


For Loops in Java

This code is run once, just before the for loop starts

Repeats the loop if this condition passes

This code is run each time the code gets to the end of the 'body'



```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```

Nested loops

- **nested loop:** A loop placed inside another loop.

```
for (int i = 0; i < 5; i++) {  
    for (int j = 0; j < 10; j++) {  
        print("*");  
    }  
    println();    // to end the line  
}
```

- Output:

```
*****  
*****  
*****  
*****  
*****
```

- The outer loop repeats 5 times; the inner one 10 times.

Nested loop question 2

- How would we produce the following output?

```
....1
...22
..333
.4444
55555
```

- Answer:

```
for (int i = 0; i < 5; i++) {
    for (int j = 0; j < 5 - i - 1; j++) {
        print(".");
    }
    for (int j = 0; j <= i; j++) {
        print(i + 1);
    }
    println();
}
```

Methods in Java

We can define new **methods** in Java just like in Karel:

```
private void name() {  
    statement;  
    statement;  
    ...  
}
```

For example:

```
private void printGreeting() {  
    println("Hello world!");  
    println("I hope you have a great day.");  
}
```

Methods in Java

```
public void run() {  
    int x = 2;  
    printX();  
}
```

```
private void printX() {  
    // ERROR! "Undefined variable x"  
    println("X has the value " + x);  
}
```

Plan For Today

- Announcements
- Recap: For Loops
- **Recap: Scope**
- Parameters
- Return

A Variable love story

By Chris Piech

Variable Scope

- The **scope** of a variable refers to the section of code where a variable can be accessed.
- **Scope starts** where the variable is declared.
- **Scope ends** at the termination of the code block in which the variable was declared.
- A **code block** is a chunk of code between { } brackets

Variable Scope

You *cannot* have two variables with the same name in the *same scope*.

```
for (int i = 1; i <= 100 * line; i++) {  
    int i = 2;           // ERROR  
    print("/");  
}
```

Variable Scope

You *cannot* have two variables with the same name in the *same scope*.

```
for (int i = 1; i <= 100 * line; i++) {  
    int i = 2;                // ERROR  
    while (...) {  
        int i = 5;           // ERROR  
    }  
}
```

Variable Scope

You *can* have two variables with the same name in *separate scopes*.

```
public void run() {  
    for (int i = 0; i < 5; i++) {           // i ok here  
        int w = 2;                          // w ok here  
    }  
  
    for (int i = 0; i < 2; i++) {           // i ok here  
        int w = 3;                          // w ok here  
    }  
}
```

Variable Scope

You *can* have two variables with the same name in *separate scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);           // prints 5  
}
```

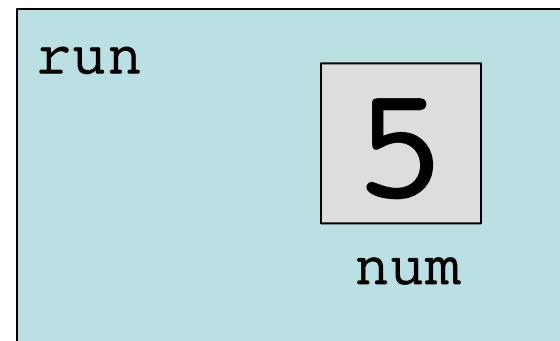
```
private void cow() {  
    int num = 10;  
    println(num);           // prints 10  
}
```

Variable Scope

You *can* have two variables with the same name in *different scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);  
}
```

```
private void cow() {  
    int num = 10;  
    println(num);  
}
```

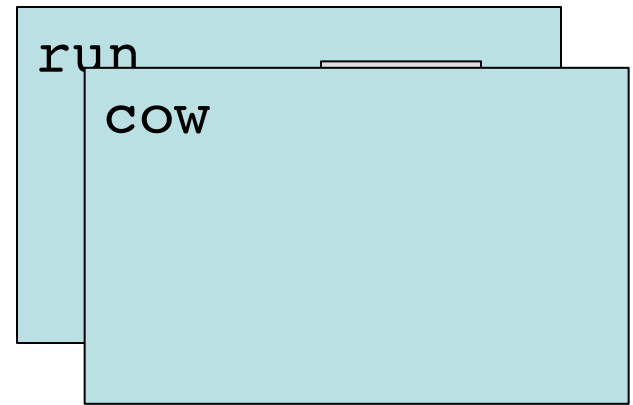


Variable Scope

You *can* have two variables with the same name in *different scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);  
}
```

```
private void cow() {  
    int num = 10;  
    println(num);  
}
```

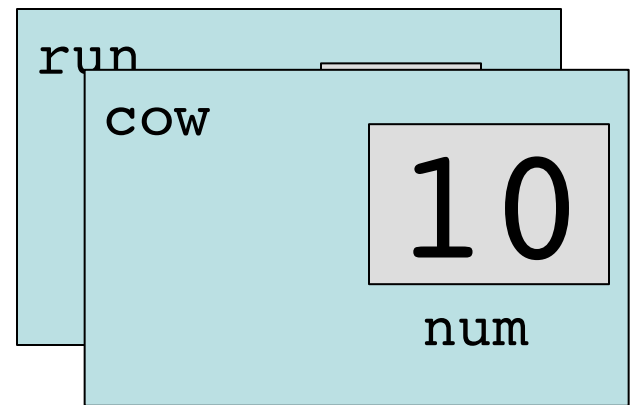


Variable Scope

You *can* have two variables with the same name in *different scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);  
}
```

```
private void cow() {  
    int num = 10;  
    println(num);  
}
```

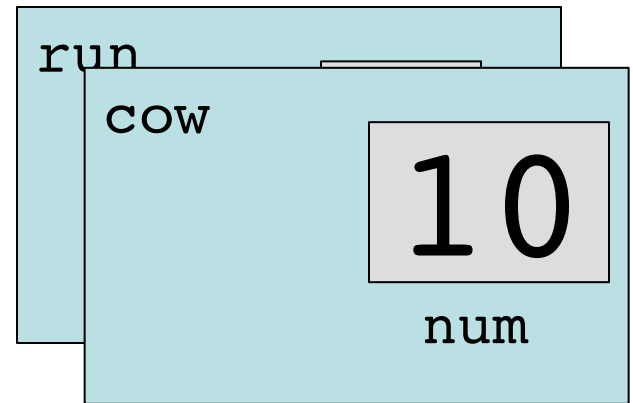


Variable Scope

You *can* have two variables with the same name in *different scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);  
}
```

```
private void cow() {  
    int num = 10;  
    println(num);  
}
```

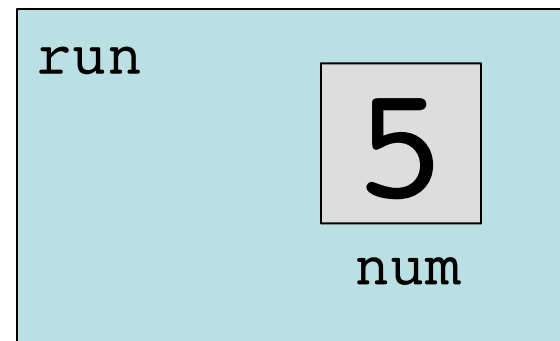


Variable Scope

You *can* have two variables with the same name in *different scopes*.

```
public void run() {  
    int num = 5;  
    cow();  
    println(num);  
}
```

```
private void cow() {  
    int num = 10;  
    println(num);  
}
```



Plan For Today

- Announcements
- Recap: For Loops
- Recap: Scope
- **Parameters**
- Return

Parameters

Parameters let you provide a method some information when you are calling it.

Methods = Toasters



parameter



Example: readInt

```
readInt( "Your guess? " );
```

Example: readInt

We call
readInt

We give readInt some
information in parenthesis
(the text to print to the user)



```
readInt( "Your guess? " );
```

Example: printGreeting

```
printGreeting(5);
```

(Prints a greeting a certain number of times)

Wouldn't it be nice if...

We call
printGreeting

We give printGreeting some
information (the number of
greetings to print)



```
printGreeting(5);
```


Methods with Parameters


Tells Java this method
needs one *int* in order to
execute.



```
private void printGreeting(int times) {  
    // use 'times' to print the greeting  
}
```

Methods with Parameters


`printGreeting(5);`



```
private void printGreeting(int times) {  
    // use 'times' to print the greeting  
}
```

Methods with Parameters

`printGreeting(5);`



```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```

Methods with Parameters

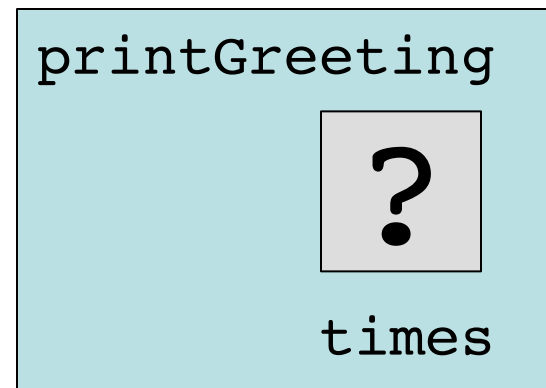
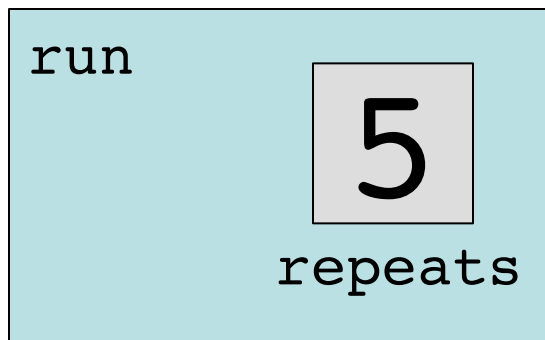
```
public void run() {  
    int repeats = 5;  
    printGreeting(repeats);  
}
```

```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```

Methods with Parameters

```
public void run() {  
    int repeats = 5;  
    printGreeting(repeats);  
}
```

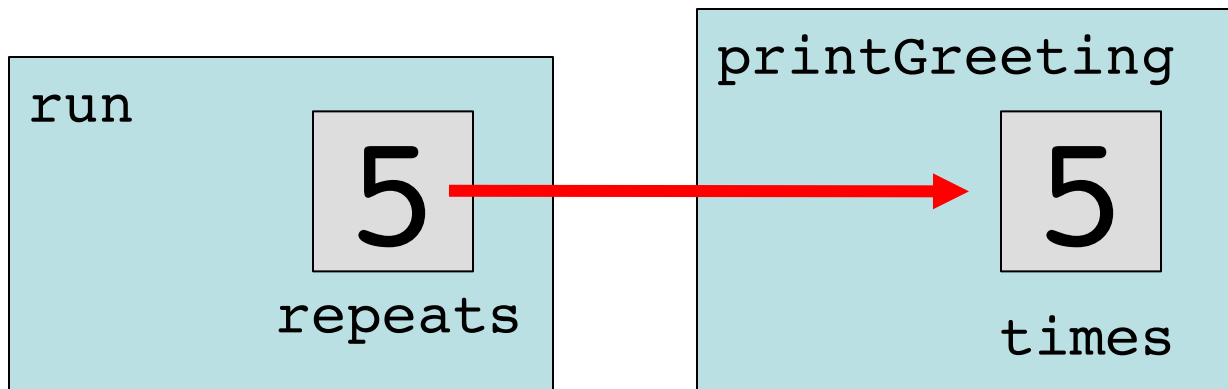
```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```



Methods with Parameters

```
public void run() {  
    int repeats = 5;  
    printGreeting(repeats);  
}
```

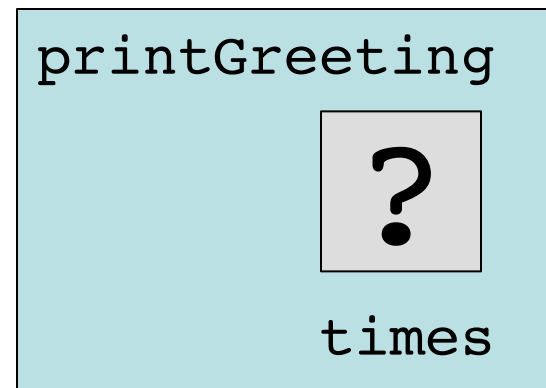
```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```



Methods with Parameters

```
public void run() {  
    int times = 5;  
    printGreeting(times);  
}
```

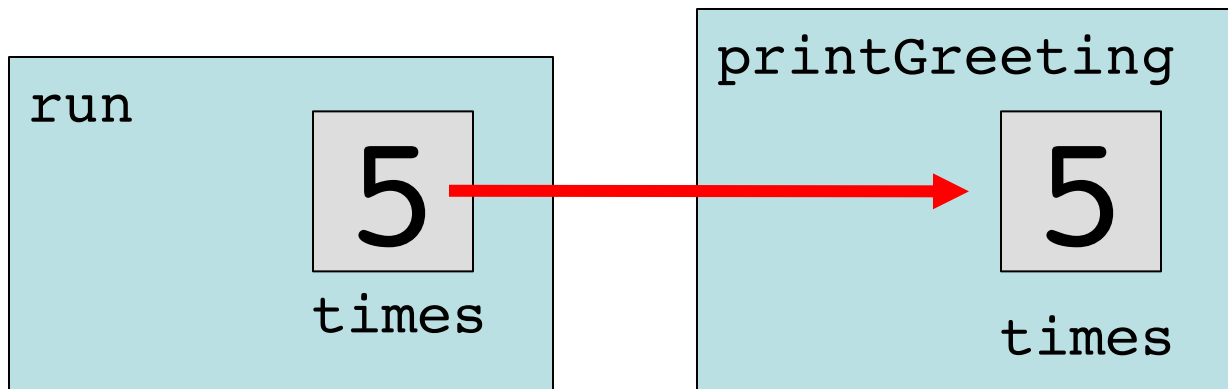
```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```



Methods with Parameters

```
public void run() {  
    int times = 5;  
    printGreeting(times);  
}
```

```
private void printGreeting(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Hello world!");  
    }  
}
```

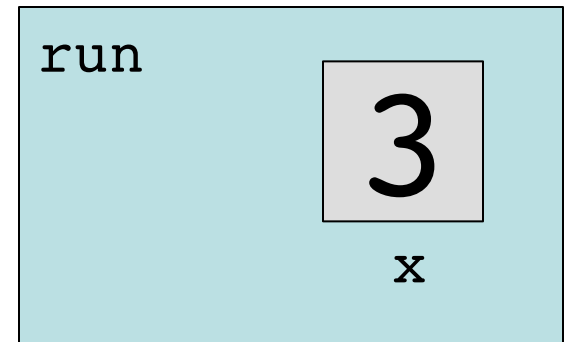


Parameters are Copies

// NOTE: This program is buggy!!

```
public void run() {  
    int x = 3;  
    addFive(x);  
    // prints "x = 3"!  
    println("x = " + x);  
}
```

```
private void addFive(int x) {  
    x += 5;  
}
```

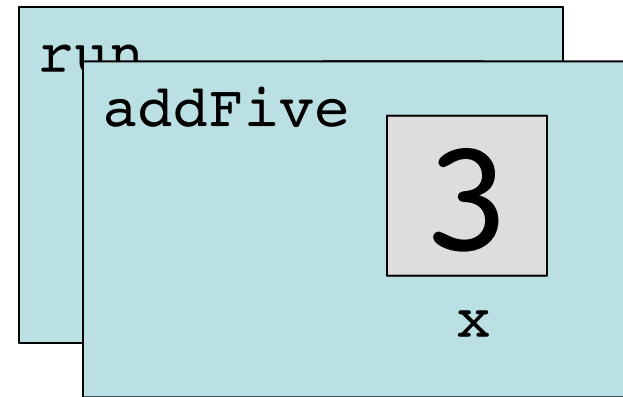


Parameters are Copies

// NOTE: This program is buggy!!

```
public void run() {  
    int x = 3;  
    addFive(x);  
    // prints "x = 3"!  
    println("x = " + x);  
}
```

```
private void addFive(int x) {  
    x += 5;  
}
```

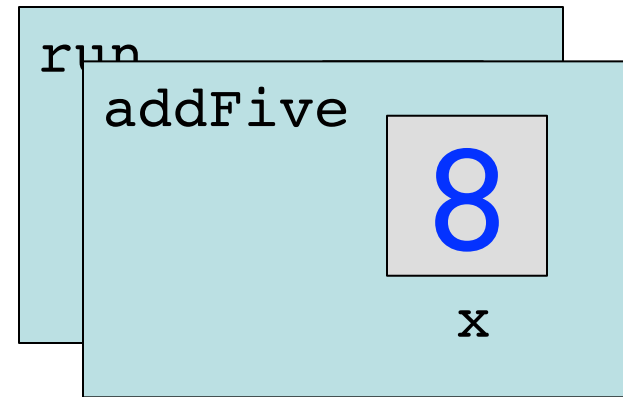


Parameters are Copies

// NOTE: This program is buggy!!

```
public void run() {  
    int x = 3;  
    addFive(x);  
    // prints "x = 3"!  
    println("x = " + x);  
}
```

```
private void addFive(int x) {  
    x += 5;  
}
```

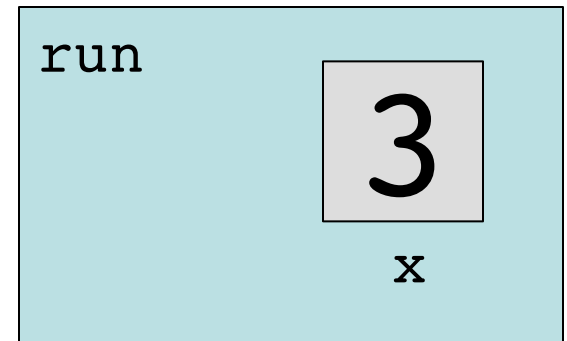


Parameters are Copies

// NOTE: This program is buggy!!

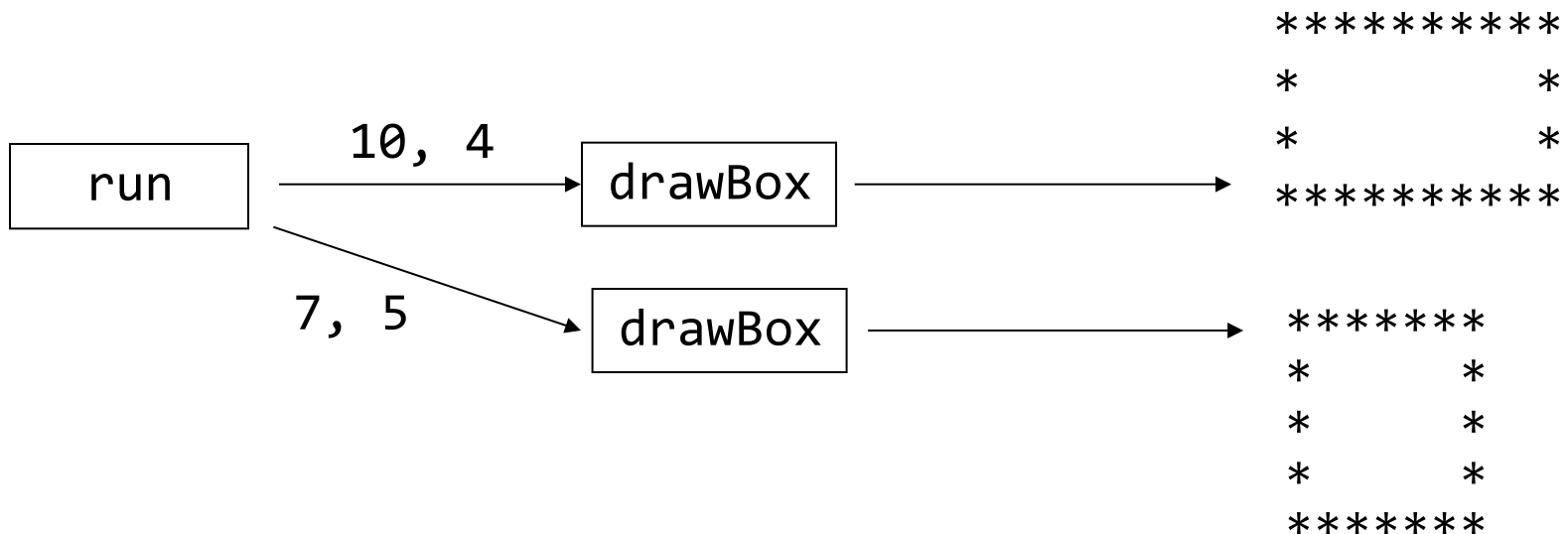
```
public void run() {  
    int x = 3;  
    addFive(x);  
    // prints "x = 3"!  
    println("x = " + x);  
}
```

```
private void addFive(int x) {  
    x += 5;  
}
```



Parameters

- **parameter:** A value passed to a method by its caller.
 - Write a method **drawBox** to draw a box of any size.
 - When *declaring* the method, we will state that it requires the caller to tell it the width and height of the box.
 - When *calling* the method, we will specify the width and height to use.



Declaring a parameter

Stating that a method requires a parameter in order to run

```
private void name(type name) {  
    statements;  
}
```

- Example:

```
private void password(int code) {  
    println("The password is: " + code);  
}
```

- When password is called, the caller must specify the integer code to print.

Multiple parameters

- A method can accept multiple parameters separated by commas: ,
 - When calling it, you must pass values for each parameter.

- Declaration:

```
private void name(type name, ..., type name) {  
    statements;  
}
```

- Call:

```
name(value, value, ..., value);
```

Passing a parameter

Calling a method and specifying values for its parameters

methodName(expression);

- Example:

```
public void run() {  
    password(42);  
    password(12345);  
}
```

Output:

The password is 42

The password is 12345

- Illegal to call without passing an `int` for that parameter.

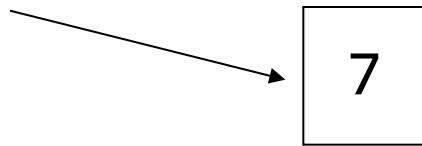
```
password();           // Error
```

```
password(3.7);       // Error
```


How params are passed

- When the method is called:
 - The value is stored into the parameter variable.
 - The method's code executes using that value.

```
public void run() {  
    chant(7);  
}
```



```
private void chant(int times) {  
    for (int i = 0; i < times; i++) {  
        println("Java is great!");  
    }  
}
```

Drawing boxes

- Lets write a program that uses methods and parameters to print the following boxes:

```
*****  
*           *  
*           *  
*****
```

```
*****  
*       *  
*       *  
*       *  
*       *  
*****
```

- The code to draw each box will be very similar.
 - Would variables help? Would constants help?

drawBox

```
drawBox(10, 4);
```

drawBox

We call
drawBox



We give drawBox some
information (the size of
the box we want)



```
drawBox(10, 4);
```

drawBox

```
private void drawBox(int width, int height) {  
    // use width and height variables  
    // to draw a box  
}
```

drawBox

```
*****  
*           *  
*           *  
*****
```

```
private void drawBox(int width, int height) {  
    line(width);  
    for (int line = 0; line < height - 2; line++) {  
        boxSide(width);  
    }  
    line(width);  
}
```


drawBox

```
*****  
*      *  
*      *  
*****
```

```
private void drawBox(int width, int height) {  
    line(width);  
    for (int line = 0; line < height - 2; line++) {  
        boxSide(width);  
    }  
    line(width);  
}
```

drawBox

```
*****  
*           *  
*           *  
*****
```



```
private void drawBox(int width, int height) {  
    line(width);  
    for (int line = 0; line < height - 2; line++) {  
        boxSide(width);  
    }  
    line(width);  
}
```


drawBox

```

** ** ** ** ** **
*                                     *
*                                     *
*-----*
** ** ** ** 

```

```
private void drawBox(int width, int height) {
    line(width);
    for (int line = 0; line < height - 2; line++) {
        boxSide(width);
    }
    line(width);
}
```

drawBox

```
*****  
*           *  
*           *  
*****
```

```
private void drawBox(int width, int height) {  
    line(width);  
    for (int line = 0; line < height - 2; line++) {  
        boxSide(width);  
    }  
    line(width);  
}
```

line

```
private void line(int count) {  
    for (int i = 0; i < count; i++) {  
        print("*");  
    }  
    println();  
}
```

boxSide

*

*

```
private void boxSide(int width) {  
    print("*");  
    for (int i = 0; i < width - 2; i++) {  
        print(" ");  
    }  
    println("*");  
}
```

boxSide

```
public void run() {  
    drawBox(10, 4);  
    drawBox(7, 6);  
}
```

```
*****  
*                                     *  
*                                     *  
*****  
*****  
*                                     *  
*                                     *  
*                                     *  
*                                     *  
*****
```

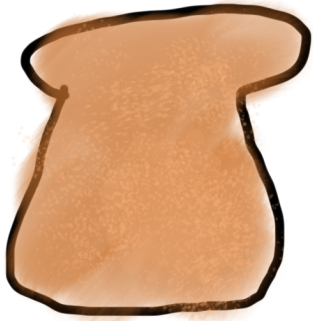
Plan For Today

- Announcements
- Recap: For Loops
- Recap: Scope
- Parameters
- **Return**

Return

Return values let you give back some information when a method is finished.

Methods = Toasters



parameter



Methods = Toasters



parameter



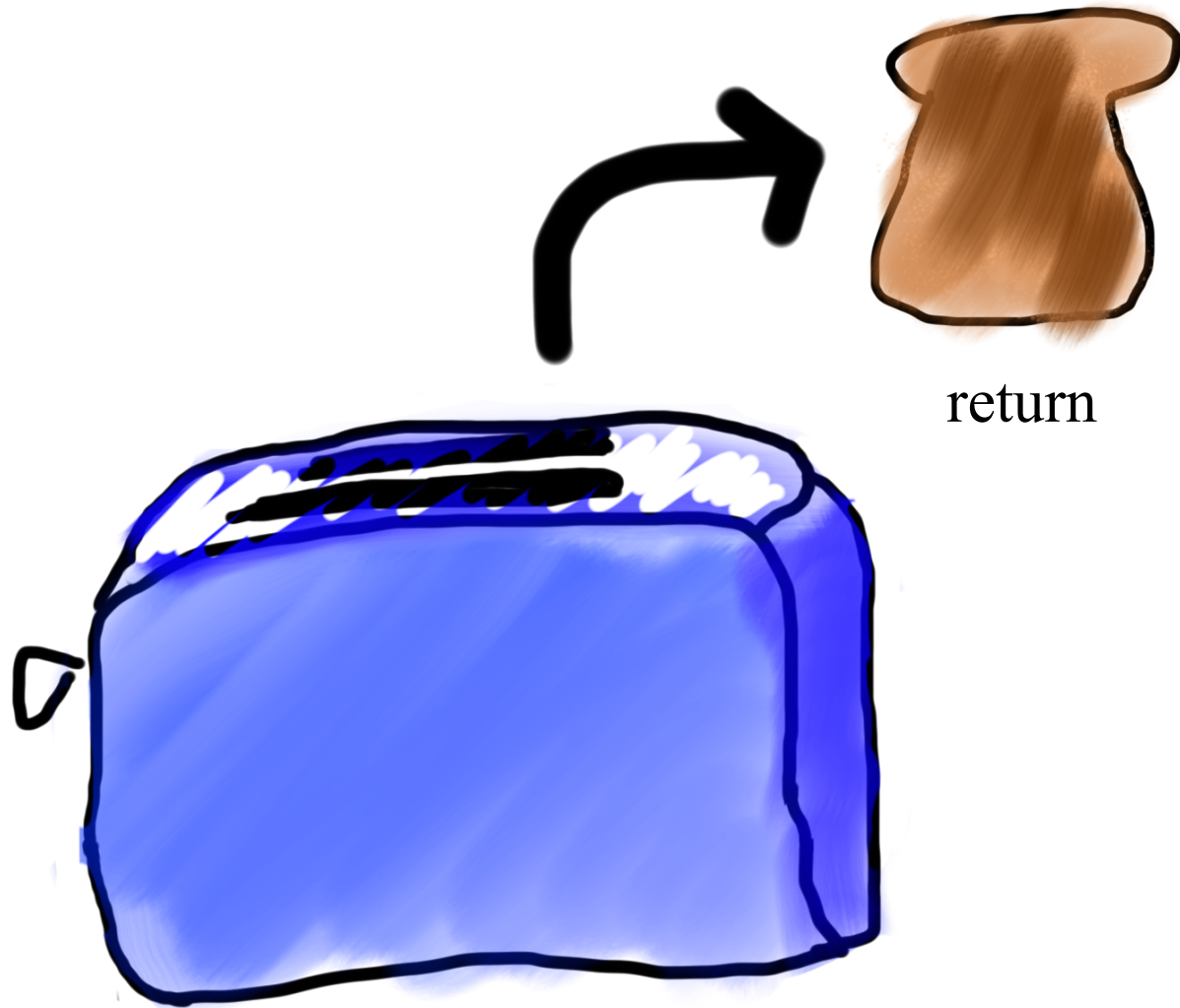
Methods = Toasters



Methods = Toasters



Methods = Toasters



Example: readInt

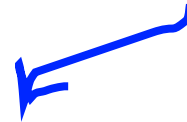
```
int x = readInt( "Your guess? " );
```

Example: readInt

We call
readInt



We give readInt some
information (the text to
print to the user)



```
int x = readInt( "Your guess? " );
```

Example: readInt

When finished, readInt gives us information back (the user's number) and we put it in x.



```
int x = readInt( "Your guess? " );
```

Example: readInt

When we set a variable equal to a method, this tells Java to save the return value of the method in that variable.

```
int x = readInt("Your guess? ");
```


Example: metersToCm

```
double cm = metersToCm( 5 );
```

(Returns the given number of m as cm)

Example: metersToCm

We call
metersToCm

We give
metersToCm some
information (the
number of meters)

double cm = metersToCm(5);



Example: metersToCm

When metersToCm finishes, it
returns the number of cm, and
we put that in this variable.



```
double cm = metersToCm( 5 );
```

Methods and Return

Tells Java this method
needs one *double* in order
to execute.



```
private double metersToCm(double meters) {  
    ...  
}
```

Methods and Return

Tells Java that, when this
method finishes, it will
return a *double*.



```
private double metersToCm(double meters) {  
    ...  
}
```

Methods and Return

Tells Java that, when this method finishes, it will return a *double*.
(Void meant returns nothing)



```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

run



meters

Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

run

5

meters

Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

run

5

meters

metersToCm

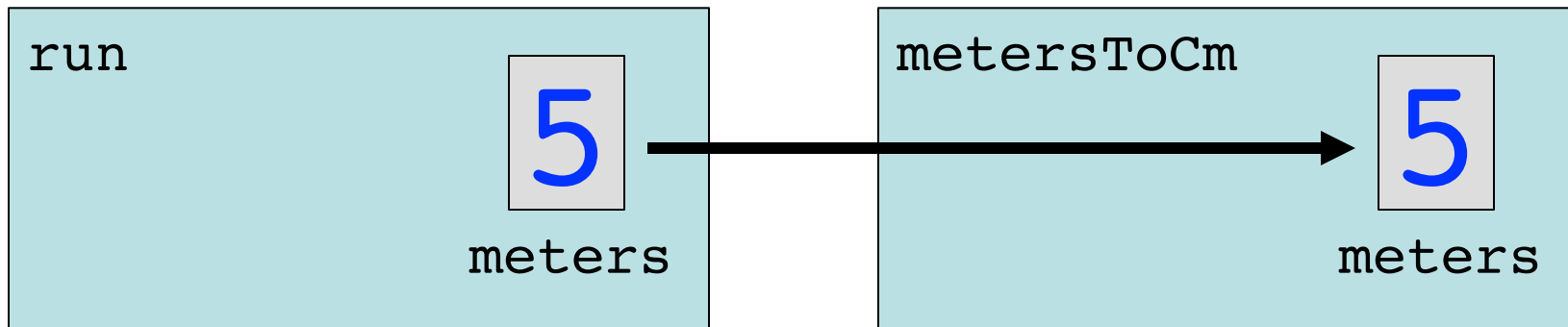
?

meters

Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

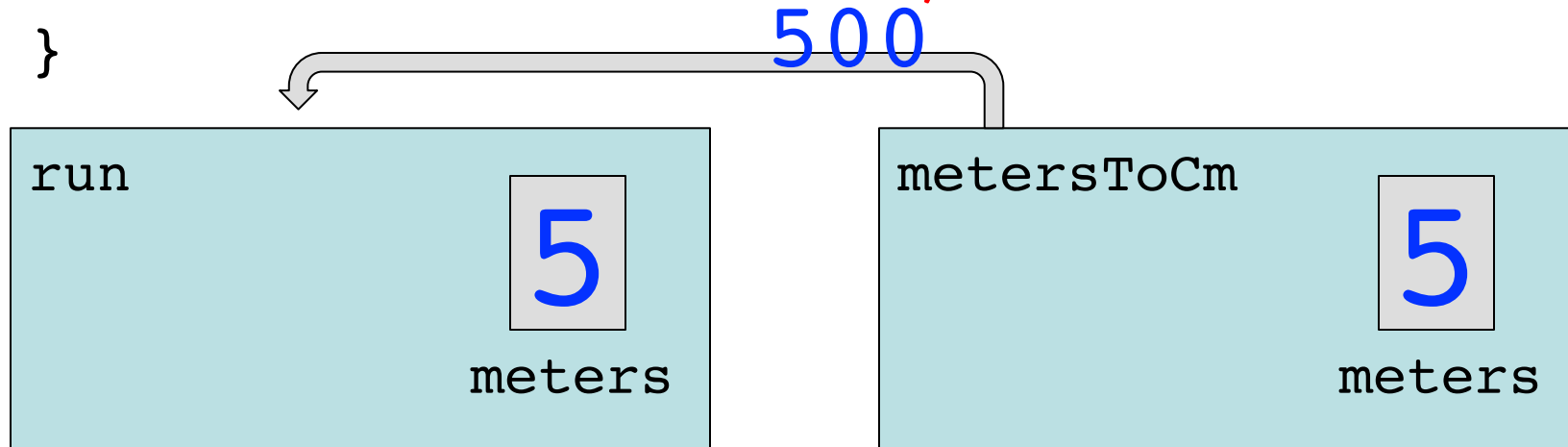
```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```



Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

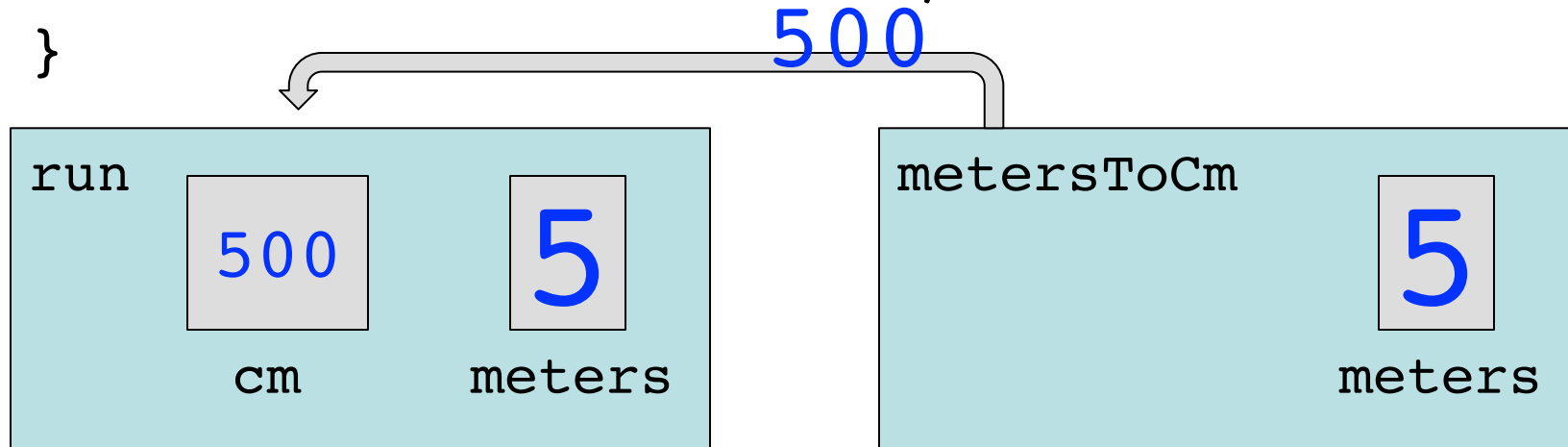
```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```



Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

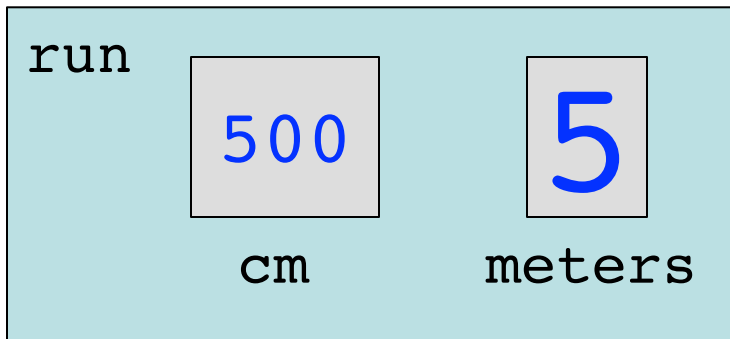
```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```



Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    double cm = metersToCm(meters);  
    println(cm + " centimeters.");  
}
```

```
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```



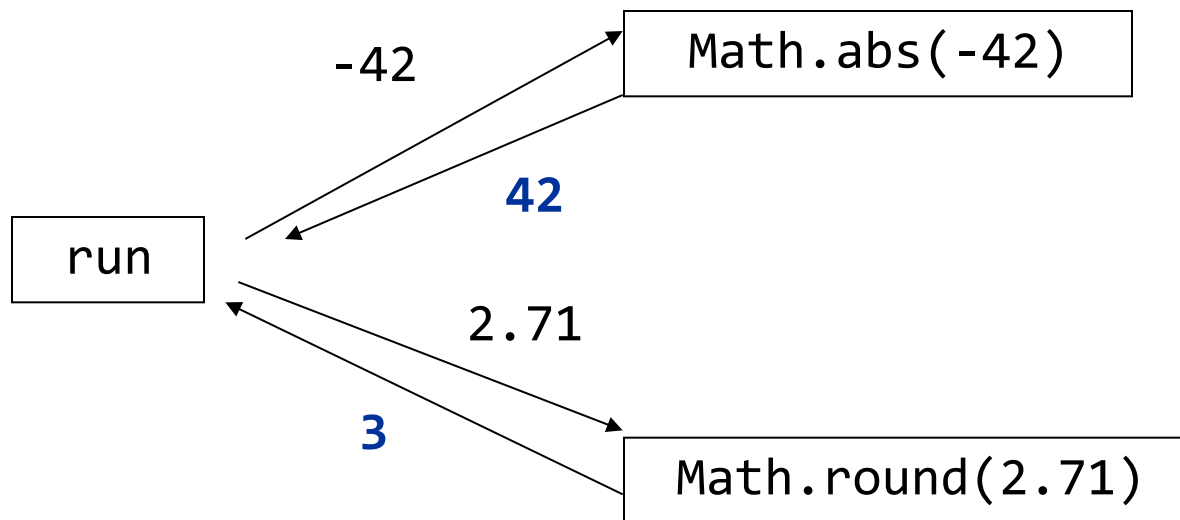
Methods and Return

```
public void run() {  
    double meters = readDouble("#meters? ");  
    println(metersToCm(meters) + "cm.");  
}  
  
private double metersToCm(double meters) {  
    return 100 * meters;  
}
```

If a method returns something, you
can use it directly in an expression!

Return

- **return:** To send out a value as the result of a method.
 - Parameters send information *in* from the caller to the method.
 - Return values send information *out* from a method to its caller.
 - A call to the method can be used as part of an expression.



- **Q:** Why return? Why not just `println` the result value?

Methods

```
visibility type nameOfMethod(parameters) {  
    statements  
}
```

- *visibility*: usually **private** or **public**
- *type*: type returned by method (e.g., **int**, **double**, *etc.*)
 - Can be **void** to indicate that nothing is returned
- *parameters*: information passed into method

Returning Booleans

```
private boolean isEven(int number) {  
  
}
```

Returning Booleans

```
private boolean isEven(int number) {  
    if (number % 2 == 0) {  
        return true;  
    }  
    else {  
        return false;  
    }  
}
```

Returning Booleans

```
private boolean isEven(int number) {  
    if (number % 2 == 0) {  
        return true;  
    }  
    else {  
        return false;  
    }  
}
```

```
public void run() {  
    int num = readInt("? ");  
    if (isEven(num)) {  
        println("Even!");  
    } else {  
        println("Odd!");  
    }  
}
```

Returning Booleans

```
private boolean isEven(int number) {  
    return number % 2 == 0;  
}
```

Returning Booleans

```
public void run() {  
    for(int i = 1; i <= 100; i++) {  
        if(isDivisibleBy(i, 7)) {  
            println(i);  
        }  
    }  
}  
  
private void isDivisibleBy(int a, int b) {  
    return a % b == 0;  
}
```

Return

Return *ends* a method's execution.

```
private int multiplyByTwo(int num) {  
    return num * 2;  
    println("Hello world?"); // not executed!  
}
```

Return

Return *ends* a method's execution.

```
private int max(int num1, int num2) {  
    if(num1 >= num2) {  
        return num1;  
    }  
    return num2; // here only if num1 < num2  
}
```

```
public void run() {  
    println(max(2,3));  
}
```


Revisiting a Bug

```
// NOTE: This program is buggy!!  
public void run() {  
    int x = 3;  
    addFive(x);  
    // prints "x = 3"!  
    println("x = " + x);  
}  
  
private void addFive(int x) {  
    x += 5;  
}
```

Fixed!

```
// NOTE: This program is feeling just fine
public void run() {
    int x = 3;
    x = addFive(x);
    // prints "x = 5"!
    println("x = " + x);
}

private int addFive(int x) {
    x += 5;
    return x;
}
```