

Conditions in Java

```
while(condition) {  
    body  
}
```

```
if(condition) {  
    body  
}
```

The condition should be a “boolean” which is either **true** or **false**

Booleans

1 < 2

true

Relational Operators

Operator	Meaning	Example	Value
==	equals	1 + 1 == 2	true
!=	does not equal	3.2 != 2.5	true
<	less than	10 < 5	false
>	greater than	10 > 5	true
<=	less than or equal to	126 <= 100	false
>=	greater than or equal to	5.0 >= 5.0	true

* All have equal precedence

Relational Operators

```
if (1 < 2) {  
    println("1 is less than 2!");  
}
```

```
int num = readInt("Enter a number: ");  
if (num == 0) {  
    println("That number is 0!");  
} else {  
    println("That number is not 0.");  
}
```

Practice: Sentinel Loops

- **sentinel**: A value that signals the end of user input.
 - **sentinel loop**: Repeats until a sentinel value is seen.
- Example: Write a program that prompts the user for numbers until the user types -1, then output the sum of the numbers.
 - In this case, -1 is the sentinel value.

Type a number: 10

Type a number: 20

Type a number: 30

Type a number: -1

Sum is 60

Practice: Sentinel Loops

```
// fencepost problem!  
// ask for number - post  
// add number to sum - fence
```

```
int sum = 0;  
int num = readInt("Enter a number: ");  
while (num != -1) {  
    sum += num;  
    num = readInt("Enter a number: ");  
}  
println("Sum is " + sum);
```

Practice: Sentinel Loops

// Solution #2 (ok, but #1 is better)

```
int sum = 0;
while (true) {
    int num = readInt("Enter a number: ");
    if (num == -1) {
        break;        // immediately exits loop
    }
    sum += num;
}
println("Sum is " + sum);
```

Compound Expressions

In order of precedence:

Operator	Description	Example	Result
!	not	!(2 == 3)	true
&&	and	(2 == 3) && (-1 < 5)	false
	or	(2 == 3) (-1 < 5)	true

Cannot "chain" tests as in algebra; use && or || instead

```
// assume x is 15
2 <= x <= 10
true    <= 10
Error!
```

```
// correct version
2 <= x && x <= 10
true    && false
false
```


Boolean Variables

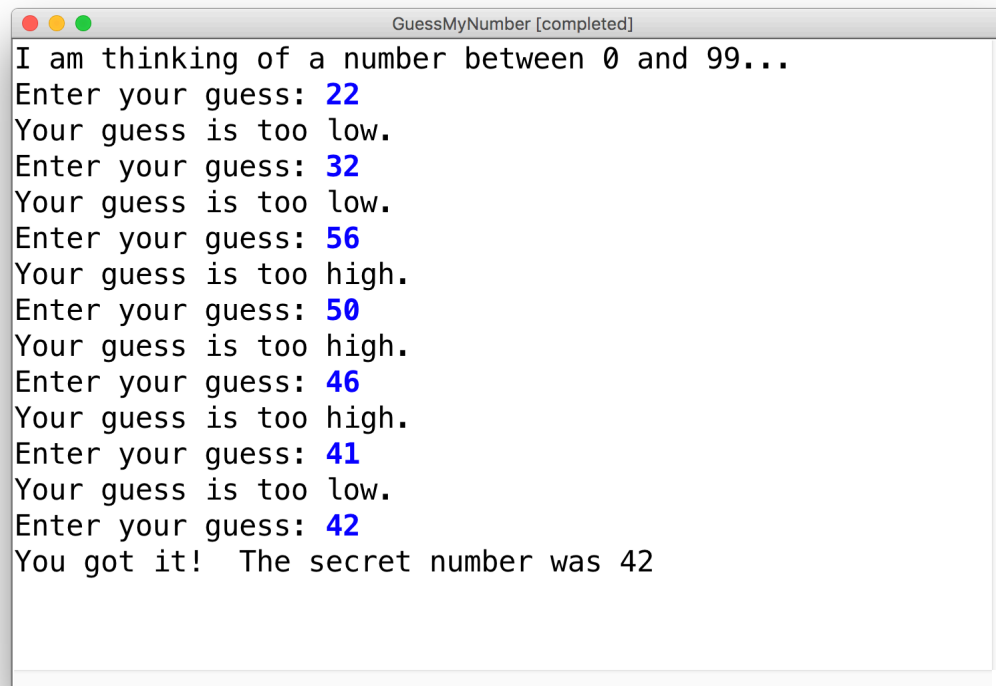
```
// Store expressions that evaluate to true/false
boolean x = 1 < 2;           // true
boolean y = 5.0 == 4.0;     // false
```

```
// Directly set to true/false
boolean isFamilyVisiting = true;
boolean isRaining = false;
```

```
// Ask the user a true/false (yes/no) question
boolean playAgain = readBoolean("Play again?", "y", "n");
if (playAgain) {
    ...
}
```

Practice: GuessMyNumber

- We wrote a program called *GuessMyNumber* that prompts the user for a number until they guess our secret number.
- If a guess is incorrect, the program provides a hint; specifically, whether the guess is too high or too low.



```
GuessMyNumber [completed]
I am thinking of a number between 0 and 99...
Enter your guess: 22
Your guess is too low.
Enter your guess: 32
Your guess is too low.
Enter your guess: 56
Your guess is too high.
Enter your guess: 50
Your guess is too high.
Enter your guess: 46
Your guess is too high.
Enter your guess: 41
Your guess is too low.
Enter your guess: 42
You got it! The secret number was 42
```

If/Else If/Else

```
if (condition1) {  
    ...  
} else if (condition2) {           // NEW  
    ...  
} else {  
    ...  
}
```

Runs the first group of statements if ***condition1*** is true; otherwise, runs the second group of statements if ***condition2*** is true; otherwise, runs the third group of statements.

You can have multiple else if clauses together.

If/Else If/Else

```
int num = readInt("Enter a number: ");  
if (num > 0) {  
    println("Your number is positive");  
} else if (num < 0) {  
    println("Your number is negative");  
} else {  
    println("Your number is 0");  
}
```

Plan For Today

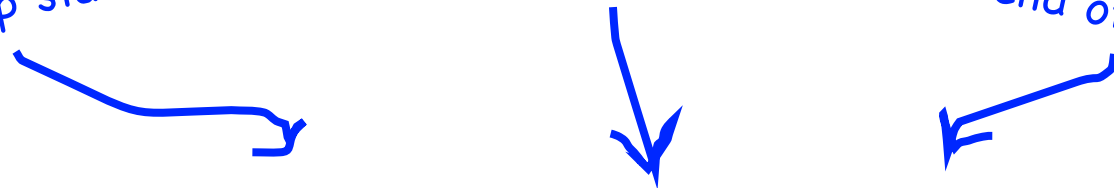
- Announcements
- Recap: If and While in Java
- **For Loops in Java**
- Methods in Java
- Scope
- Parameters

For Loops in Java

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

Repeats the loop if this condition passes

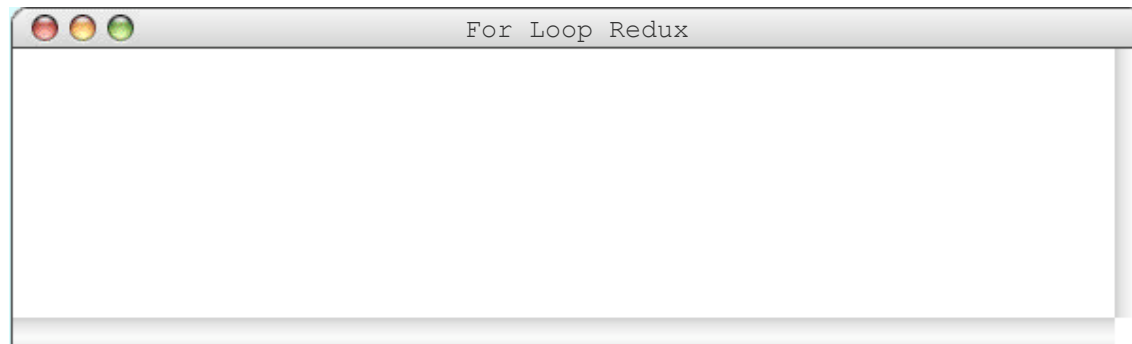
This code is run each time the code gets to the end of the 'body'



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

For Loops in Java

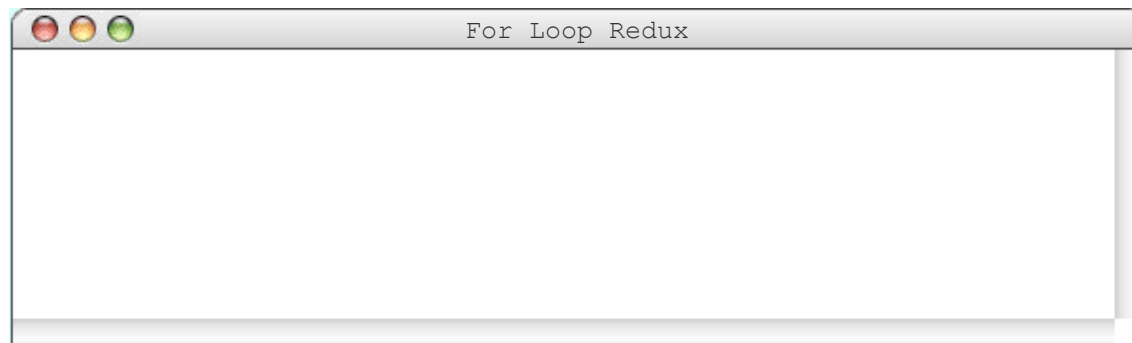
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 0

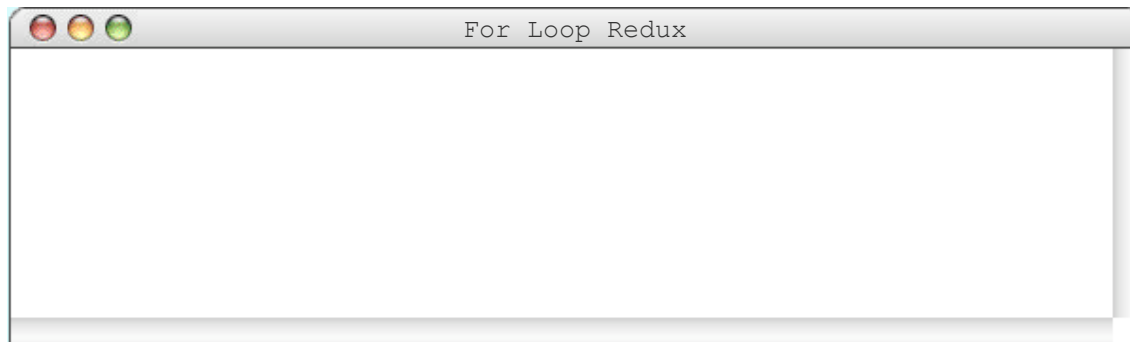
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 0

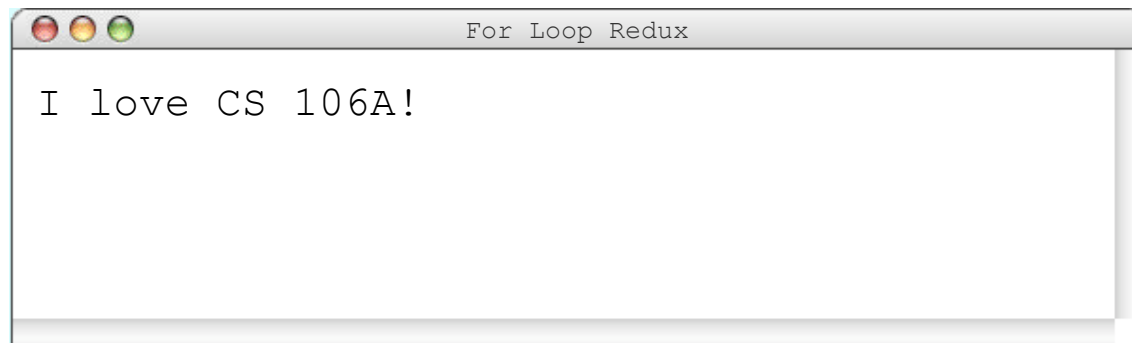
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 0

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

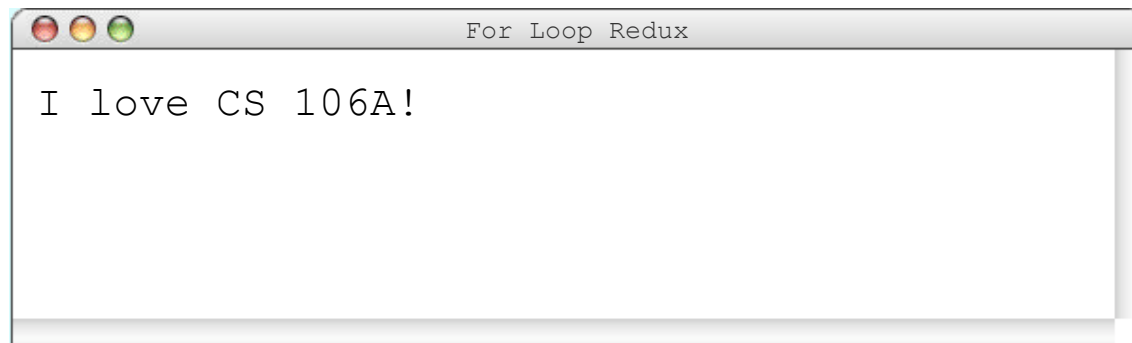


For Loops in Java

i 0

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

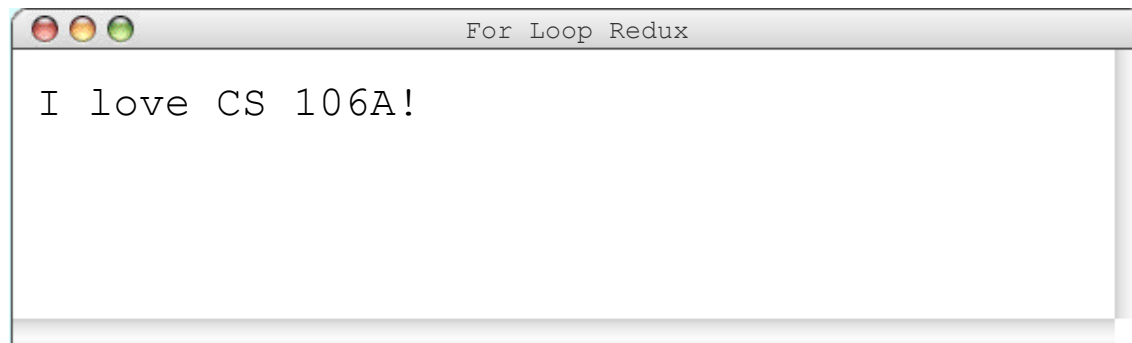
```
}
```



For Loops in Java

i 1

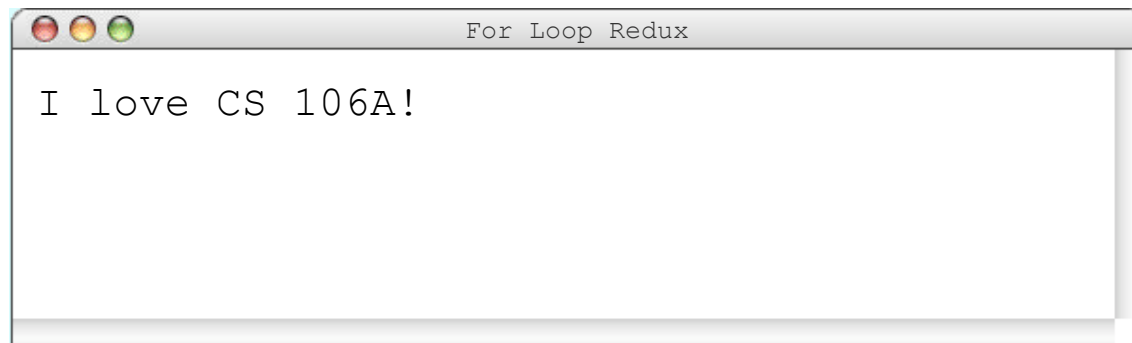
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 1

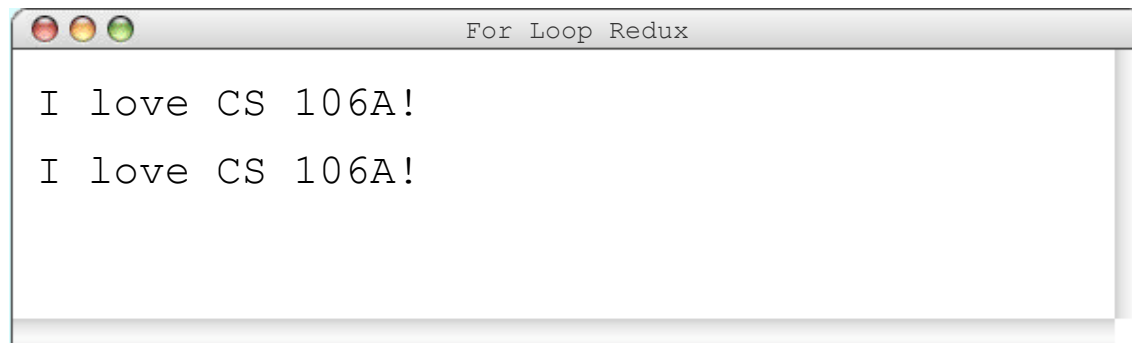
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 1

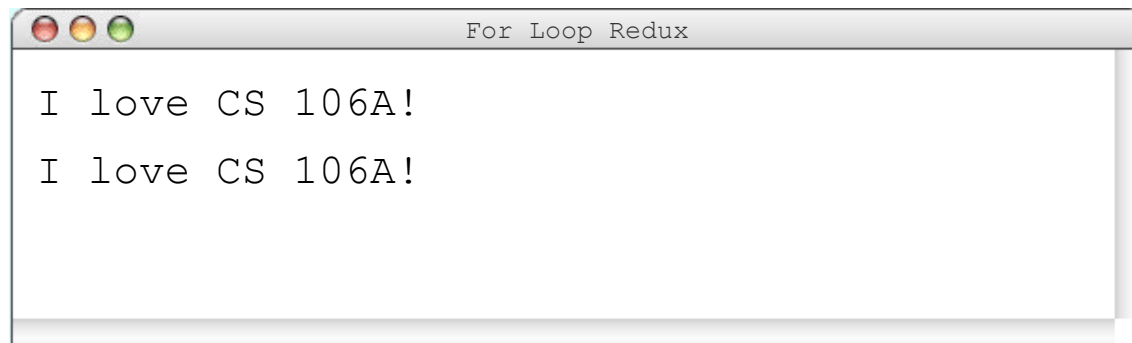
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 2

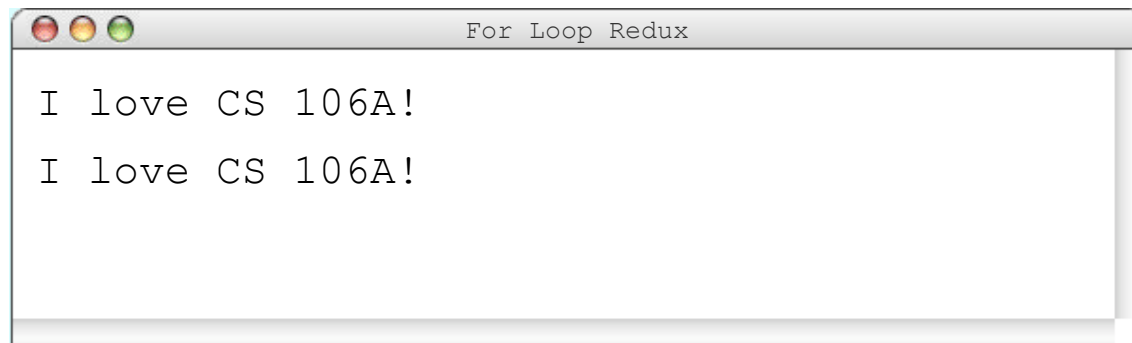
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 2

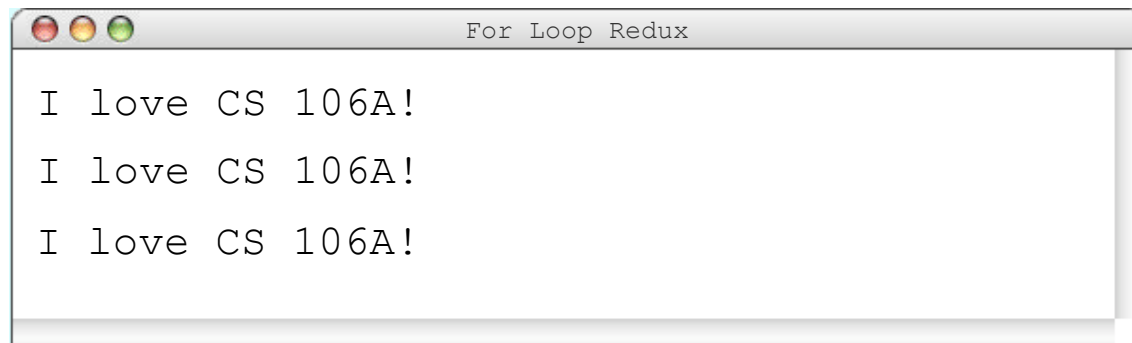
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 2

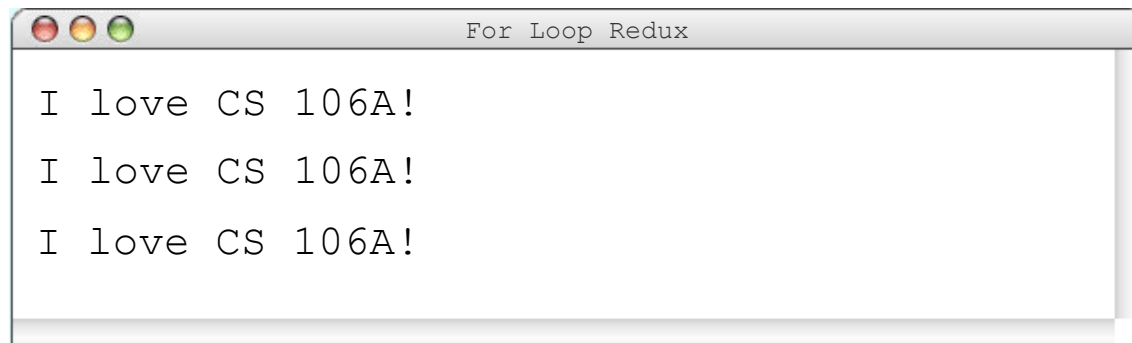
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

i 3

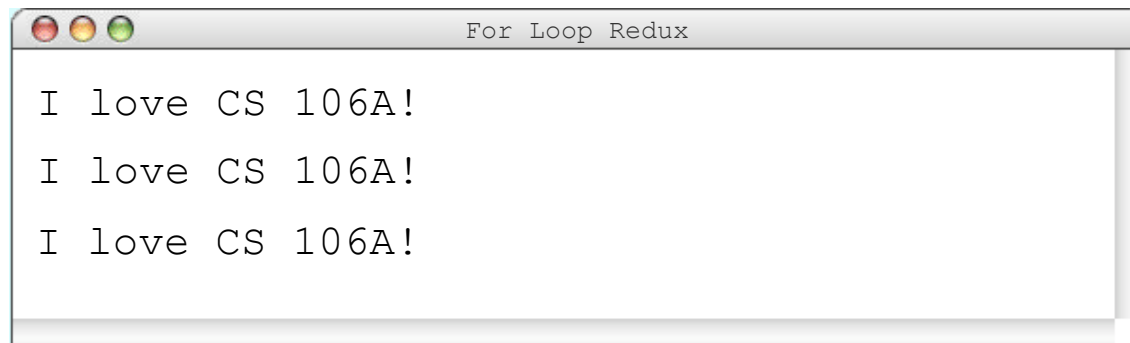
```
for (int i = 0; i < 3; i++) {  
    println("I love CS 106A!");  
}
```



For Loops in Java

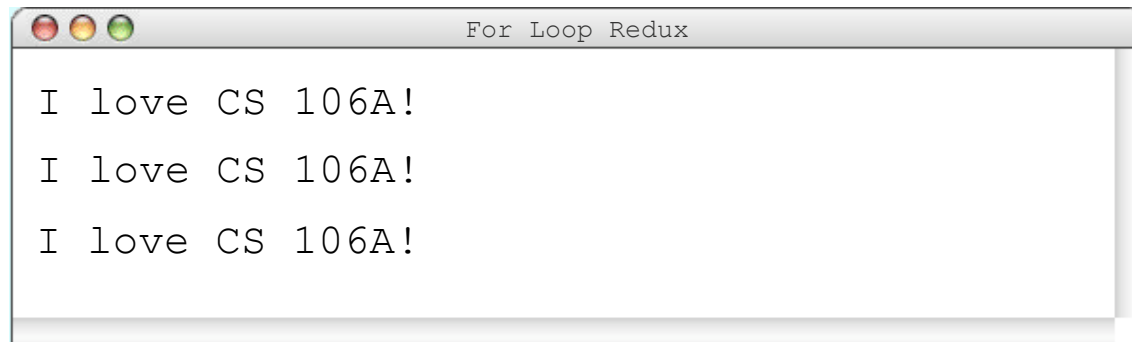
i 3

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



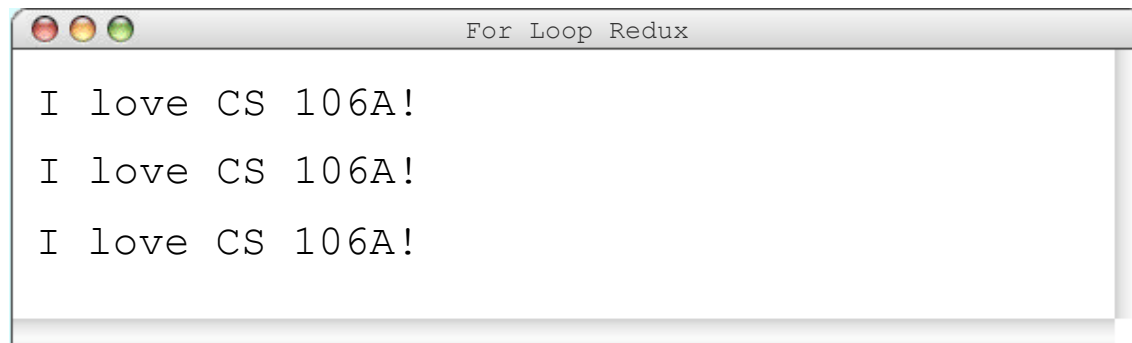
For Loops in Java

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



For Loops in Java

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



Using the For Loop Variable

```
// prints the first 100 even numbers
for(int i = 1; i <= 100; i++) {
    println(i * 2);
}
```

Using the For Loop Variable

```
// Launch countdown
for(int i = 10; i >= 1; i--) {
    println(i);
}
println("Blast off!");
```

Output:

10

9

8

...

Blast off!

Using the For Loop Variable

```
// Adds up 1 + 2 + ... + 99 + 100
int sum = 0;
for(int i = 1; i <= 100; i++) {
    sum += i;
}
println("The sum is " + sum);
```


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

- **Q:** What output is produced by the following code?

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

- | | | | | |
|-----------|-----------|-----------|-----------|-----------|
| A. | B. | C. | D. | E. |
| ***** | ***** | * | 1 | 12345 |
| ***** | **** | ** | 22 | |
| ***** | *** | *** | 333 | |
| ***** | ** | **** | 4444 | |
| ***** | * | ***** | 55555 | |

(How would you modify the code to produce each output above?)

Nested loop question 2

- How would we produce the following output?

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

Nested loop question 2

- How would we produce the following output?

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

- Answer:

```
for (int i = 0; i < 5; i++) {
```

```
}
```

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(".");
    }
}
```

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);
    }
}
```

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();
}
```

Plan For Today

- Announcements
- Recap: If and While in Java
- For Loops in Java
- **Methods in Java**
- Scope
- Parameters

Defining New Commands in Karel

We can make new commands (or **methods**) for Karel. This lets us *decompose* our program into smaller pieces that are easier to understand.

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

For example:

```
private void turnRight() {  
    turnLeft();  
    turnLeft();  
    turnLeft();  
}
```

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: If and While in Java
- For Loops in Java
- Methods in Java
- **Scope**
- Parameters

A Variable love story

By Chris Piech

Once upon a time...

...x was looking for love!

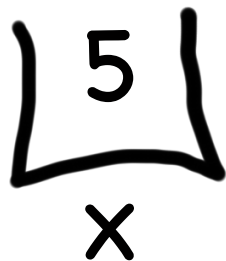
```
int x = 5;
```

```
if(lookingForLove()) {
```

```
    int y = 5;
```

```
}
```

```
println(x + y);
```



A hand-drawn diagram consisting of a large curly brace on the left and a vertical line on the right, enclosing the number 5. Below the brace is the letter x.

...x was looking for love!

```
int x = 5;
```

```
if(lookingForLove()) {
```

```
    int y = 5;
```

```
}
```

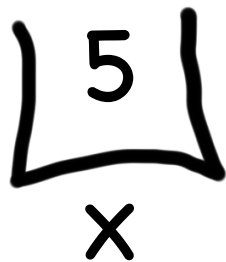
```
println(x + y);
```

x was definitely
looking for love

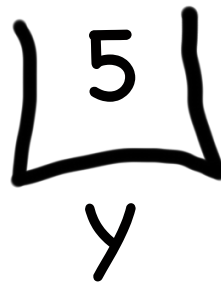
A hand-drawn diagram consisting of a large, slightly irregular bracket shape. Inside the top part of the bracket is the number '5'. Below the bottom curve of the bracket is the letter 'x'. This diagram visually represents the state of the variable 'x' after the code execution, where it holds the value 5.

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



A hand-drawn diagram showing the number 5 inside a hand-drawn box. Below the box is the letter x.



A hand-drawn diagram showing the number 5 inside a hand-drawn box. Below the box is the letter y.

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```

5
x

5
y

Hi, I'm y

“Wow!”

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```

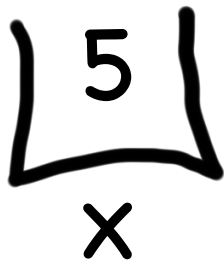
Wow

5
x

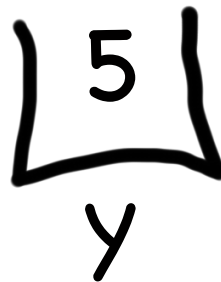
5
y

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



A hand-drawn diagram consisting of a large, slightly irregular bracket shape. Inside the bracket is the number 5. Below the bracket is the letter x.

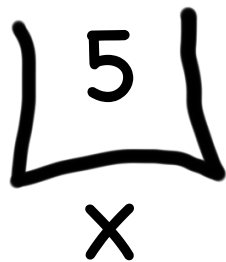


A hand-drawn diagram consisting of a large, slightly irregular bracket shape. Inside the bracket is the number 5. Below the bracket is the letter y.

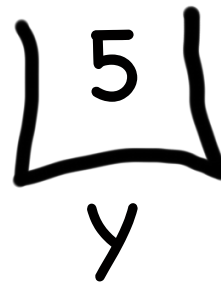
We have so much
in common

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



A hand-drawn diagram showing a variable `x` containing the value 5. The number 5 is enclosed in a hand-drawn box, and the letter `x` is written below it.

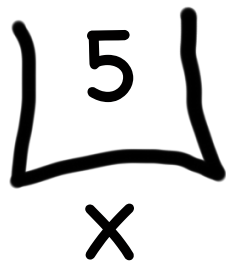


A hand-drawn diagram showing a variable `y` containing the value 5. The number 5 is enclosed in a hand-drawn box, and the letter `y` is written below it.

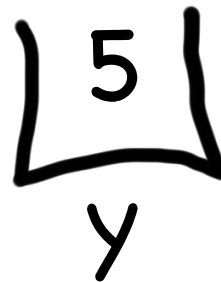
We both have
value 5!

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



A hand-drawn diagram consisting of a box with a curved bottom, containing the number 5. Below the box is the letter x.



A hand-drawn diagram consisting of a box with a curved bottom, containing the number 5. Below the box is the letter y.

Maybe sometime
we can...

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```

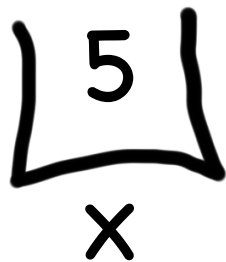
5
x

5
y

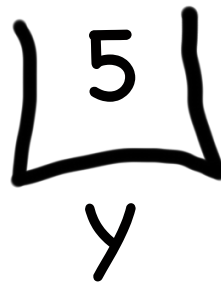
println together?

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



A hand-drawn diagram showing the number 5 inside a hand-drawn box. Below the box is the letter x.



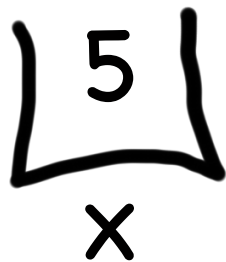
A hand-drawn diagram showing the number 5 inside a hand-drawn box. Below the box is the letter y.

It was a beautiful match...

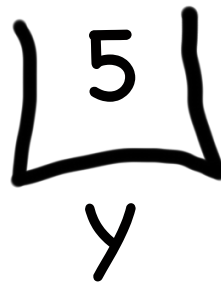
...but then tragedy struck.

Tragedy Strikes

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



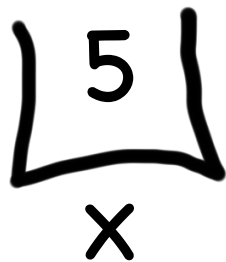
A hand-drawn diagram showing the variable `x` with a bracket above it containing the number 5, indicating its value.



A hand-drawn diagram showing the variable `y` with a bracket above it containing the number 5, indicating its value.

Tragedy Strikes

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```



Noooooooooooooooooooo!

You see...

when a program exits a code block,
all variables declared inside that block go away!

Since **y** is inside the if-block...

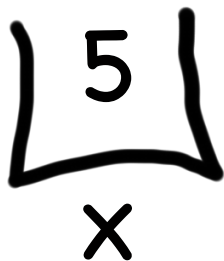
```
int x = 5;
```

```
if(lookingForLove()) {
```

```
    int y = 5;
```

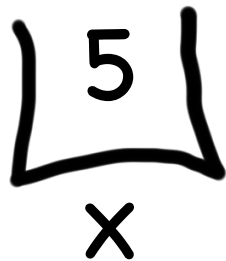
```
}
```

```
println(x + y);
```



...it goes away here...

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}  
println(x + y);
```

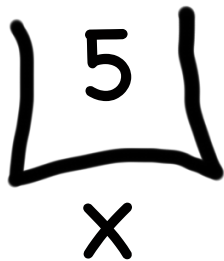


...and doesn't exist here.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
}
```

```
println(x + y);
```

Error.
Undefined
variable y.



The End

Sad times ☹

Variable Scope

Variables have a lifetime (called scope):

```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```

Variable Scope

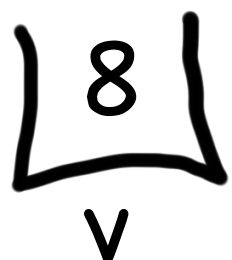
Variables have a lifetime (called scope):

```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```

Variable Scope

Variables have a lifetime (called scope):

```
public void run() {  
    double v = 8; ← Comes to life here  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```

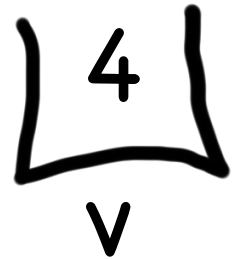


Variable Scope

Variables have a lifetime (called scope):

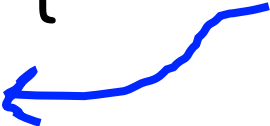
```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```

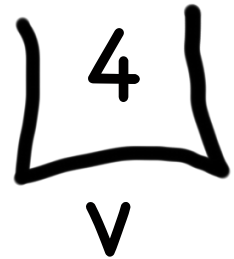
← This is the **inner most** code block in which it was declared....



Variable Scope

Variables have a lifetime (called scope):

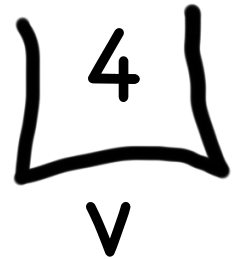
```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  Still alive here...  
        ... some code  
    }  
    ... some other code  
}
```



Variable Scope

Variables have a lifetime (called scope):

```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```



It goes away here (at the end of its code block)

Variable Scope

Variables have a lifetime (called scope):

```
public void run() {  
    double v = 8;  
    if (condition) {  
        v = 4;  
        ... some code  
    }  
    ... some other code  
}
```



It goes away here (at the end of its code block)

Variable Scope

Variables have a lifetime (called scope):

```
public void run() {  
    ... some code  
    if (condition) {  
        int w = 4;  
        ... some code  
    }  
    ... some other code  
}
```



This is the scope of **w**

Variable Scope

Variables have a lifetime (called scope):

```
public void run( ) {
```

```
    ... some code
```

```
    if ( condition ) {
```

```
        int w = 4;
```

```
        ... some code
```

```
    }
```

```
    ... some other code
```

```
}
```

w is created here

w goes away
here (at the
end of its code
block)

Variable Scope

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

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

A Variable love story

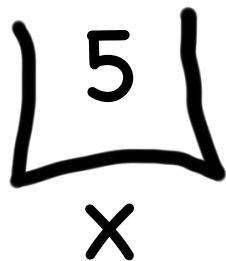
Chapter 2
By Chris

The programmer fixed the bug

...x was looking for love!

```
int x = 5;
```

```
if(lookingForLove()) {  
    int y = 5;  
    println(x + y);  
}
```



A hand-drawn diagram consisting of a large, hand-drawn curly brace. Inside the top part of the brace is the number '5'. Below the bottom of the brace is the variable name 'x'. This diagram visually represents the state where the variable 'x' holds the value '5'.

...x was looking for love!

```
int x = 5;
```

```
if(lookingForLove()) {
```

```
    int y = 5;
```

```
    println(x + y);
```

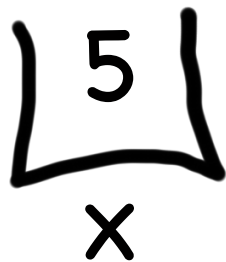
```
}
```

x was definitely
looking for love

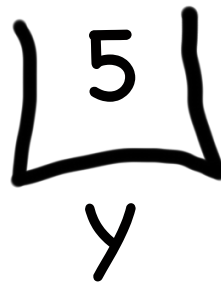
A hand-drawn diagram consisting of a large left curly brace and a large right curly brace. The number '5' is written between the two braces. Below the braces, the letter 'x' is written, indicating that the variable x holds the value 5.

And met y.

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
    println(x + y);  
}
```



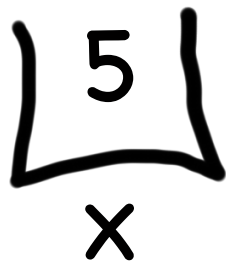
A hand-drawn diagram showing the variable `x` with a bracket above it containing the value 5.



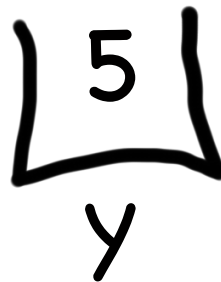
A hand-drawn diagram showing the variable `y` with a bracket above it containing the value 5.

Since they were both “in scope”...

```
int x = 5;  
if(lookingForLove()) {  
    int y = 5;  
    println(x + y);  
}
```



A hand-drawn diagram showing the variable `x` with a bracket above it containing the value 5.



A hand-drawn diagram showing the variable `y` with a bracket above it containing the value 5.

...they lived happily ever after.
The end.

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

```
private 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*.

```
private 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*.

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

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

Revisiting Sentinel Loops

```
// sum must be outside the while loop!  
// Otherwise it will be redeclared many times.  
int sum = 0;  
int num = readInt("Enter a number: ");  
while (num != -1) {  
    sum += num;  
    num = readInt("Enter a number: ");  
}  
println("Sum is " + sum);
```

Plan For Today

- Announcements
- Recap: If and While in Java
- For Loops in Java
- Methods in Java
- Scope
- **Parameters**

Parameters

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

Methods = Toasters



Methods = Toasters



parameter



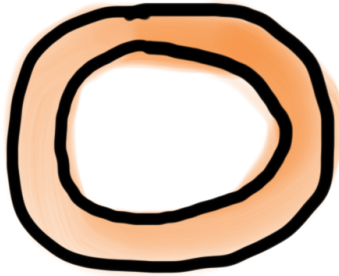
Methods = Toasters



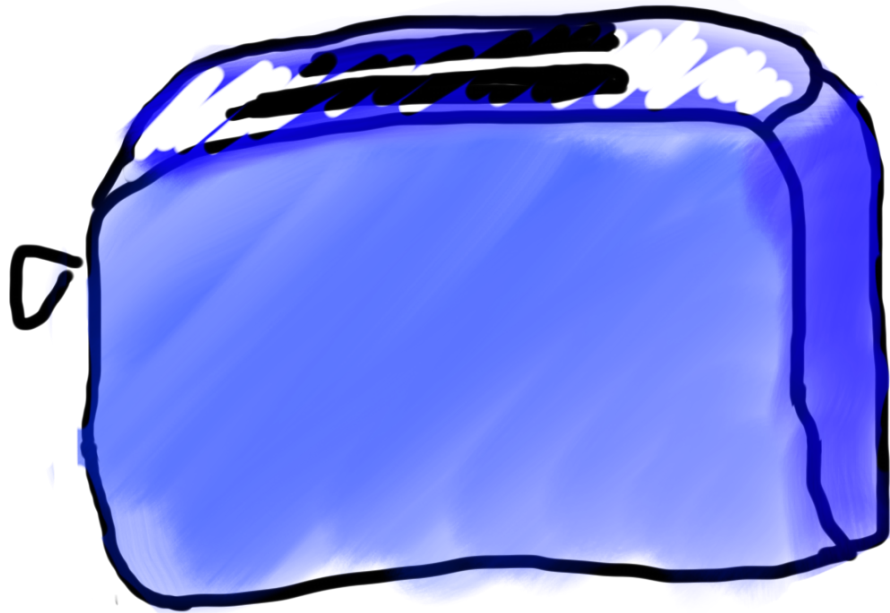
parameter



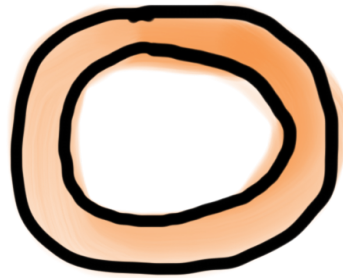
Methods = Toasters



parameter



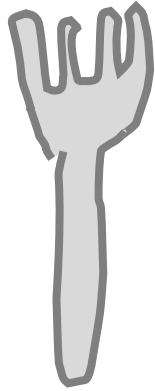
Methods = Toasters



parameter



Methods = Toasters



Invalid parameter



Methods = Toasters



Drawing boxes

- Consider the task of printing the following boxes:

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

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

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

Wouldn't it be nice if...

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

Continued next time...