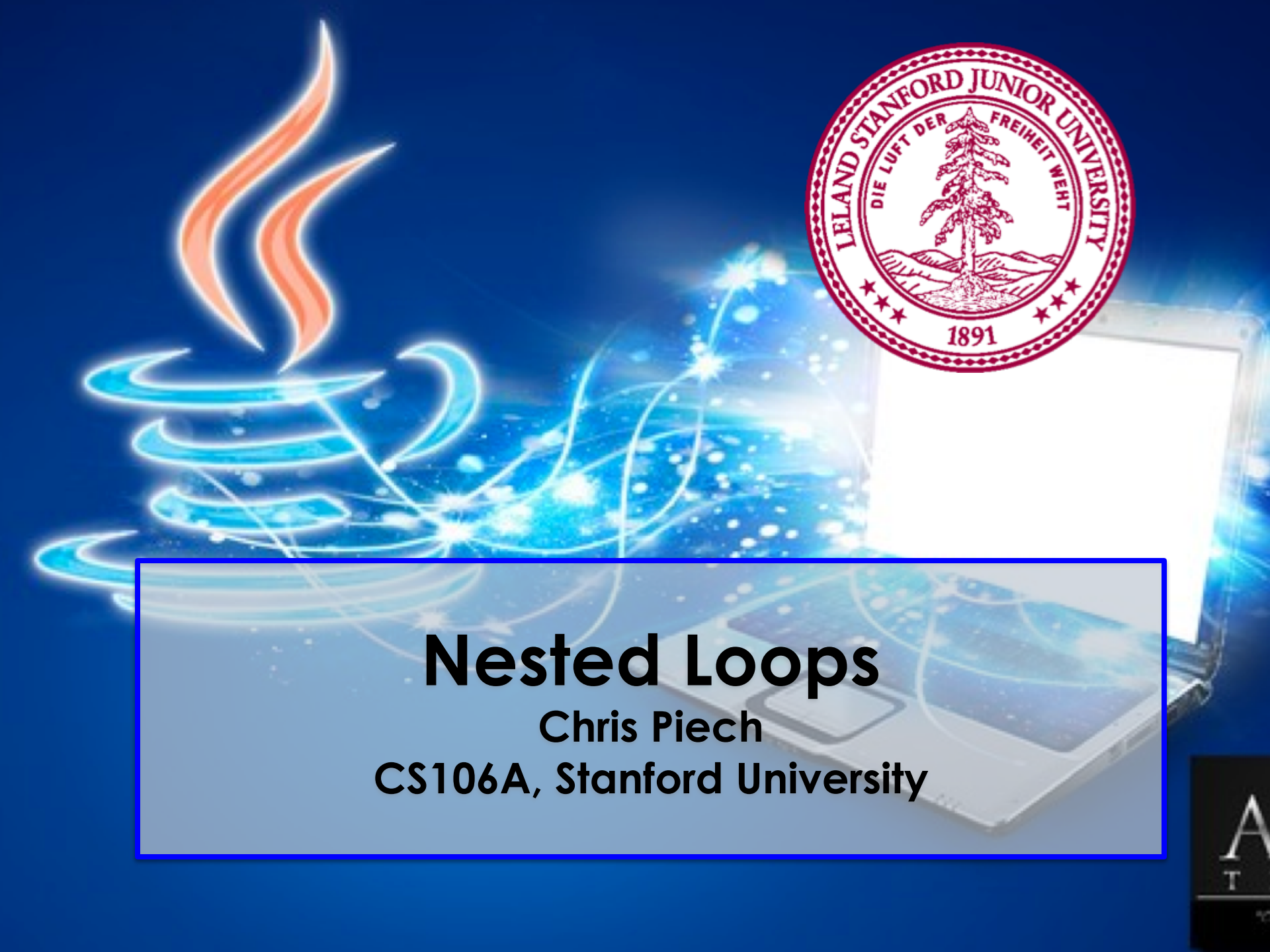
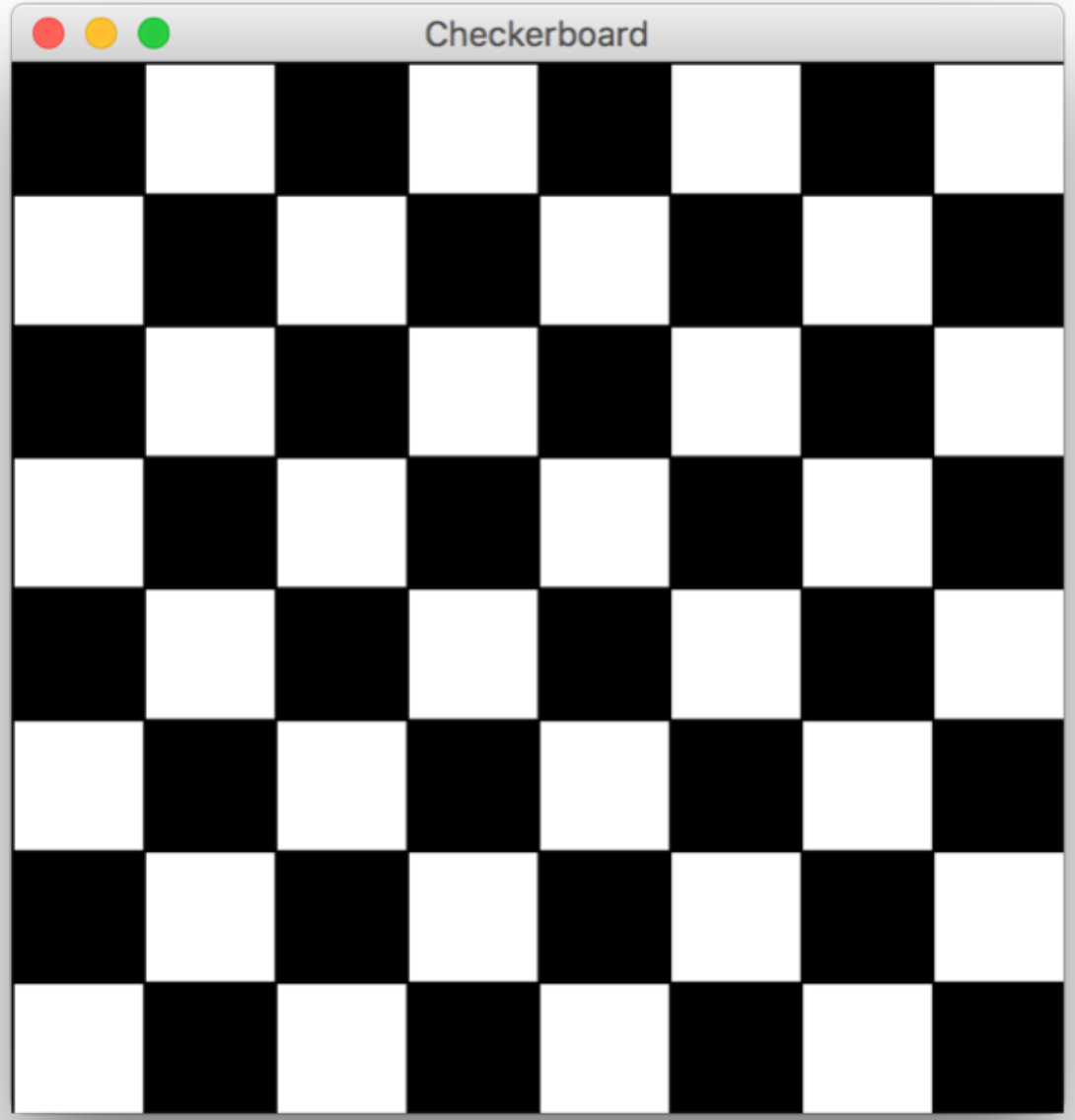


Nested Loops

Chris Piech
CS106A, Stanford University


Checkerboard

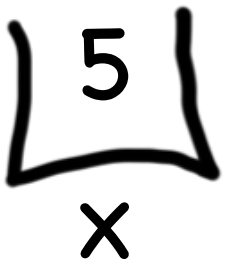
A Variable love story

By Chris

Once upon a time…

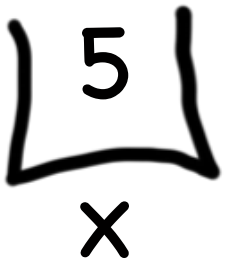
X was looking for love!

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



X was looking for love!

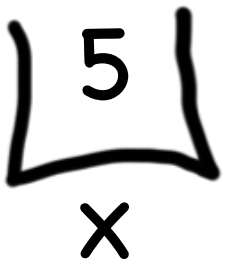
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



X was looking for love!

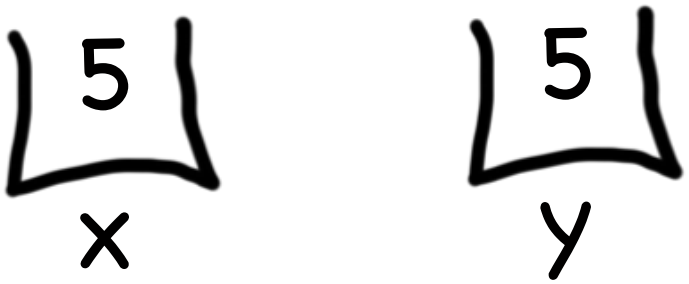
x was definitely looking for love

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



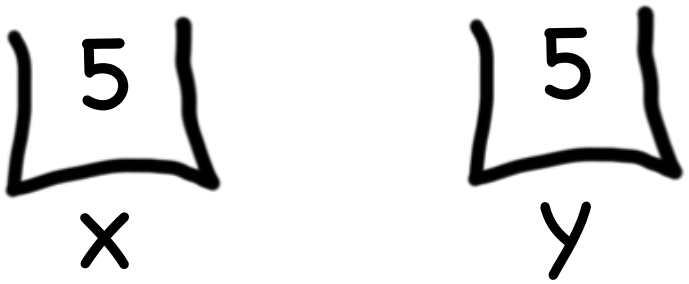
And met y

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



And met y

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

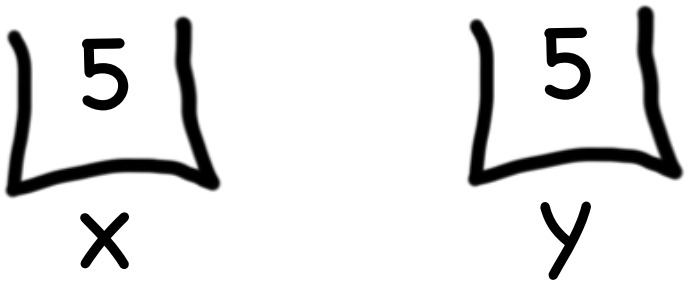


“Wow!”

And met y

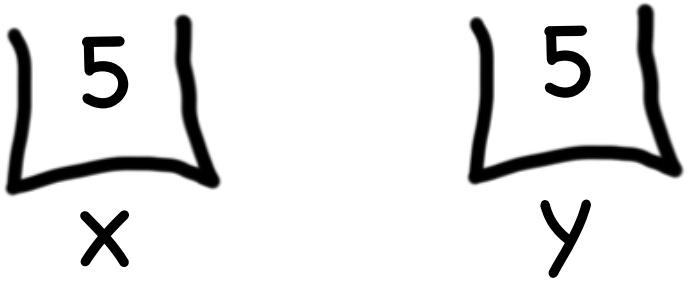
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```

Wow



And met y

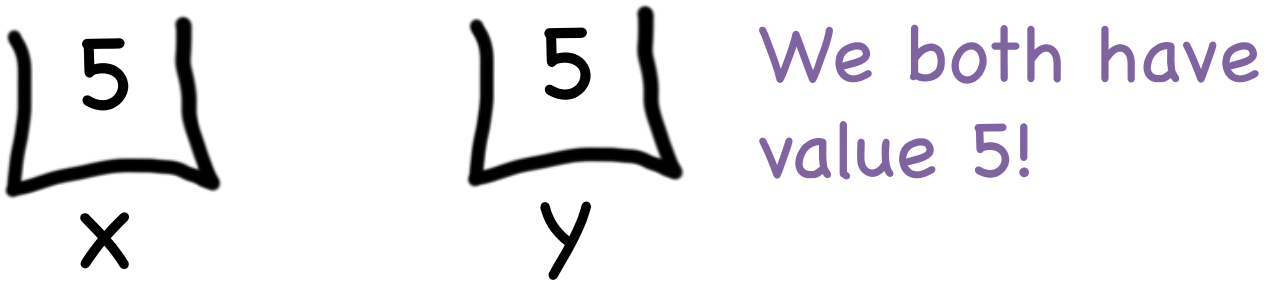
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



We have so much in common

And met y

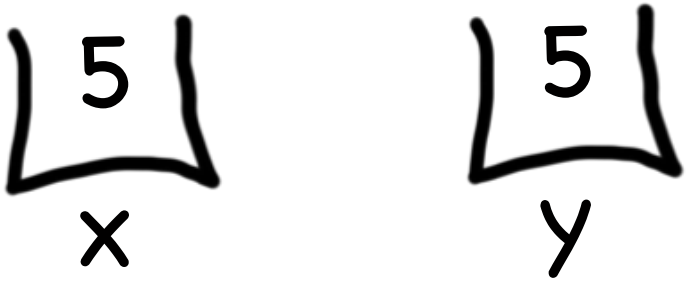
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



We both have value 5!

And met y

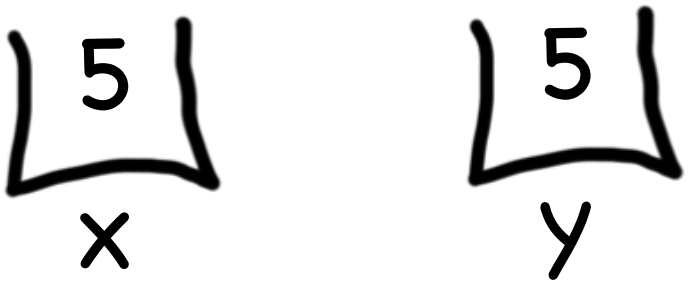
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



Maybe one day we can…

And met y

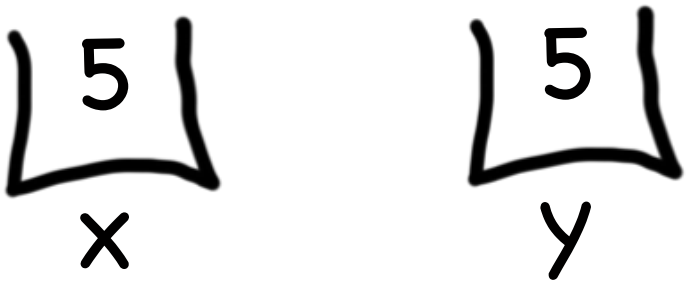
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



println together?

They got along

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

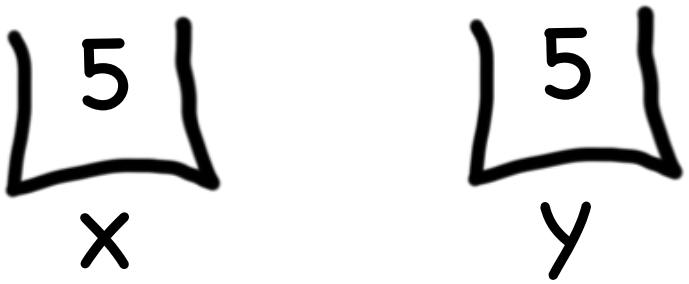


It was a beautiful match…

But then tragedy struck.

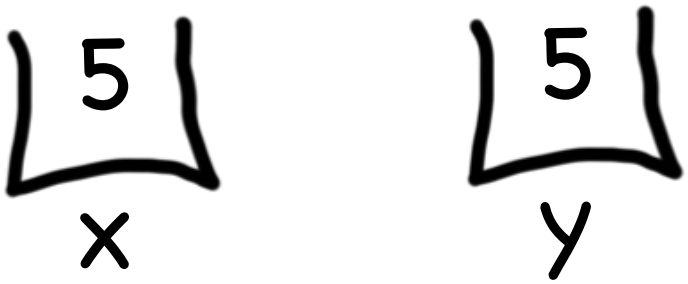
Tragedy Struck

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



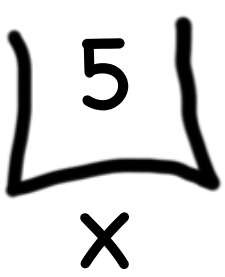
Tragedy Struck

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



Tragedy Struck

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

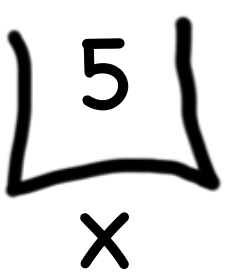


Noooooooooooooooo!

You see…

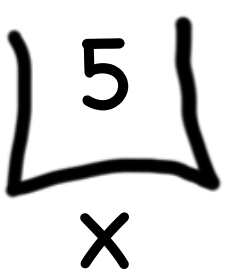
When a program exits a code block…

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



All variables declared inside that block..

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

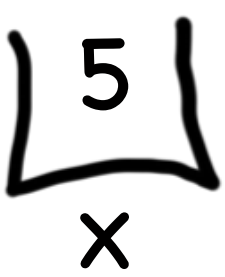


Get deleted from memory!

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

Since y was declared in the if-block

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

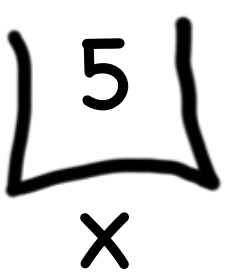


It gets deleted from memory here

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

And doesn't exist here

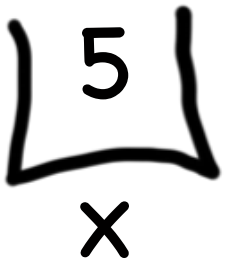
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
}
println(x + y);
```



And doesn't exist here

```
int
if(
}
println(x + y);
```

Error. Undefined variable y.



The End

Sad times ☹

Variables have a lifetime (called scope)

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

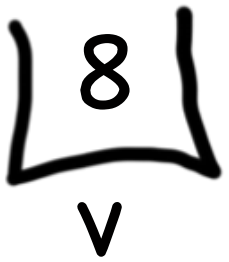

Variables have a lifetime (called scope)

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


Vars come to existence when declared

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

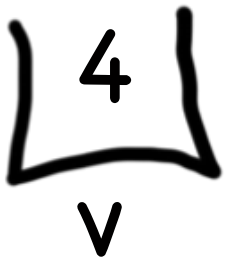
Comes to life here



Live until end of their code block

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

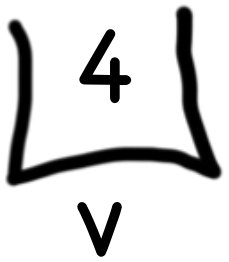
This is the **inner most** code block in which it was declared….



Live until end of their code block

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

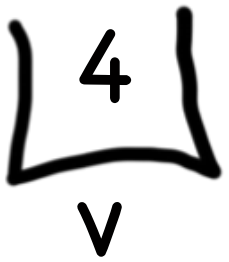
Still alive here…



Live until end of their code block

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

It dies here (at the end of its code block)



Live until end of their code block

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

It dies here (at the end of its code block)

Example 2

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

This is the scope of w

Example 2

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

w comes to life here

w dies here (at the end of its code block)

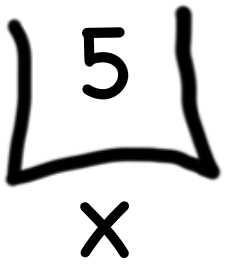
A Variable love story

Chapter 2

The programmer fixed her bug

x was looking for love!

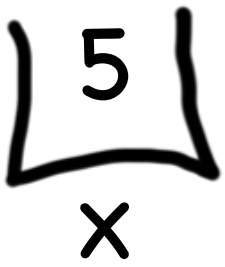
```
int x = 5;
if(lookingForLove()) {
    int y = 5;
    println(x + y);
}
```



x was looking for love…

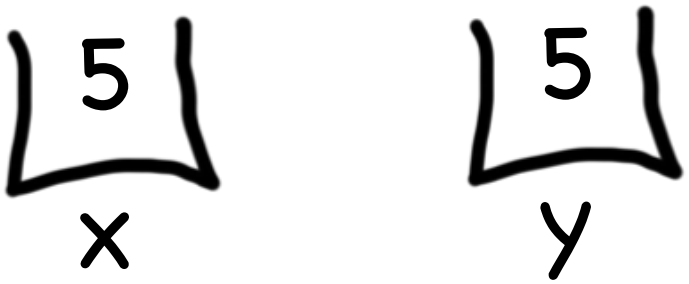
x was definitely looking for love

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



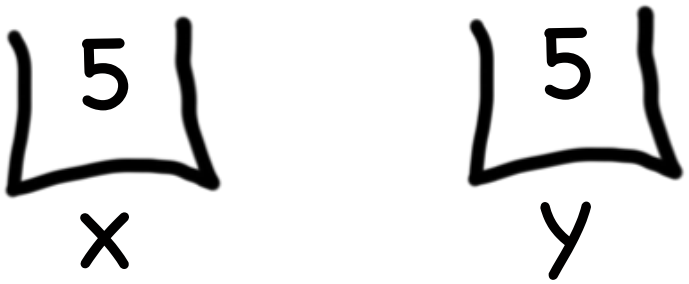
x met y

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



Since they were both “in scope”

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



The story had a happy ending!

Scope Formally

- 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 inner-most code block in which the variable was defined.

- A **code block** is a chunk of code between { } brackets

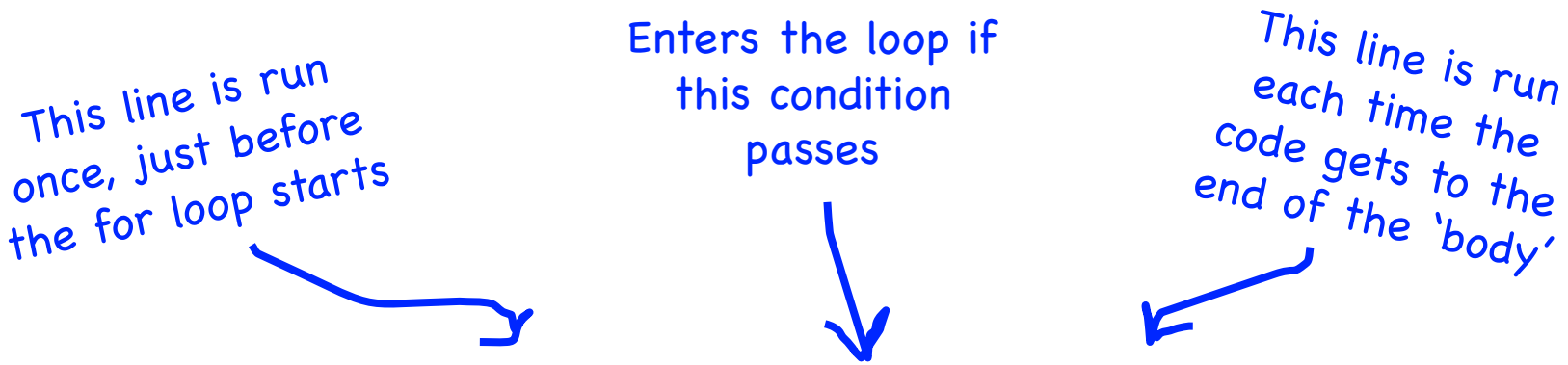
Back to our regularly scheduled program…

How would you println “Stanford rocks socks” 100 times

For Loop Redux

```
public void run() {
   for(int i = 0; i < 100; i++) {
      println("Stanford rocks socks!");
   }
}
```

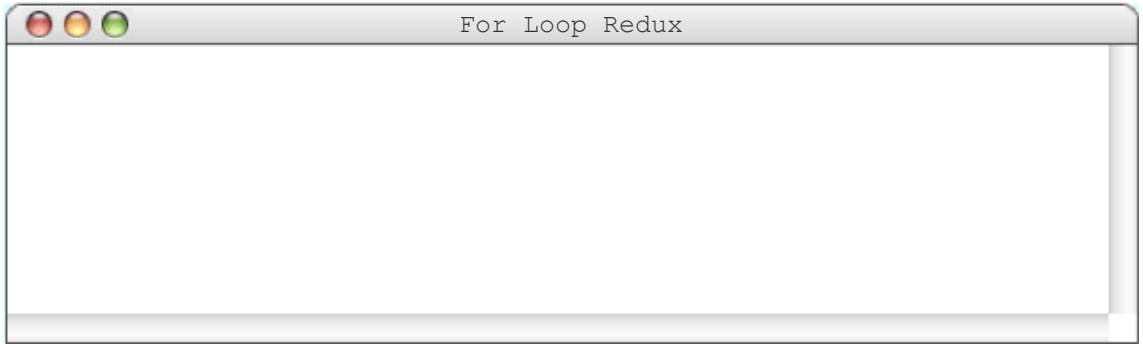

For Loop Redux




```
for(int i = 0; i < 100; i++) {
   println("Stanford rocks socks!");
}
```

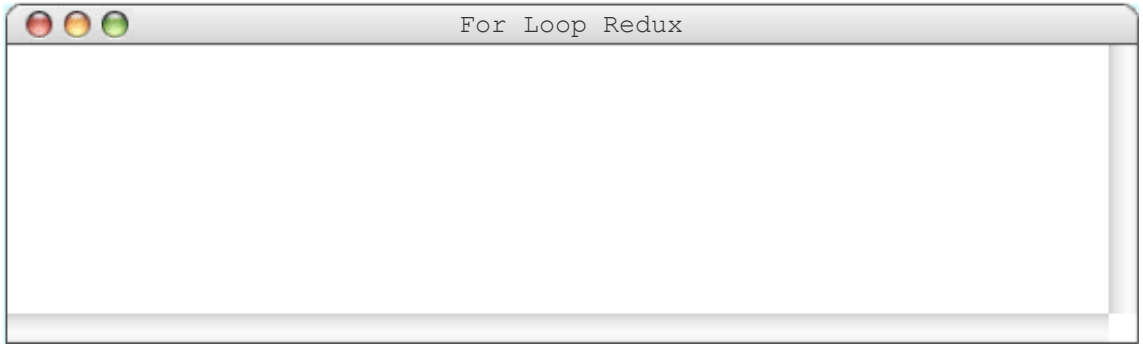
For Loop Redux

```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

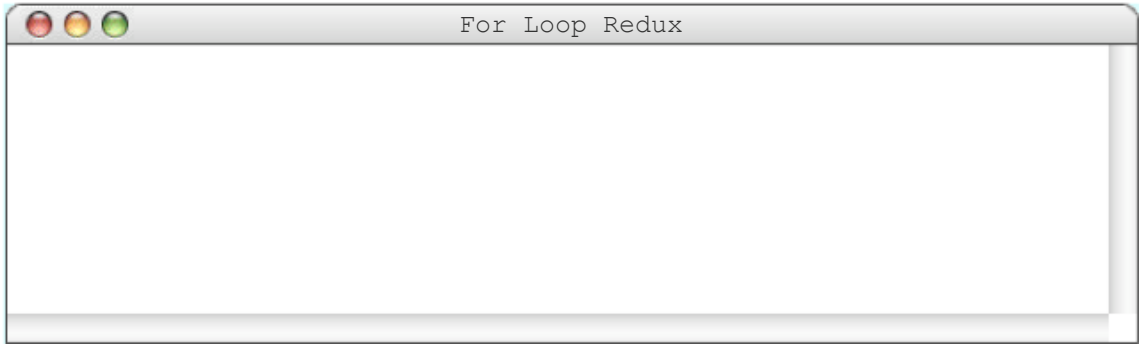
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	0

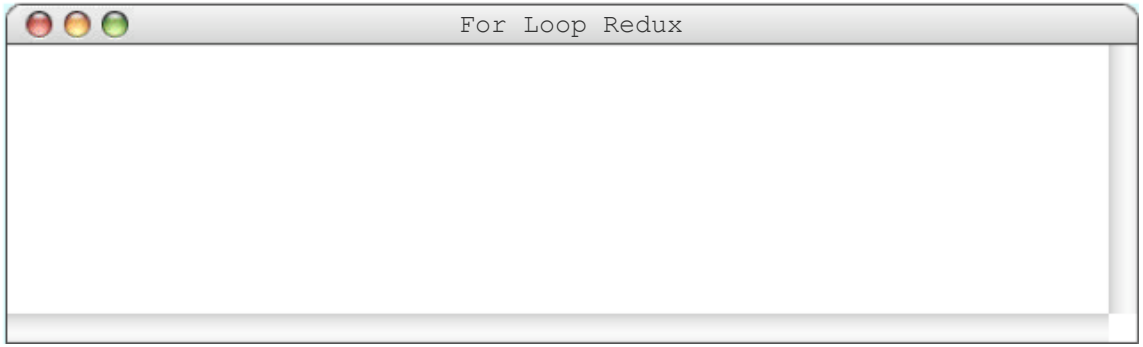
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	0

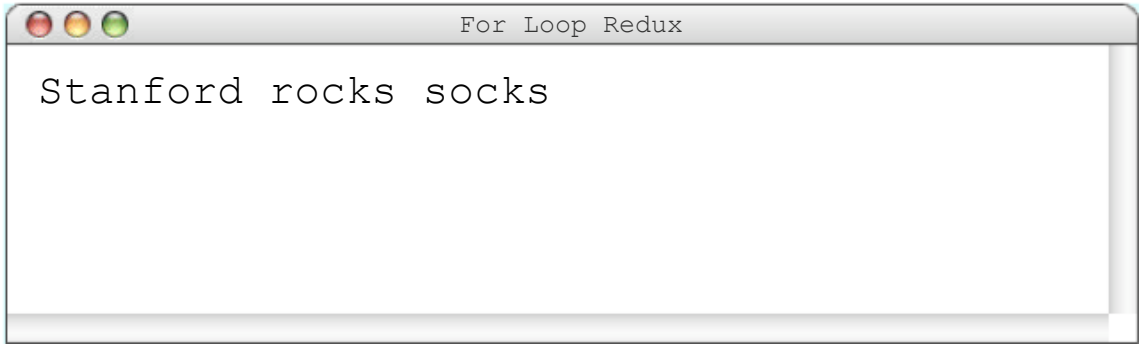
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	0

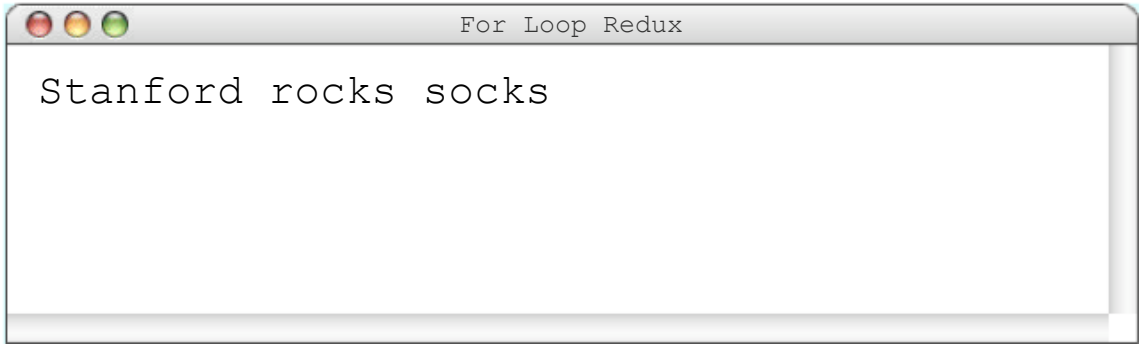
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i 1

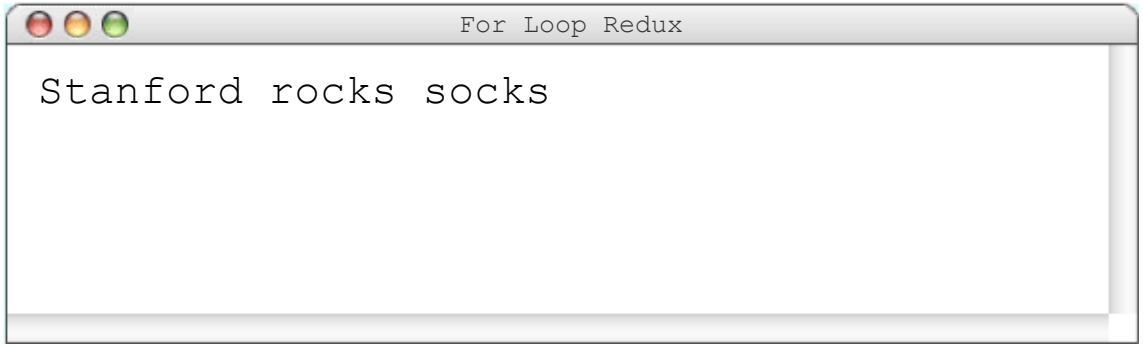
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i 1

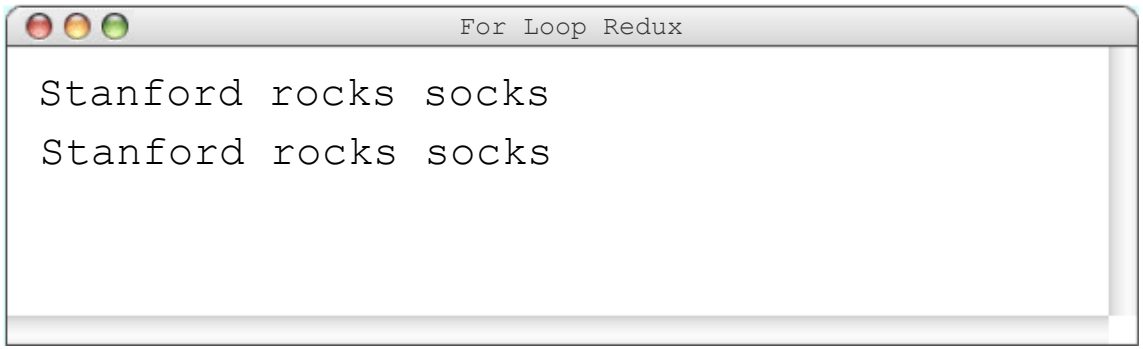
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i 1

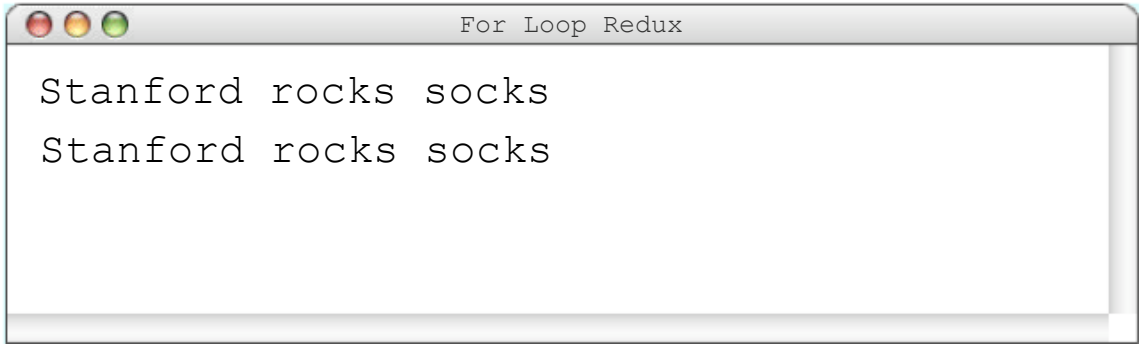
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i 2

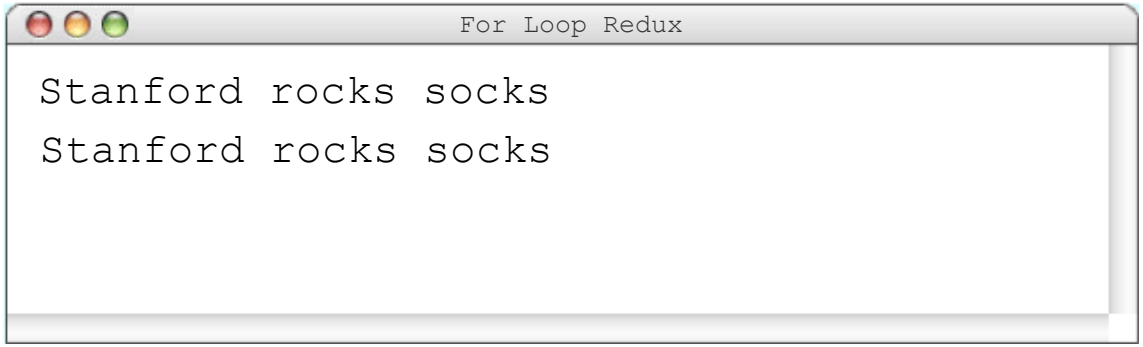
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	2

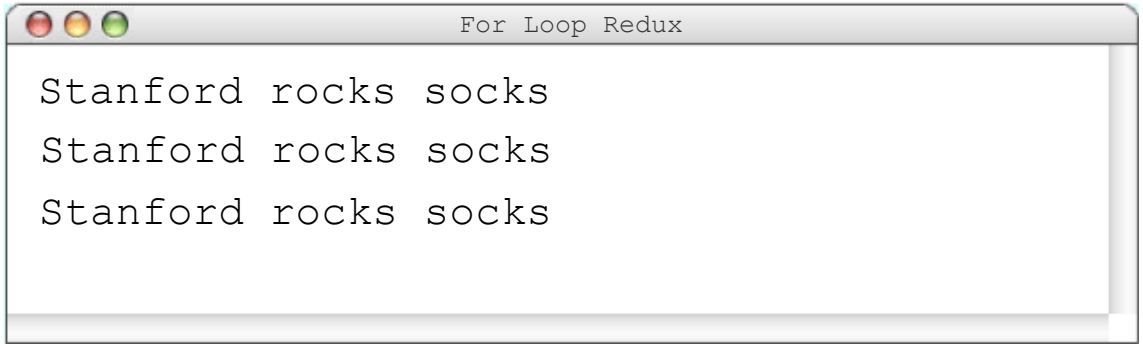
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	2

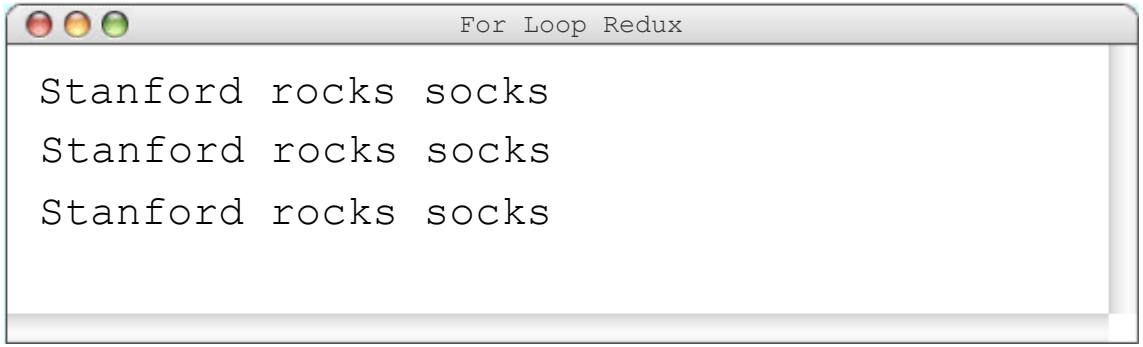
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

i	3

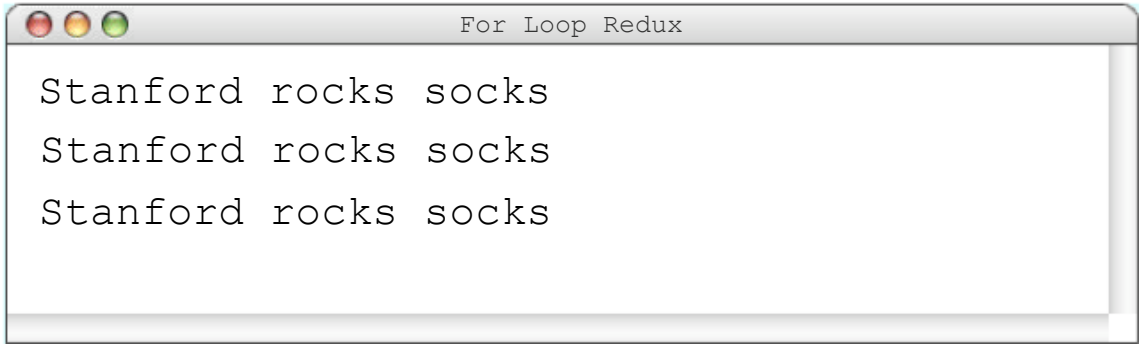
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

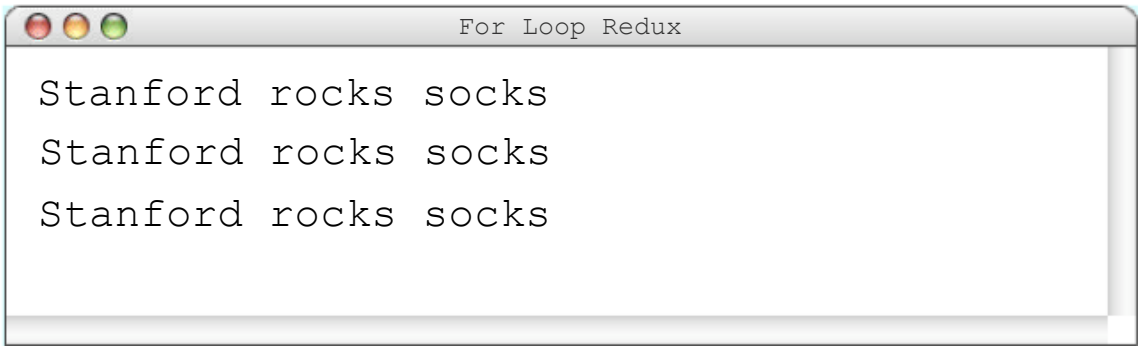
i	3

```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



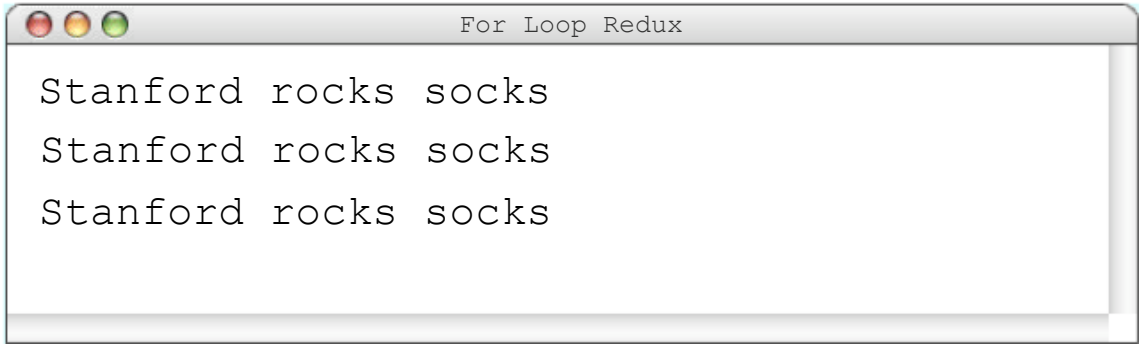
For Loop Redux

```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



For Loop Redux

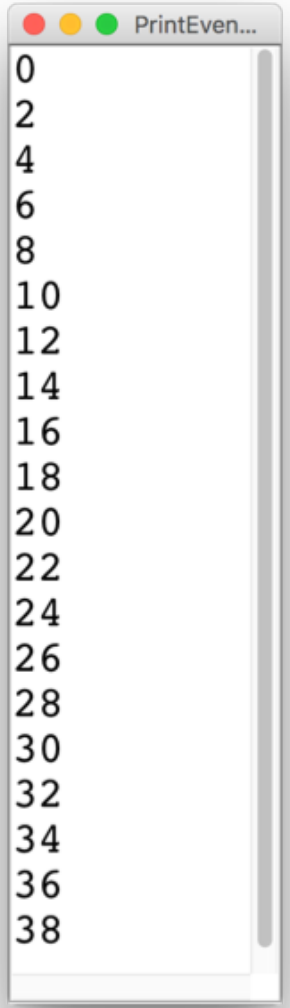
```
for(int i = 0; i < 3; i++) {
   println("Stanford rocks socks!");
}
```



You can use the for loop variable

How would you println the first 100 even numbers?

Printing Even Numbers

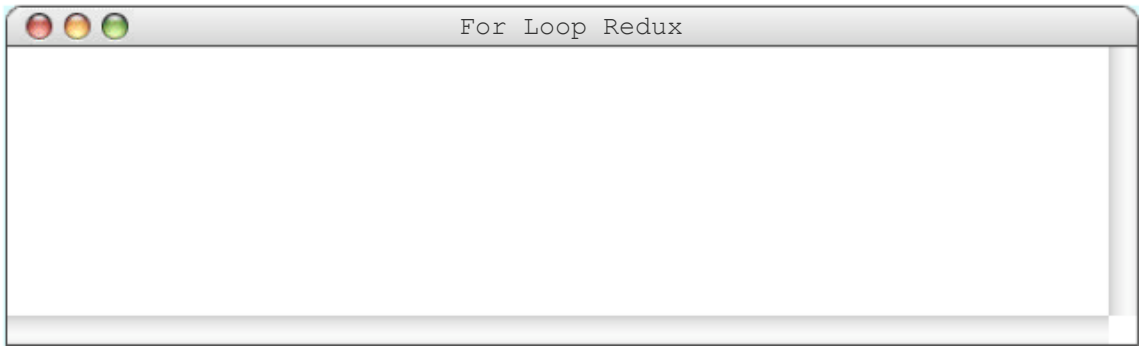


Printing Even Numbers

```
for(int i = 0; i < NUM_NUMS; i++) {
   println(i * 2);
}
```

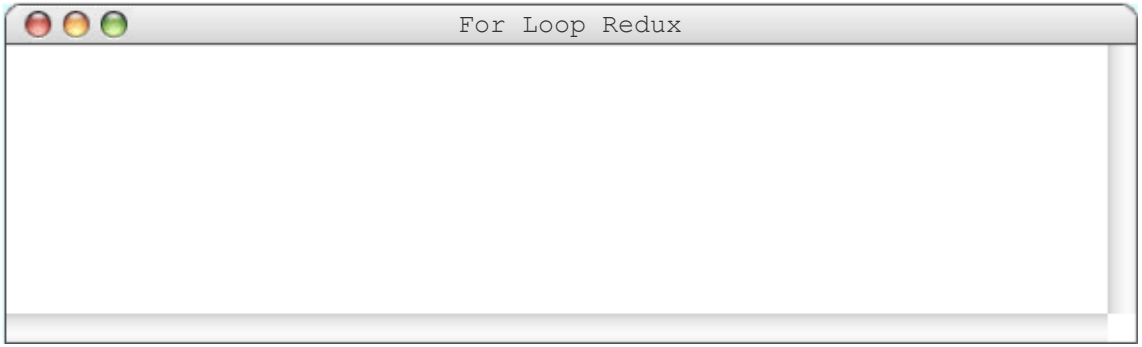

Printing Even Numbers

```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

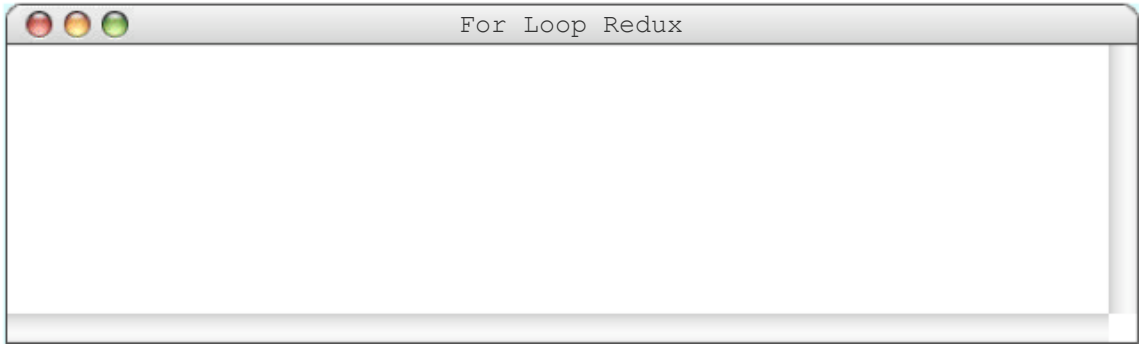
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	0

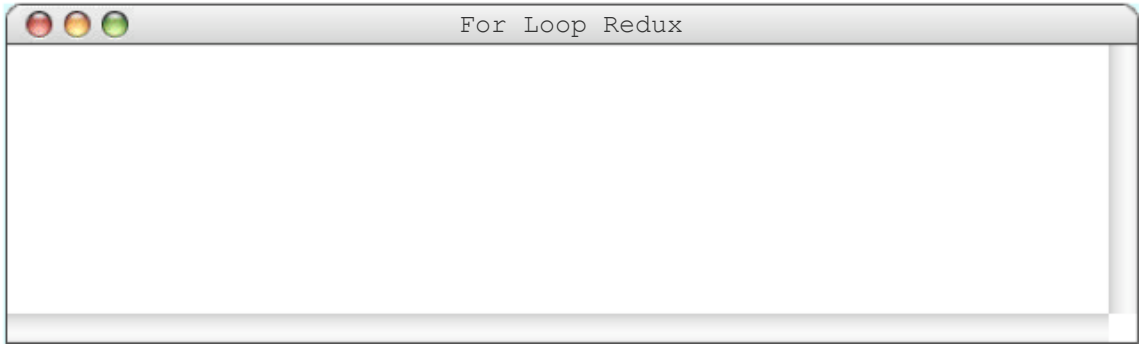
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	0

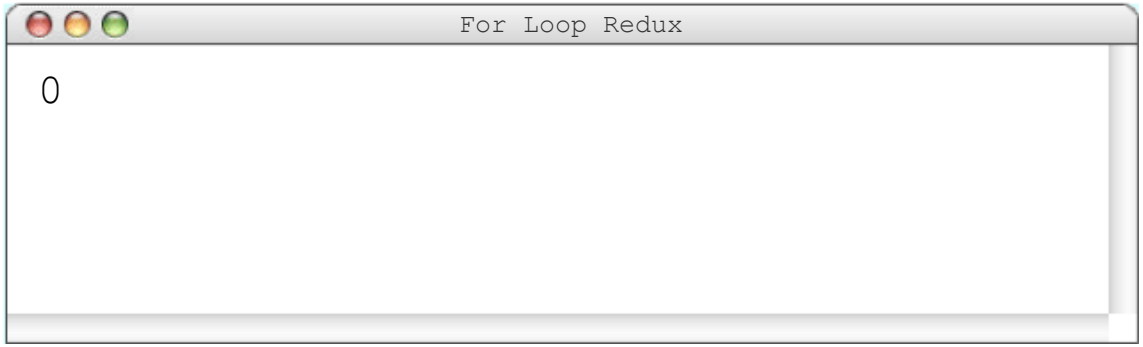
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	0

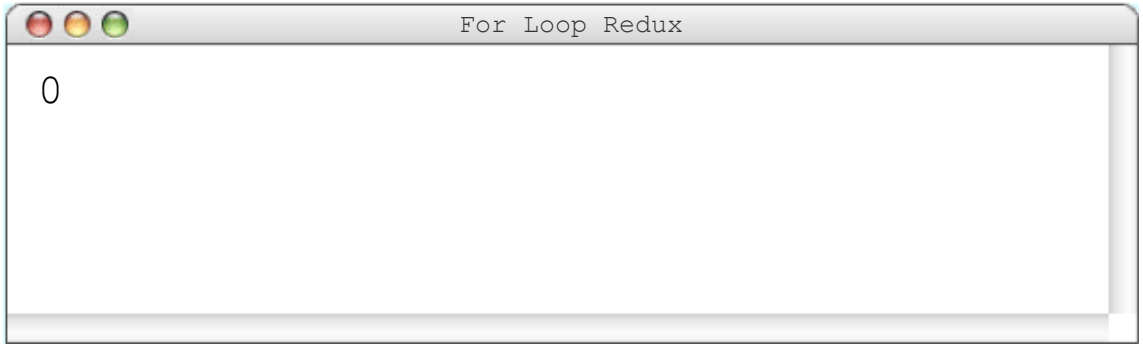
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i 1

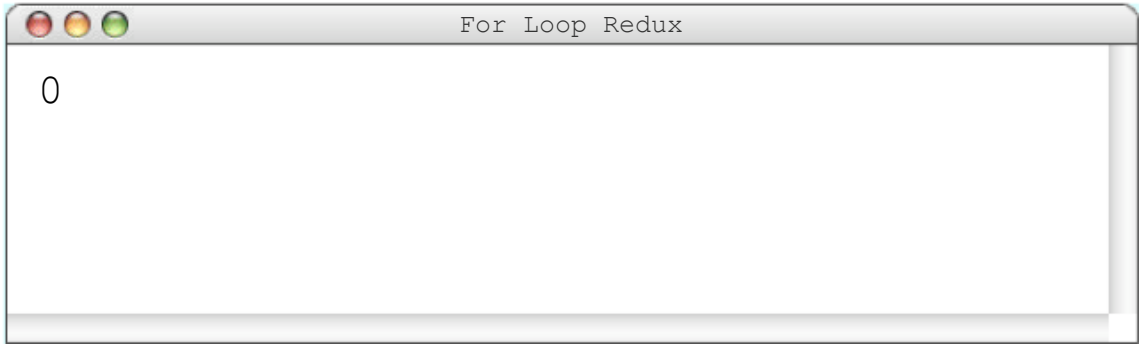
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	1

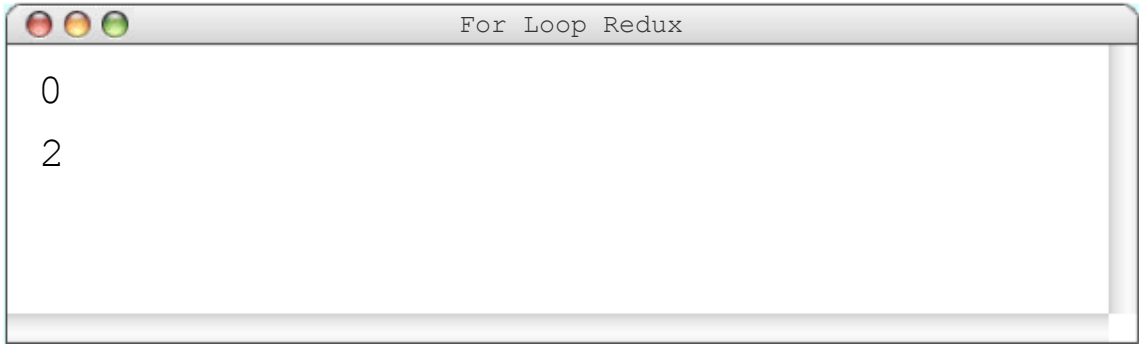
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i | 1

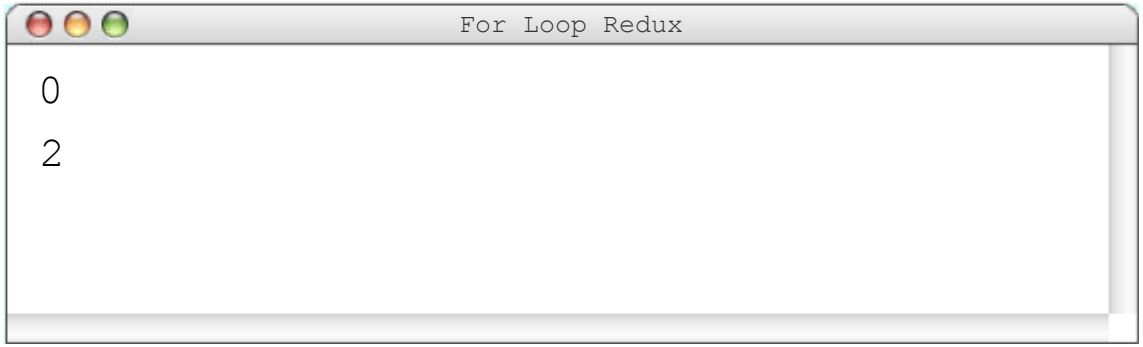
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	2

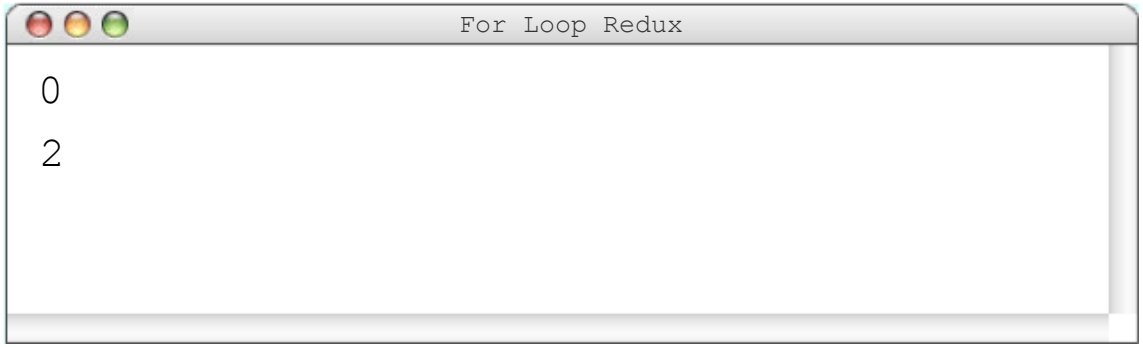
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	2

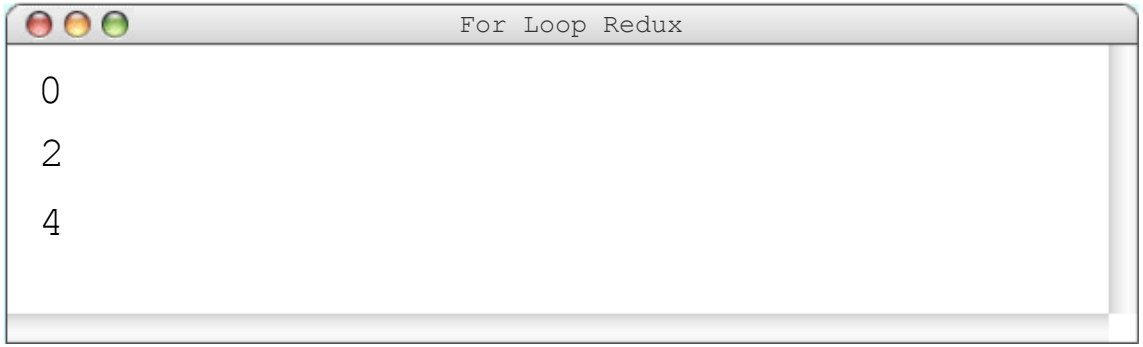
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i | 2

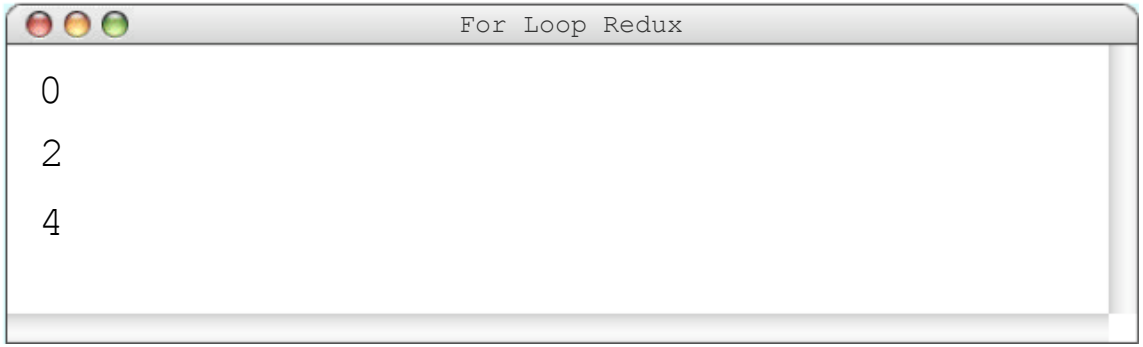
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	3

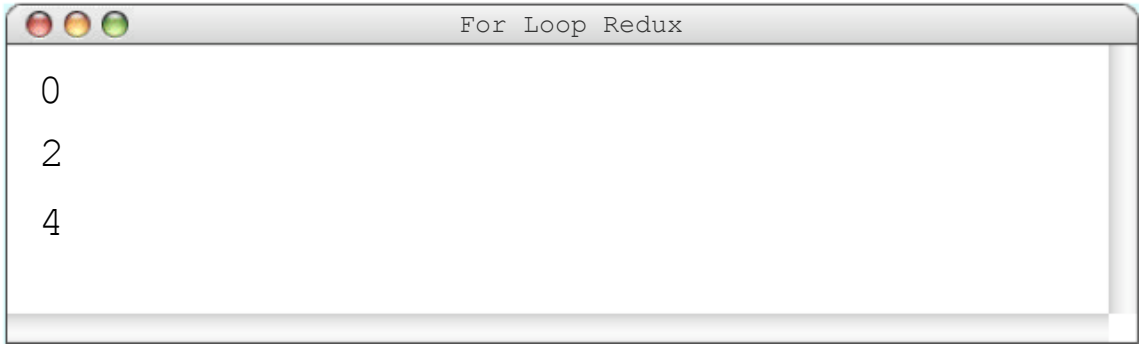
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

i	3

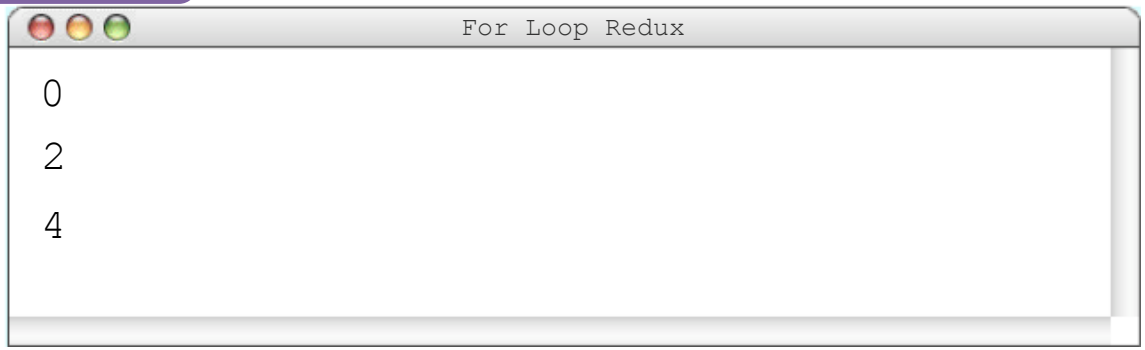
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



Printing Even Numbers

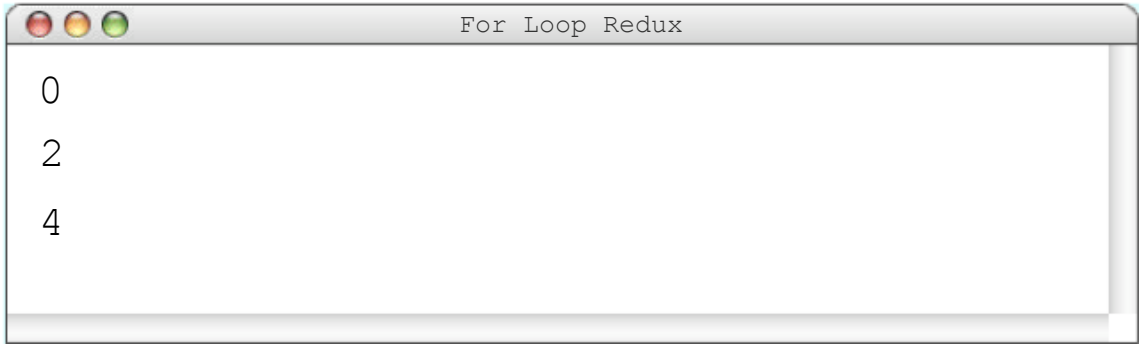
i | 3

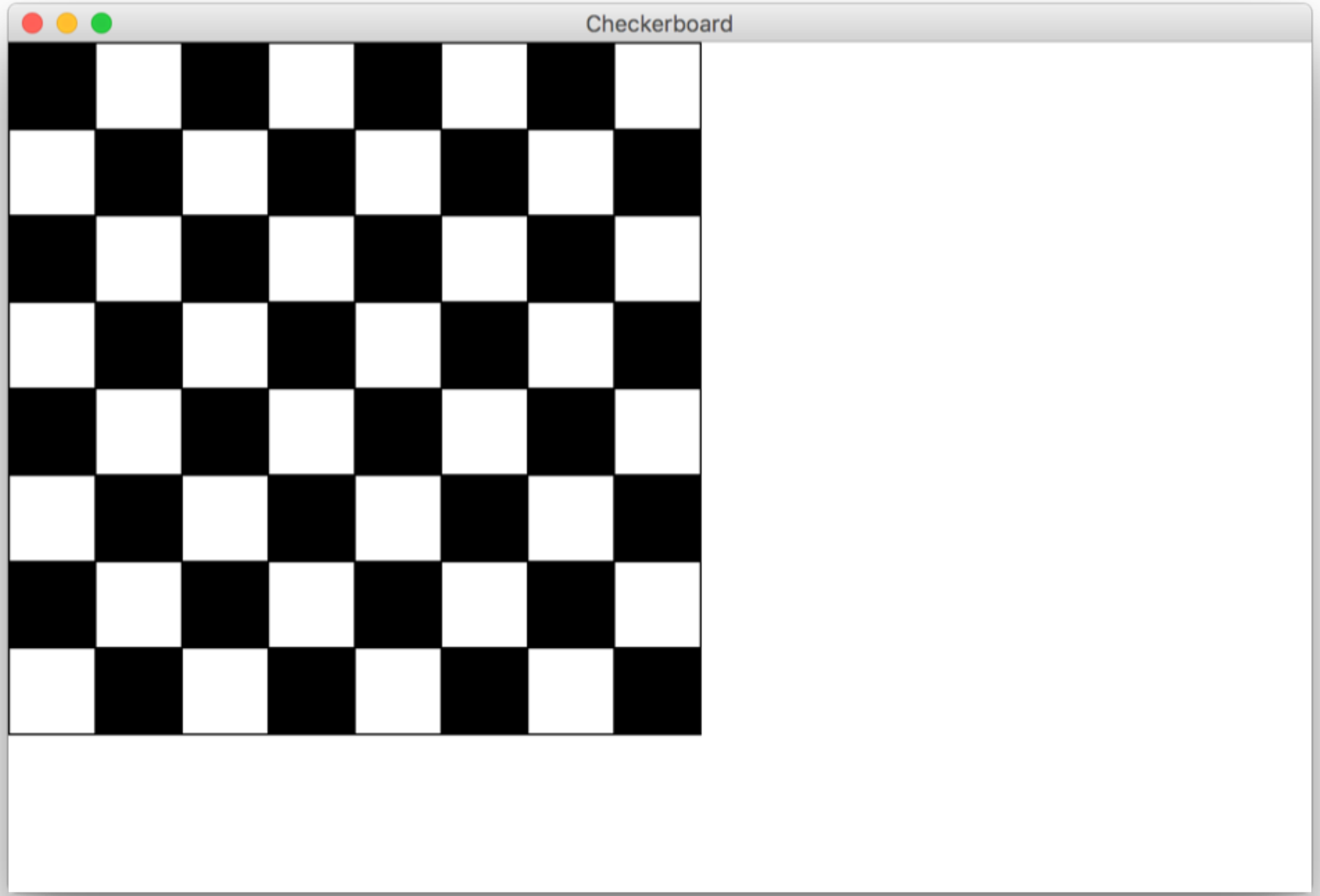
```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```



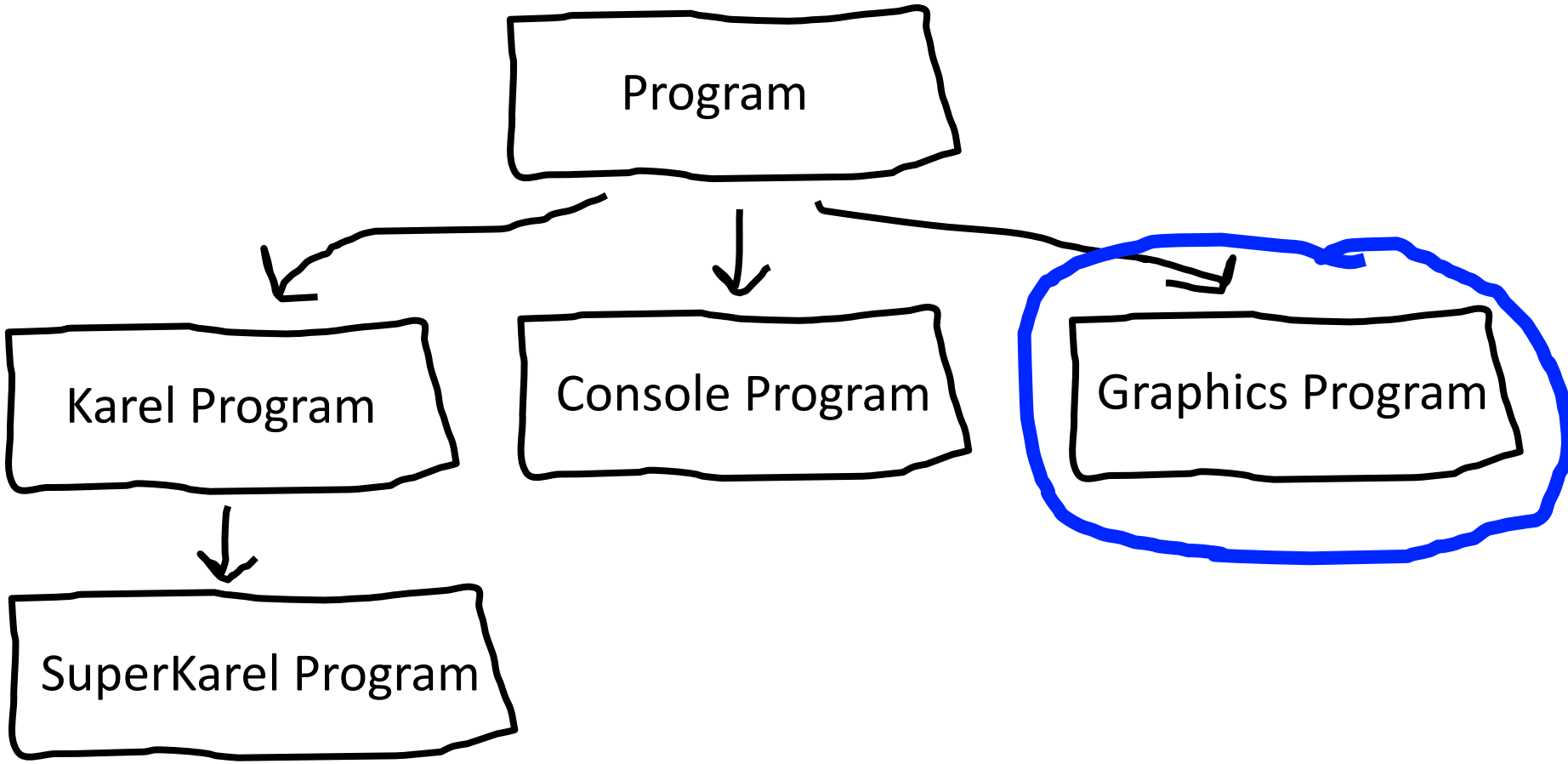
Printing Even Numbers

```
for(int i = 0; i < 3; i++) {
   println(i * 2);
}
```

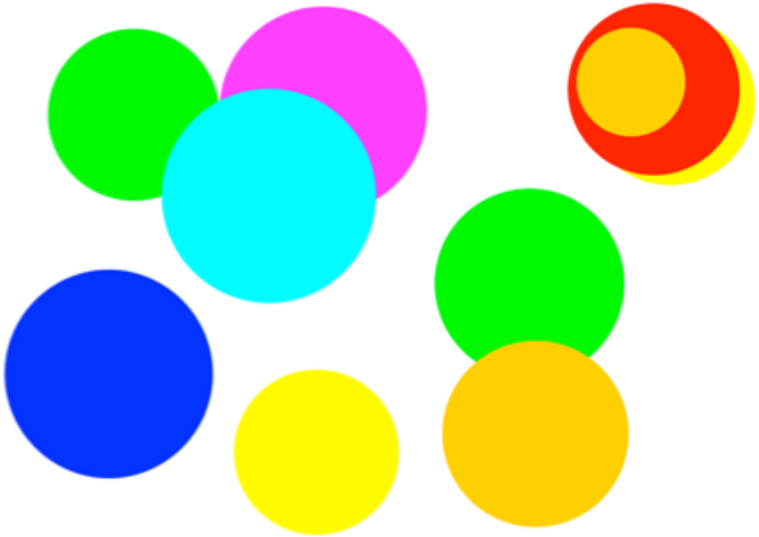


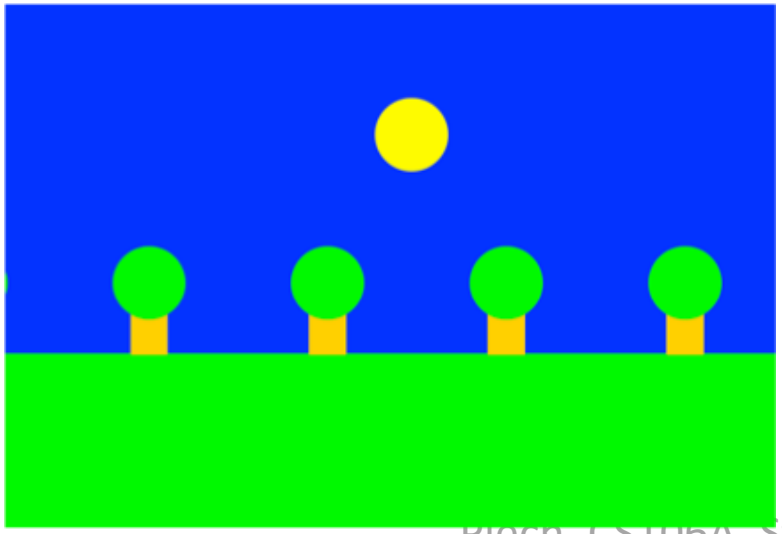

Checkerboard

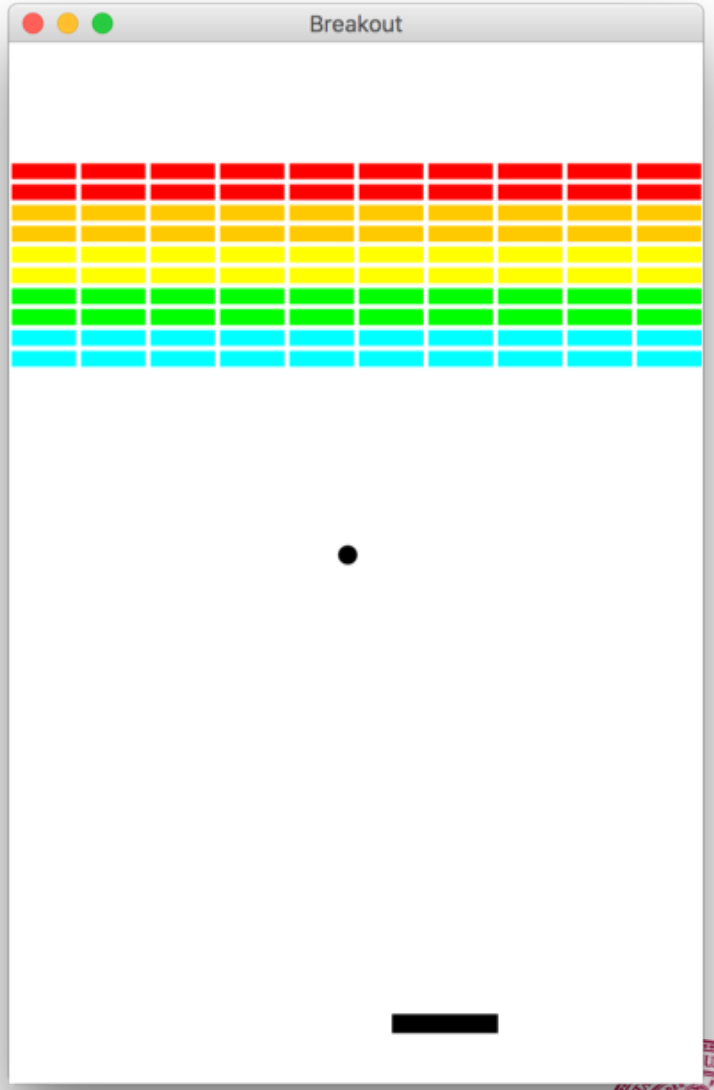
Types of Programs



Graphics Programs





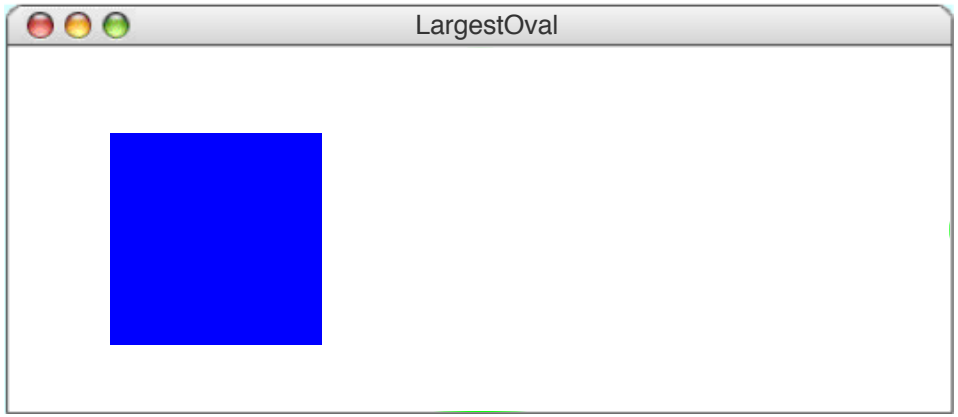


GRect

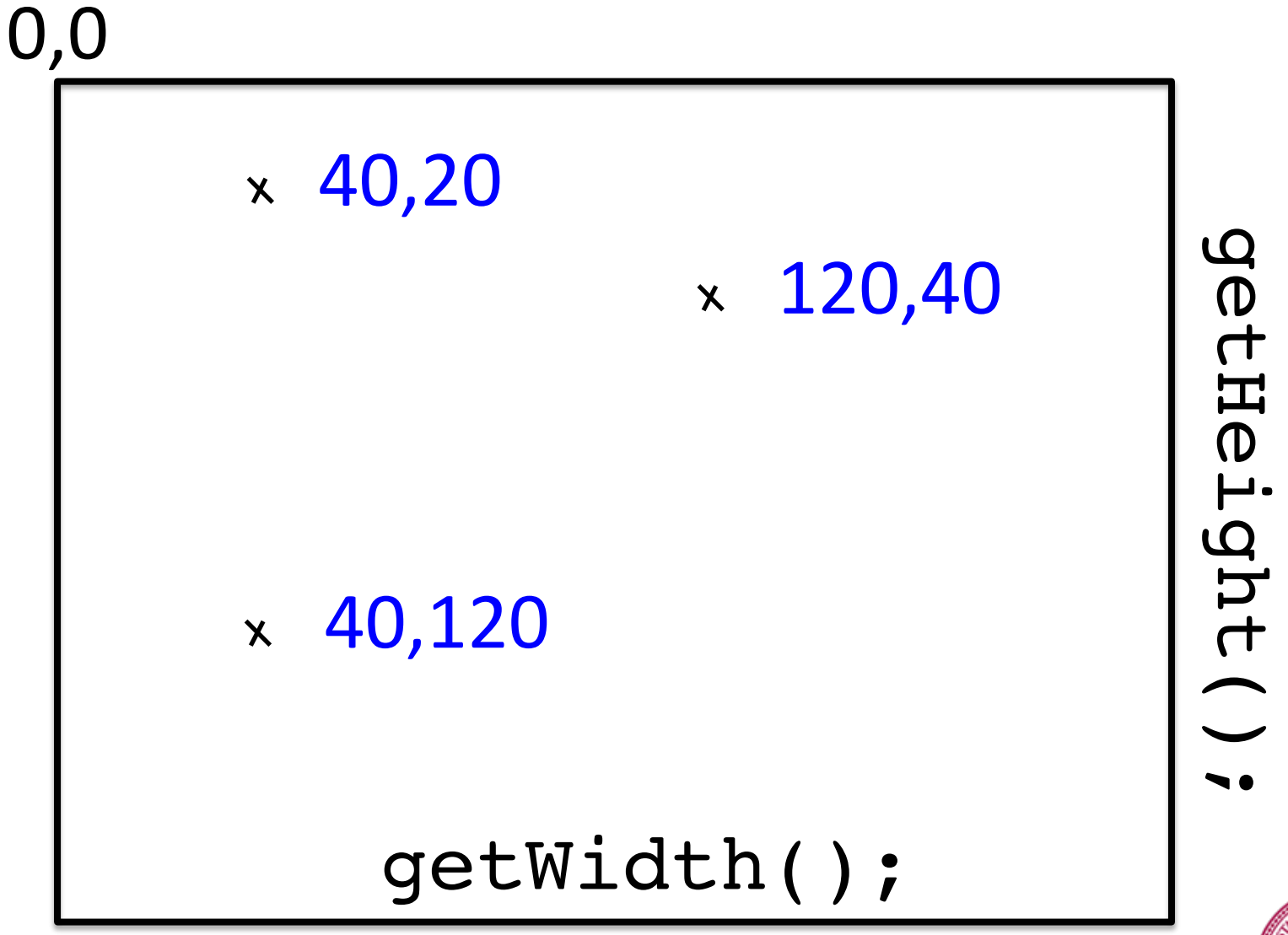
`GRect` is a variable type that stores a rectangle.

As an example, the following `run` method displays a blue square

```
public void run() {
   GRect rect = new GRect(50, 50, 200, 200);
   rect.setFilled(true);
   rect.setColor(Color.BLUE);
   add(rect);
}
```



Graphics Coordinates

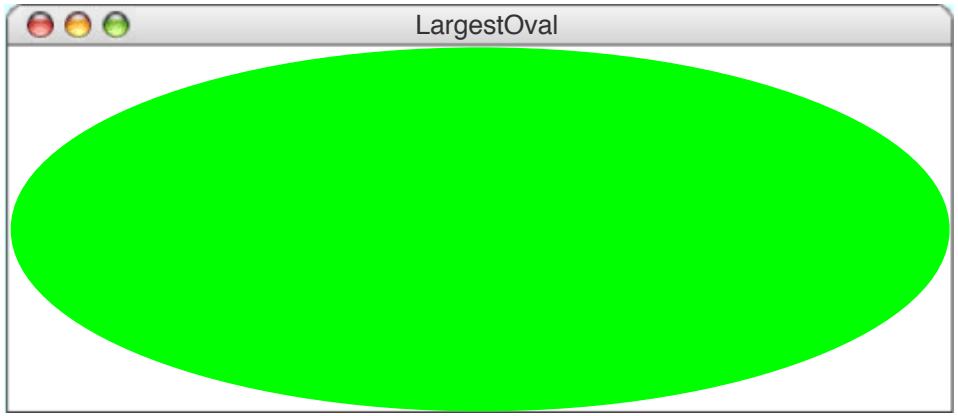


GOval

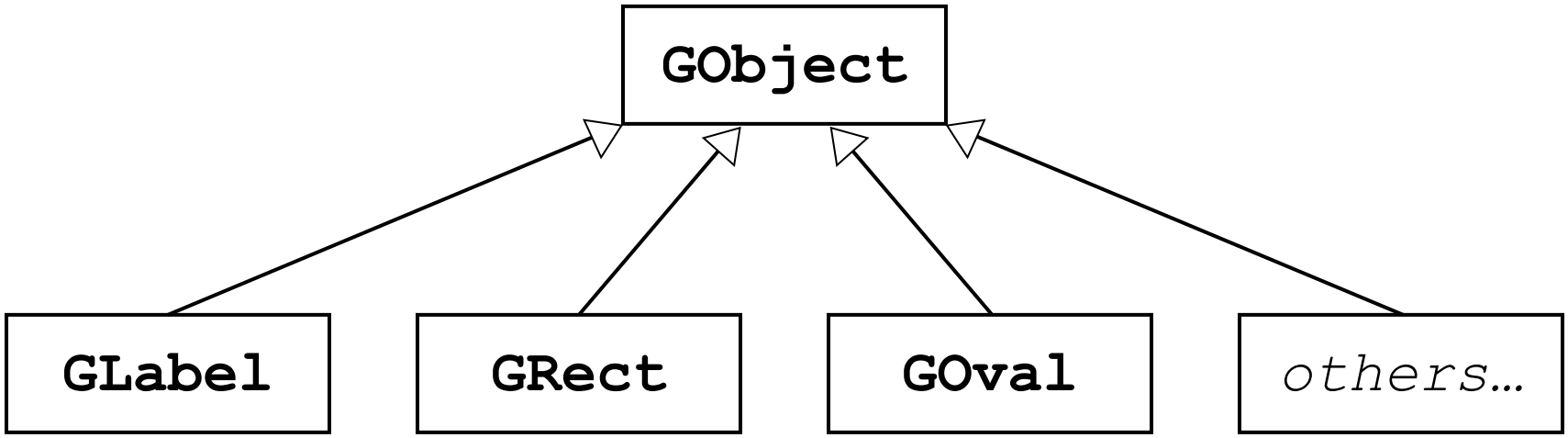
The `GOval` class represents an elliptical shape defined by the boundaries of its enclosing rectangle.

As an example, the following `run` method creates the largest oval that fits within the canvas:

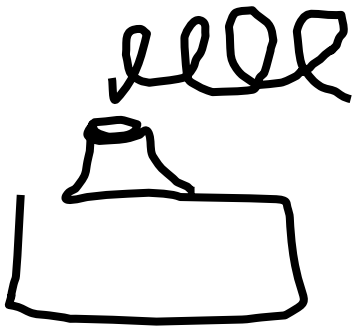
```
public void run() {
   GOval oval = new GOval(0, 0, getWidth(), getHeight());
   oval.setFilled(true);
   oval.setColor(Color.GREEN);
   add(oval);
}
```



Graphics Variable Types




```
GRect myRect = new GRect(350, 270);
```



Primitives vs Classes

Primitive Variable Types

```
int
double
char
boolean
```

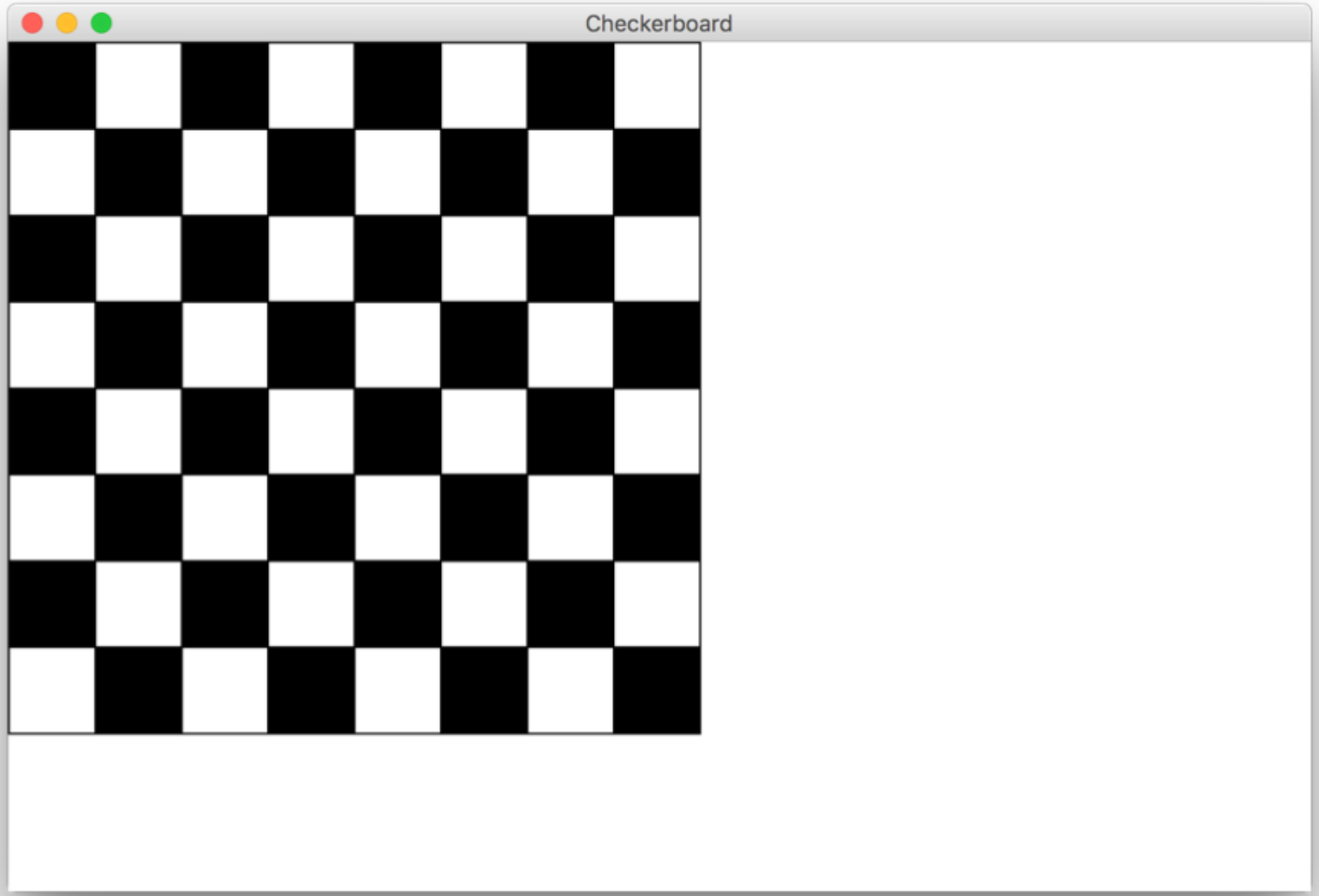
Class Variable Types

```
GRect
GOval
GLine
…
```

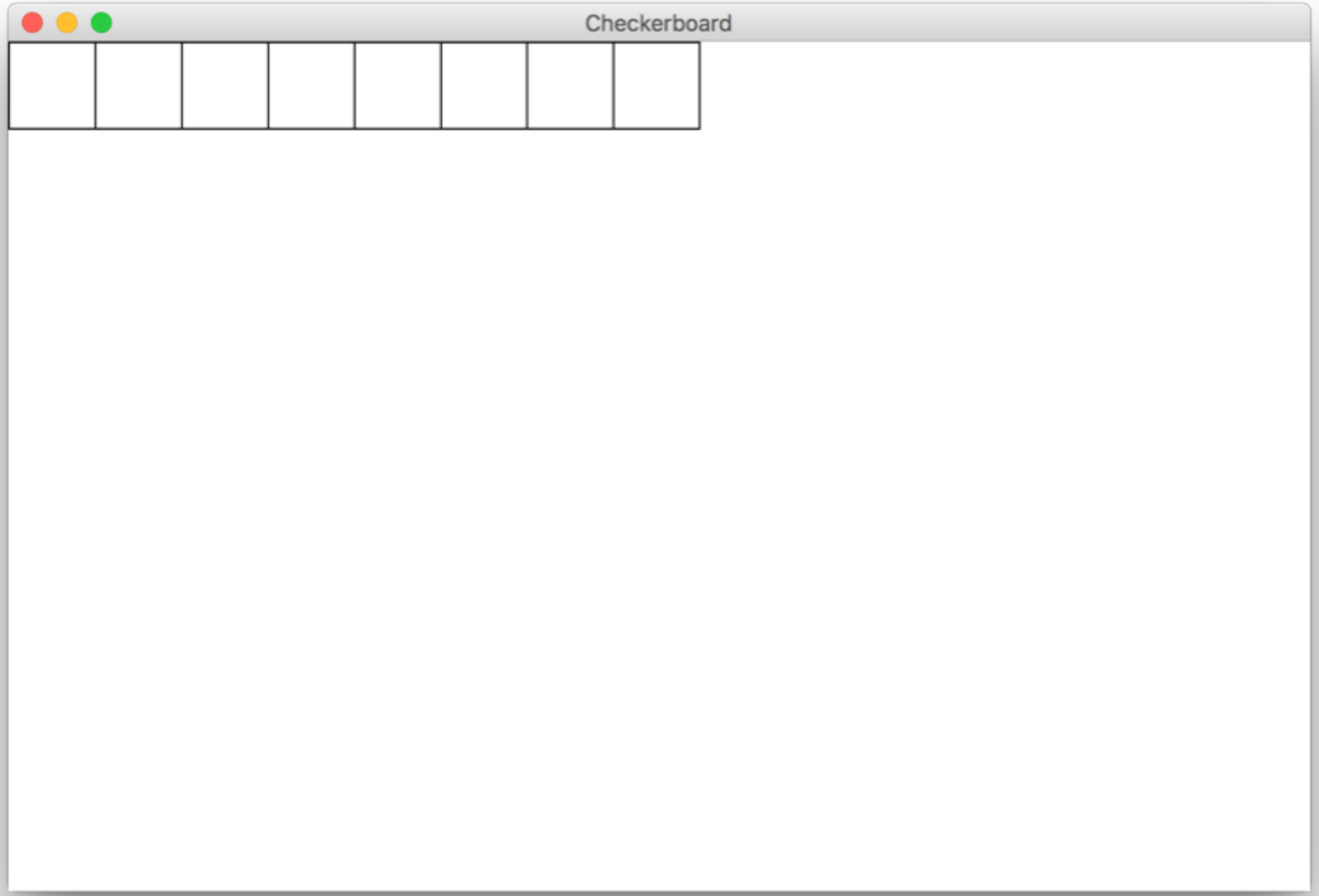
Class variables:

1. Have upper camel case types
2. You can call methods on them
3. Are constructed using **`new`**
4. Are stored in a special way

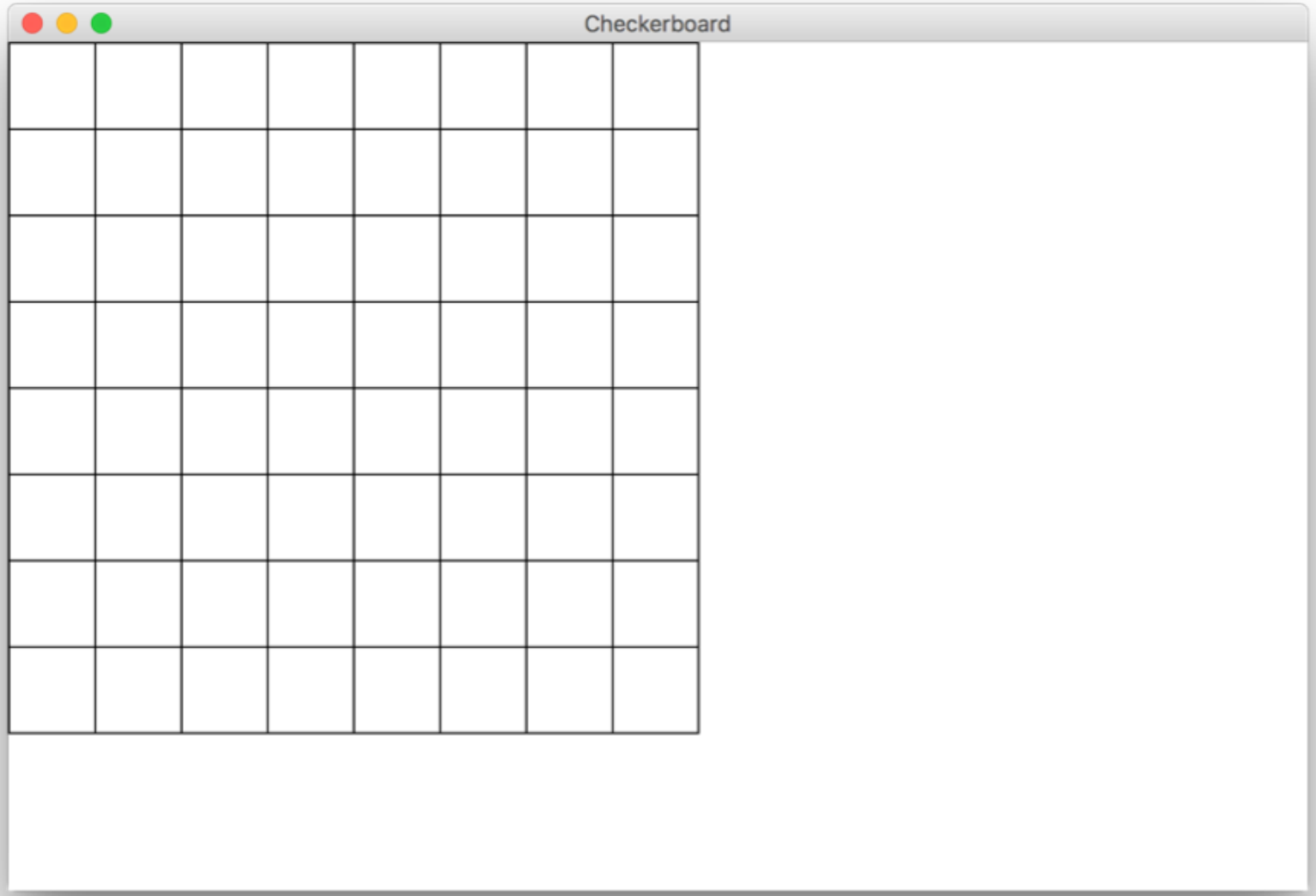
Goal



Milestone 1



Milestone 2



Milestone 3