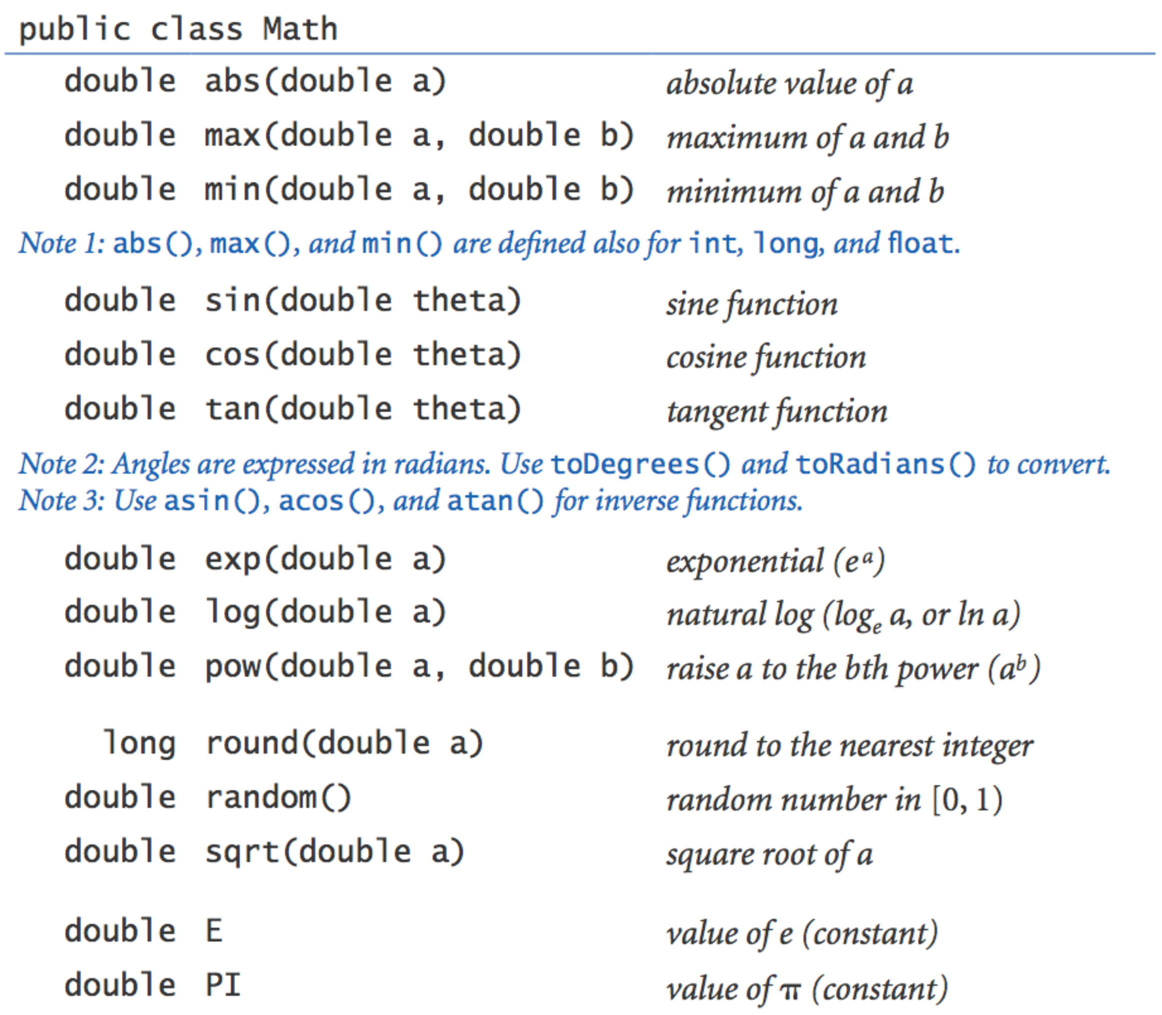
Java Math Library (Excerpts)



`public class Math`

`double abs(double a)`	*absolute value of a*
`double max(double a, double b)`	*maximum of a and b*
`double min(double a, double b)`	*minimum of a and b*

Note 1: `abs()`, `max()`, *and* `min()` *are defined also for* `int`, `long`, *and* `float`.

`double sin(double theta)`	*sine function*
`double cos(double theta)`	*cosine function*
`double tan(double theta)`	*tangent function*

Note 2: Angles are expressed in radians. Use `toDegrees()` *and* `toRadians()` *to convert.*
Note 3: Use `asin()`, `acos()`, *and* `atan()` *for inverse functions.*

`double exp(double a)`	*exponential* (e^a)
`double log(double a)`	*natural log* ($\log_e a$, *or* $\ln a$)
`double pow(double a, double b)`	*raise a to the bth power* (a^b)
`long round(double a)`	*round to the nearest integer*
`double random()`	*random number in* [0, 1)
`double sqrt(double a)`	*square root of a*
`double E`	*value of e (constant)*
`double PI`	*value of* π *(constant)*

`char`: Single Characters

Single characters are stored as (small) integers!

Expression	Result?
'A'	
'A' + 0	
(int) 'A'	
(char) 65	
(int) 'a'	
(int) '0'	
'3' – '0'	

Character codes are defined by the ASCII and Unicode standards.

`boolean`: True/False

`true`, `false`, `==`, `!=`, `<`, `>`, `<=`, `>=`, `&&` (and), `||` (or), `!` (not)

Expression	Result?
true	
!false	
'A' == 'a'	
Math.PI != 3.14	
'a' > 'b	
1.7 <= (17 / 10)	
true && true	
true && false	
false && false	
true || true	
true || false	
false || false	
(1 < 3) && (3 == (6 / 2))	
(1 >= 3) || !(3 == (6 / 2))	

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`String`: Text

Expression	Result?
"This is a string literal."	
"1" + "2"	
1 + " + " + 2 + " = " + 3	
'1' + "2"	
0 + '1' + "2"	
"" + Math.sqrt(2)	
(String) Math.sqrt(2)	
`(string) Math.sqrt(2)`	
"A" == "A"	
"A".equals("A")	
"B" < "A"	
"B".compareTo("A")	
"B".compareTo("B")	
"B".compareTo("C")	

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Data Type Conversion

- Some variable types can be converted to other types

- Via **casting**

```
float f = 10.0;
int i = (int) f;
```

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Primitive Data Types

Type	Range	Default	Bytes
boolean	{ true, false }	false	?
byte	{ 0..255 }	0	1
int	{ -2,147,483,648 ... 2,147,483,647 }	0	4
long	{ -9,223,372,036,854,775,808 ... 9,223,372,036,854,775,807 }	0	8
float	{ -3.40282347E+38 ... 3.40282347E+38 }	0.0	4
double	*much larger/smaller*	0.0	8
char	*a single character* 'a', 'b', ...	'\u0000'	2

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